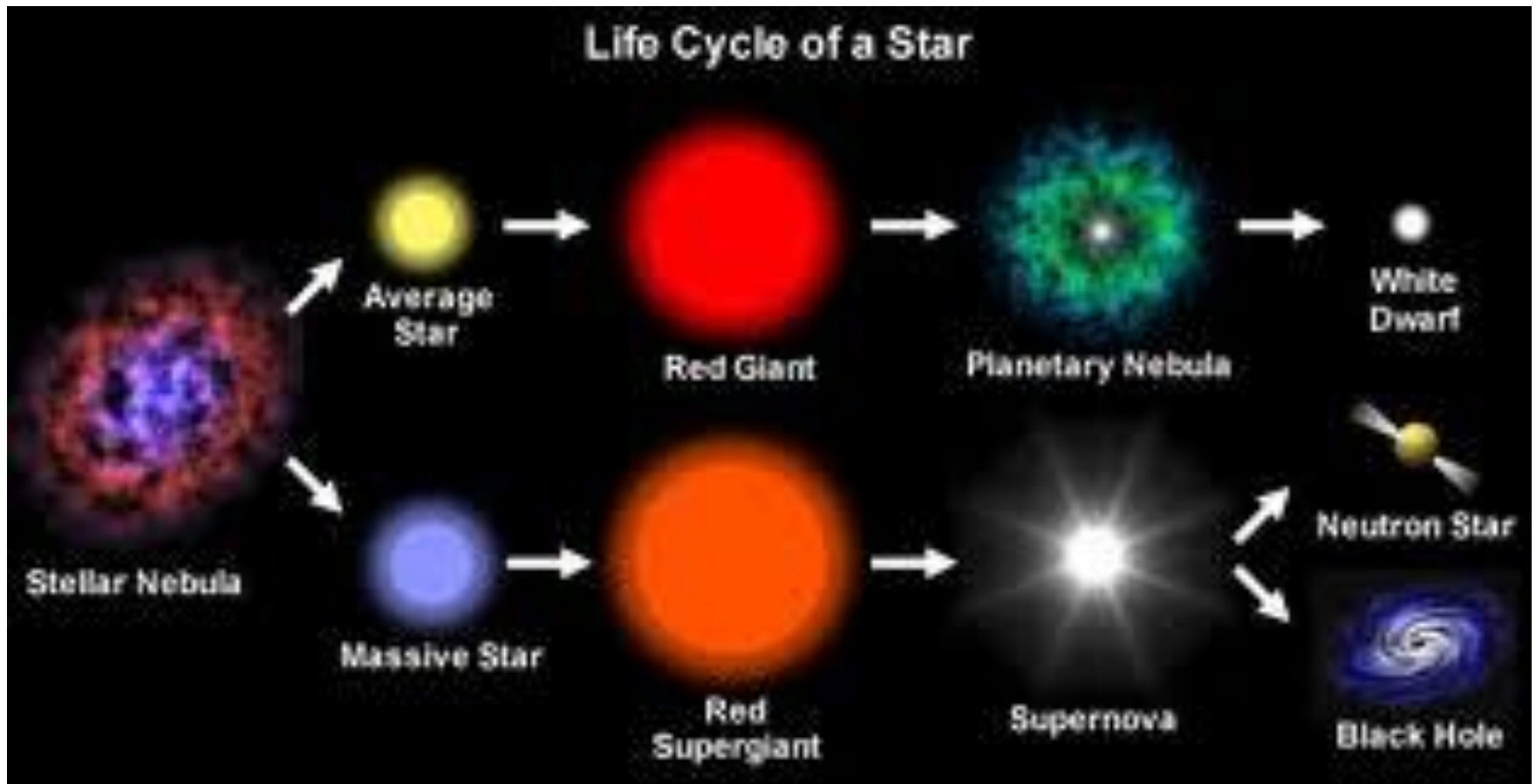


Life Cycles of Stars



The universe started with the ...

Big Bang!

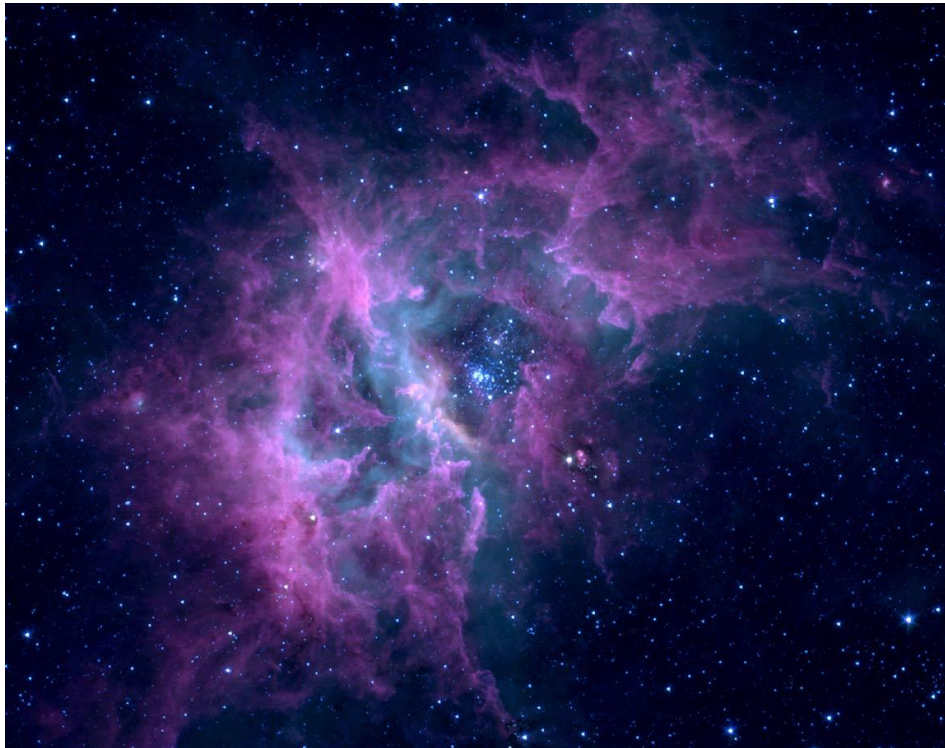
- Everything continued to expand, clouds of dust started to gravitate towards each other forming stars.



A star's life begins in a ...

Nebula!

- A cloud of gas and dust, consisting mostly of Hydrogen



A star's life begins...

- Gas and dust begin to clump together to form a **Protostar** (a baby star).



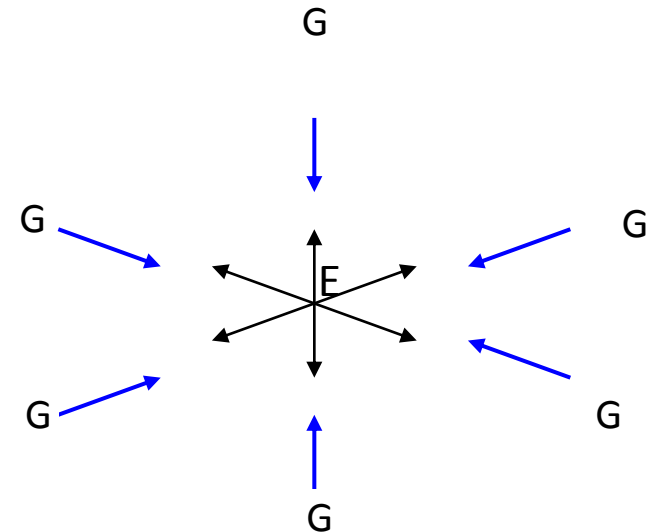
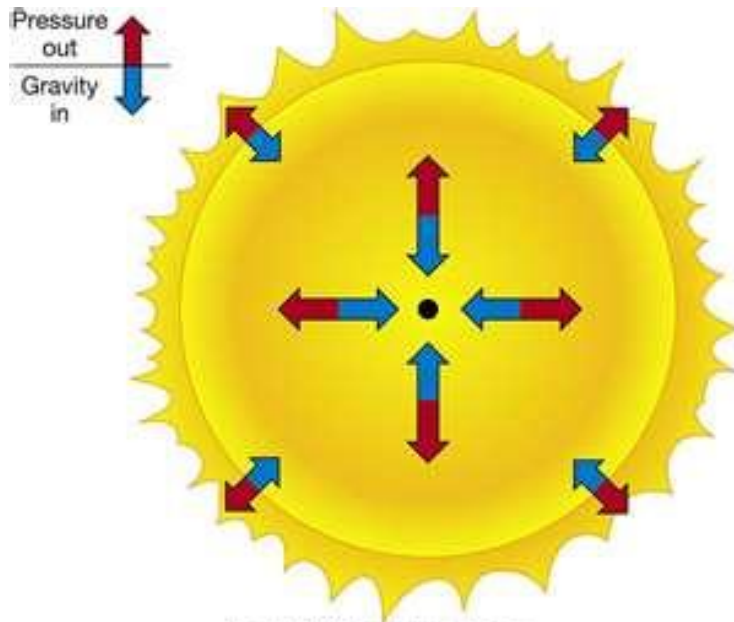
A star's life begins...

- The smaller a star is the longer it will live.
 - Larger stars have more fuel, but they have to burn (fuse) it faster in order to maintain equilibrium.
 - Because fusion occurs at a faster rate in massive stars, large stars use all their fuel in a shorter length of time.
 - So...A smaller star has less fuel, but its rate of fusion is not as fast. Therefore, smaller stars live longer than larger stars because their rate of fuel consumption is not as rapid.



A star's life begins...

- The star's main goal in life is to achieve stability, or equilibrium, where pressure from fusion within the core is equal to the force of gravity pushing down on it (this keeps the star “alive”).




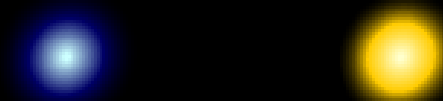
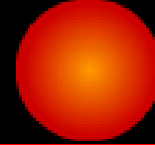


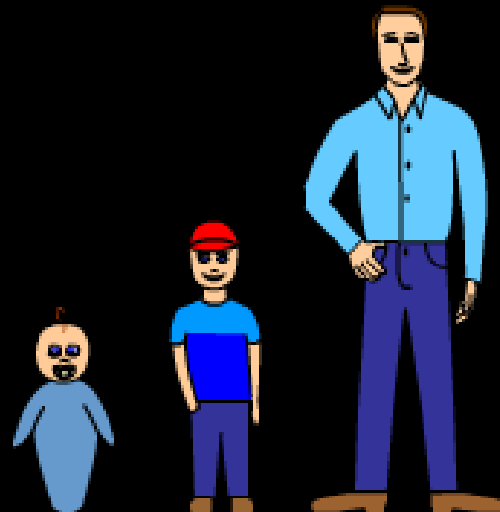
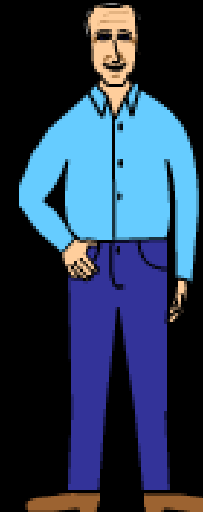
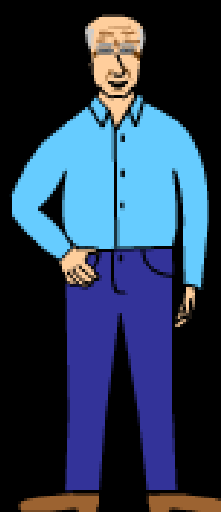
A star's life begins...

Continuous steps occur inside the core of a main sequence star, until there is no more Hydrogen.

- Step 1 - Nuclear fusion (hydrogen turning to helium).
Gravity = gas pressure (equilibrium)
- Step 2 - Out of fuel
- Step 3 - Fusion stops, temperature drops
- Step 4 - Core contracts (gravity pulling atoms in)
- Step 5 - Increased temperature (more atoms, more collisions) and density in the core reinitiates nuclear fusion, equilibrium is achieved, and the cycle begins again at Step 1.

Life Cycle of a Star like our Sun...

Nebula → Protostar → Main Sequence Star → Red Giant → Planetary Nebula → White Dwarf

Protostar	Fusion ignition - Main Sequence	Red Giant/Supergiant	White Dwarf/Black Hole
			
Fetus	Infancy through Adulthood	Middle Age	Old Age-Death
			

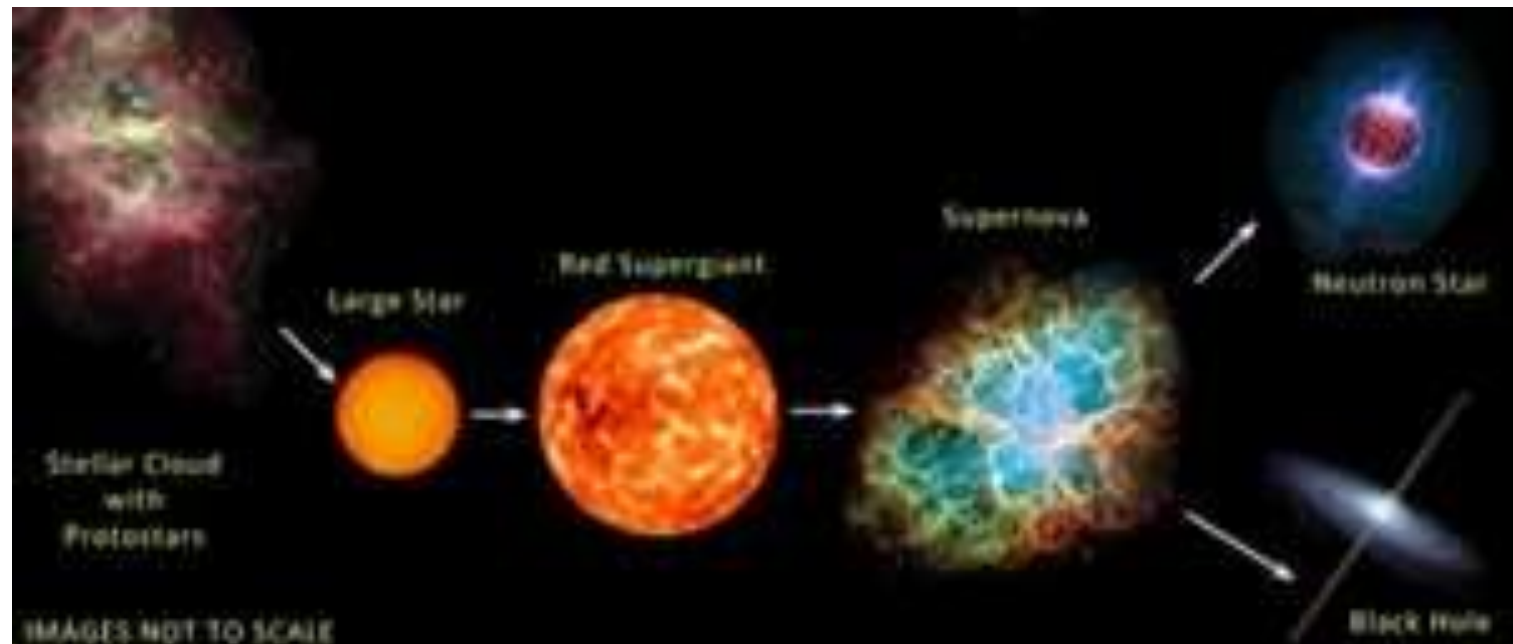
Life Cycle of a Star like our Sun...

- Our sun is at the Main Sequence stage in its life.
 - When the hydrogen in the core has been used up, the core shrinks and hydrogen fusion begins in the outer layers,
 - which then expands the entire star, turning it into a Red Giant.
 - The sun begins to die when helium is fusing into other elements, then the gases at the sun's surface start to blow away in bursts, called a Planetary Nebula (or halo of gases,
 - Resulting in a hot carbon-oxygen core called a White Dwarf.

Life Cycle of a Star With Greater Mass Than Our Sun...

Nebula → Protostar → Main Sequence Star →
Red Supergiant → Supernova

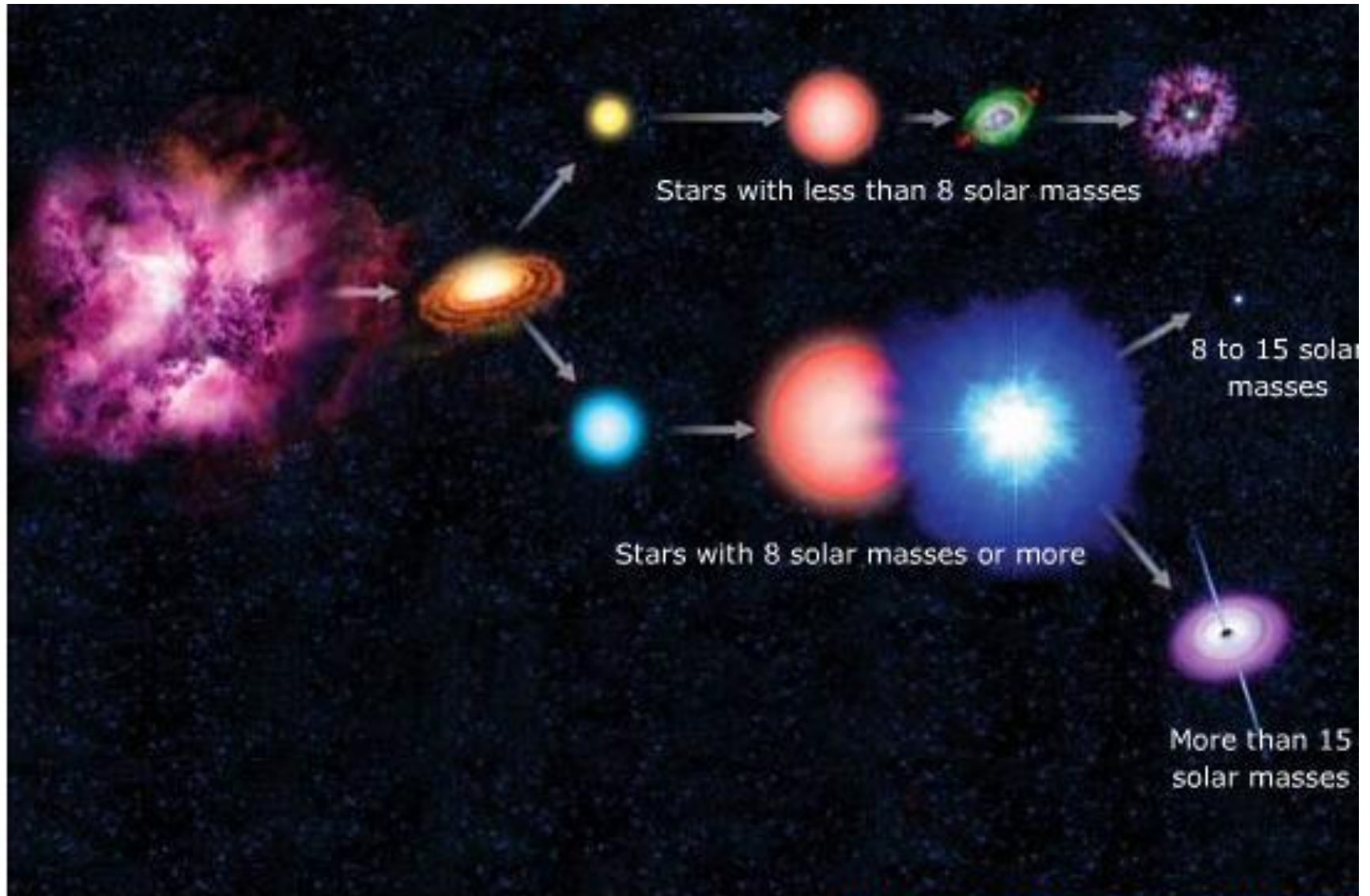
Black Hole or Neutron Star



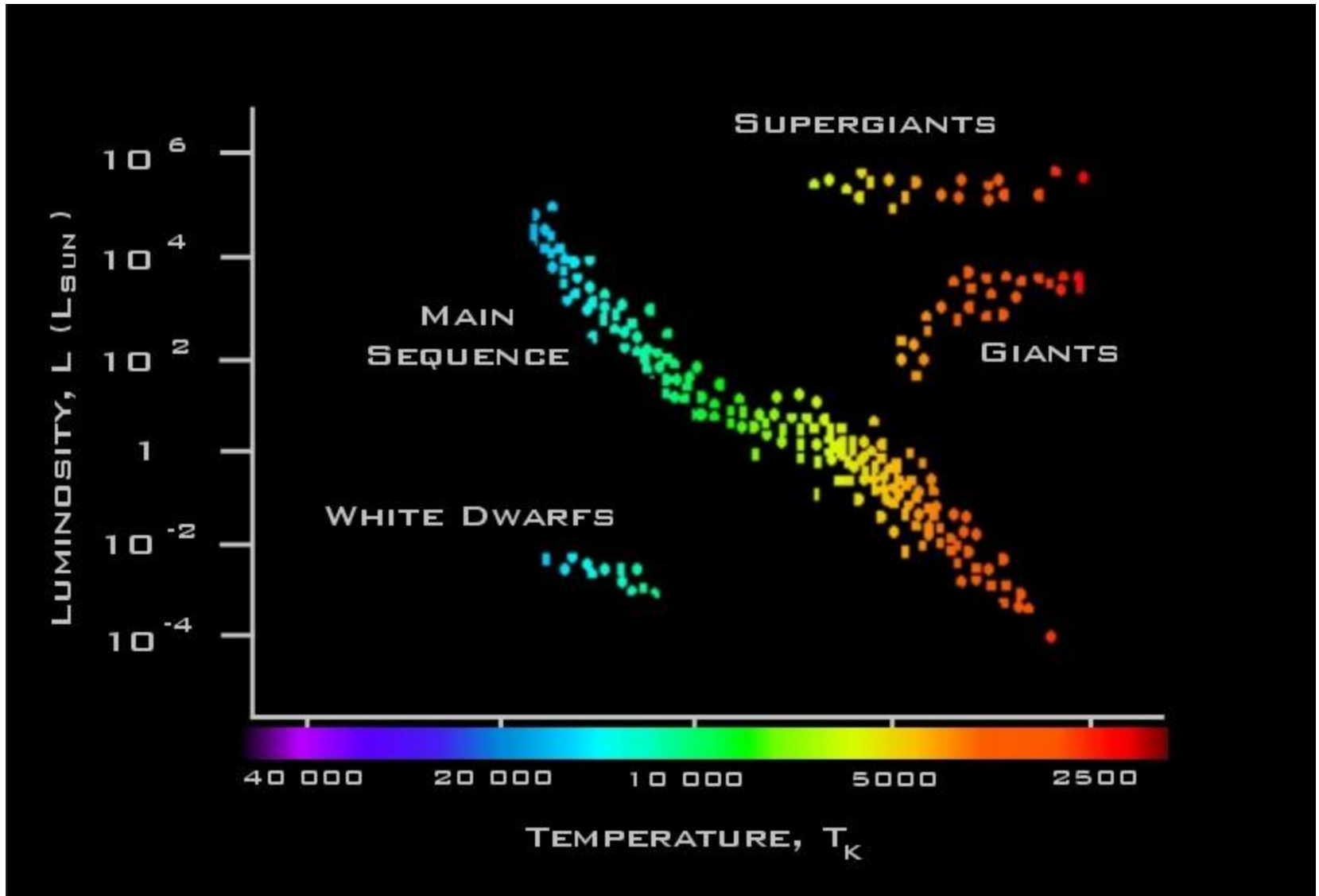
Life Cycle of a Star With Greater Mass Than Our Sun...

- Massive stars go through the same life stages as our sun (just on a larger scale) upto the Main Sequence stage,
- Then the massive stars expand into a Red Supergiant,
- Explode into a Supernova,
- Then turn into a Black Hole or a Neutron Star.

Life Cycle of Stars



Hertzsprung-Russell (HR) Diagram



HR Diagram

- The Hertzsprung-Russell (HR) Diagram is a tool that shows relationships and differences between stars (temperatures, brightness, colors, etc.)
- It is something of a "family portrait." It shows stars of different ages and in different stages, all at the same time.
 - A star in the upper left corner of the diagram would be hot and bright.
 - A star in the upper right corner of the diagram would be cool and bright.
 - The Sun rests approximately in the middle of the diagram, and it is the star which we use for comparison.
 - A star in the lower left corner of the diagram would be hot and dim.
 - A star in the lower right corner of the diagram would be cold and dim.

Hertzprung-Russell Diagram

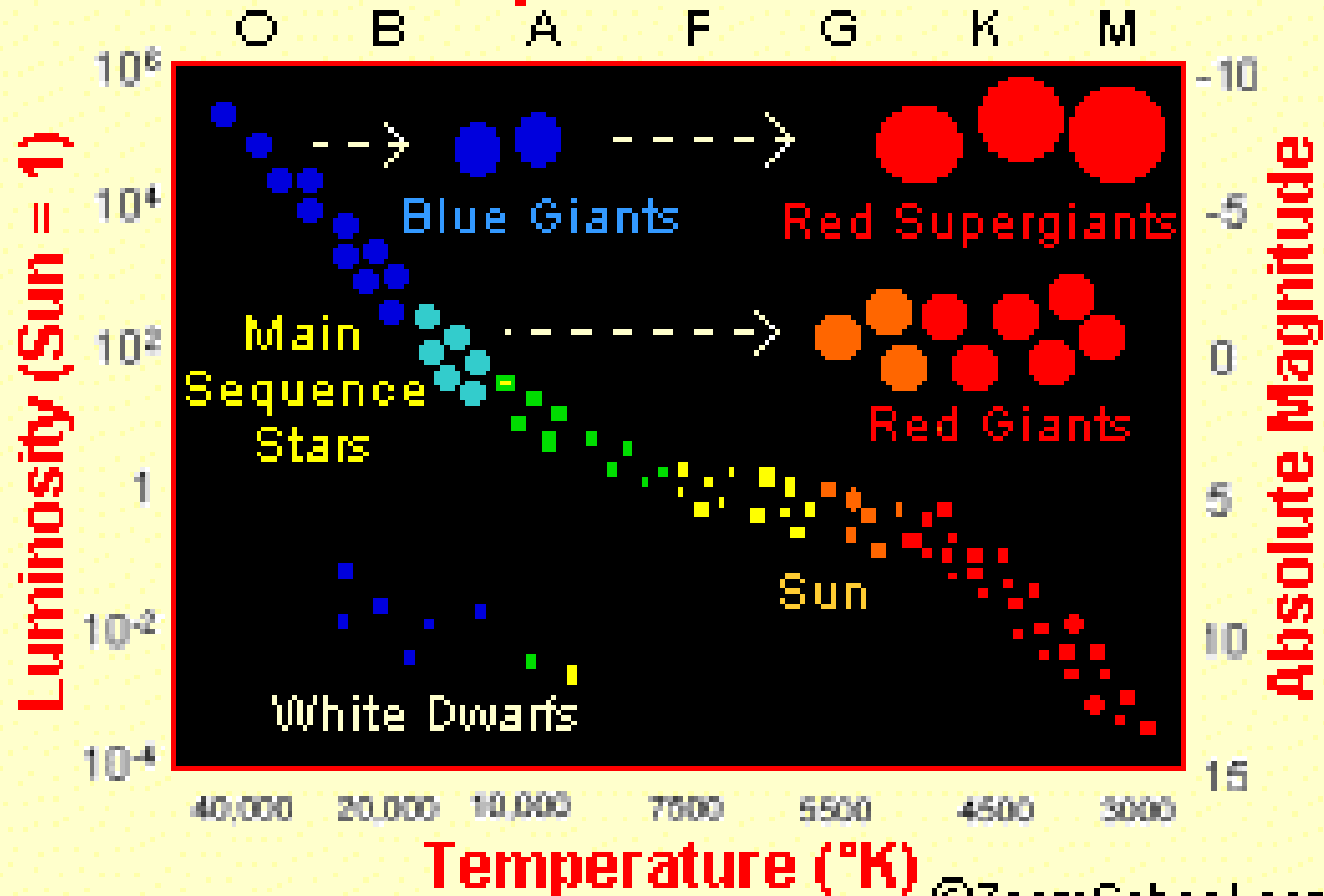
Spectral Class

Hot and
Bright


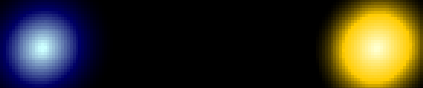
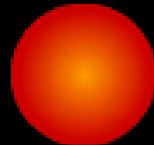

Cool and
Bright

Hot and
Dim

Cool and
Dim



- The larger a star the brighter the star.

Protostar	Fusion ignition - Main Sequence	Red Giant/Supergiant	White Dwarf/Black Hole
			
Fetus	Infancy through Adulthood	Middle Age	Old Age-Death
