

Characteristics of Stars

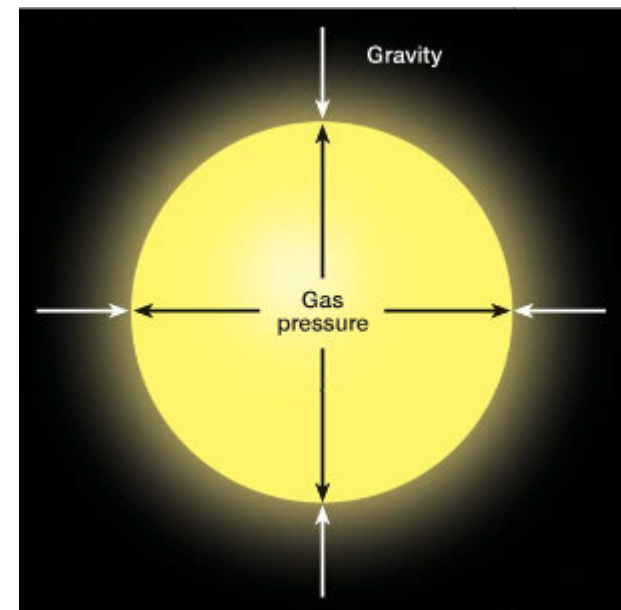
Star Birth

- The birthplaces of stars are dark, cool interstellar clouds made up of dust and gases.
- A shock wave from a near by explosion of a star may trigger a contraction of dust and gases.
- Gravity squeezes particles toward the center, and gravity energy is converted into heat energy.



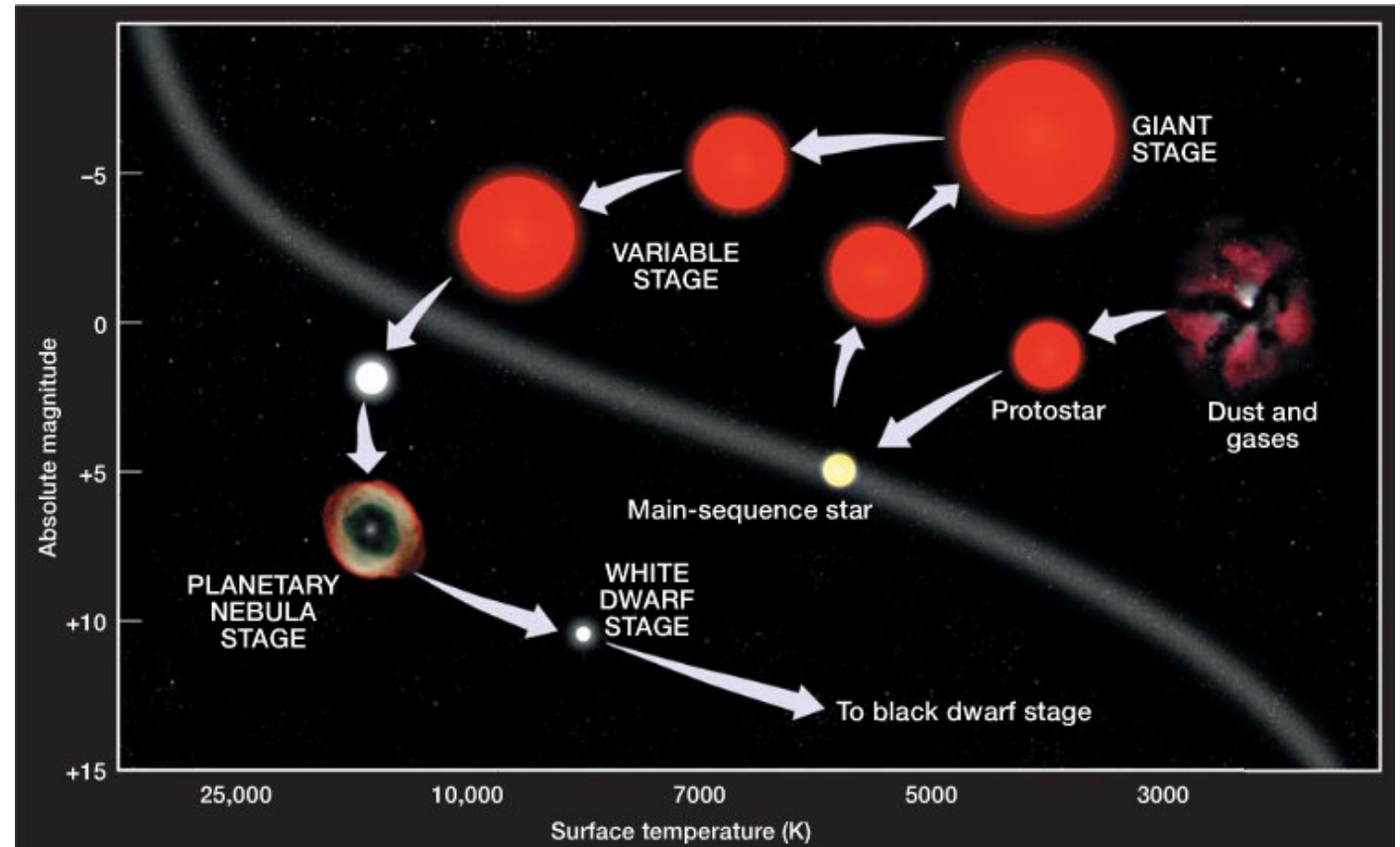
Protostar Stage

- As time passes (millions of years) the temperature of the gaseous body slowly rises, this forms a large red object called a **protostar**.
- When the core reaches about 10 million K, pressure within is so great that nuclear fusion of hydrogen begins, and a star is born.
- The outward pressure of gases exactly balances the inward force of gravity.
- When this balance is reached, the star becomes stable.



Main-Sequence Stage

- An average star spends 90 percent of its life as a hydrogen-burning main-sequence star.
- A yellow star like the Sun, remains a main-sequence star for about 10 billion years.



Red-Giant Stage

- The red-giant stage occurs because the zone of hydrogen fusion continually moves outward, leaving behind a helium core.
- Eventually all the hydrogen is consumed in the core.
- Without a source of energy, the core can't support itself against the inward force of gravity, the core contracts.
- Eventually, all usable nuclear fuel is used up and it is squeezed into a much smaller star.

Burnout and Death

- All stars, regardless of size, eventually run out of fuel and collapse due to gravity.

Death of Low-Mass Star

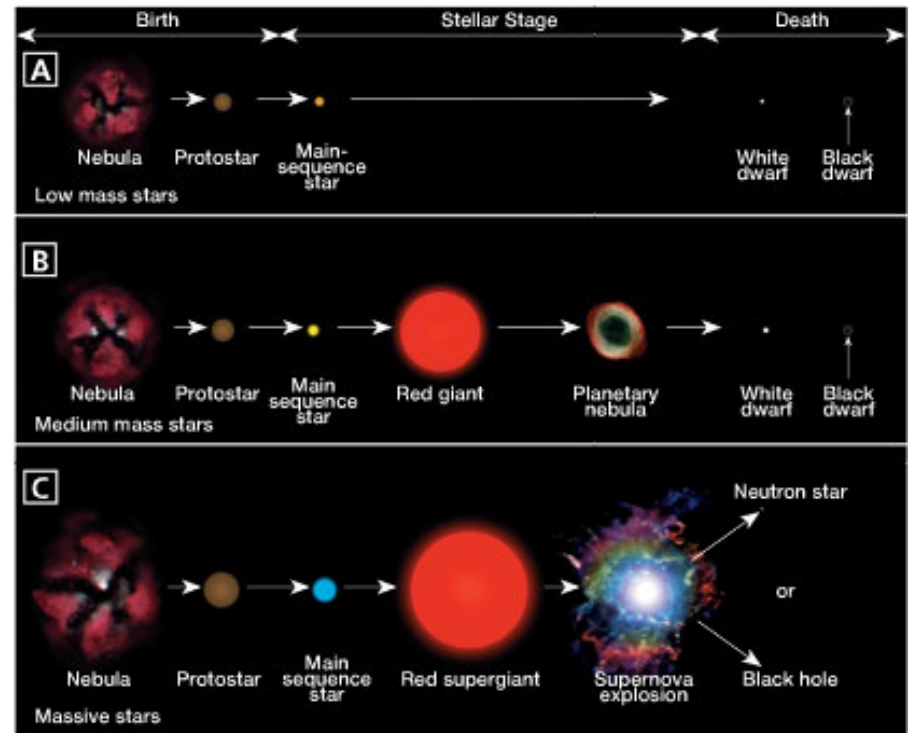
- Never reach high enough temperatures and pressures to fuse helium, only use hydrogen.
- Never evolve into red giants; consume their hydrogen and collapse into a white dwarf.

Death of Medium-Mass Stars

- Do fuse helium at a faster rate and evolve into red giants, and collapse and create a planetary nebula, then into a white dwarf and end as a black dwarf.

Death of Massive Stars

- Develop in red supergiant and collapse in a supernova explosion, then become neutron stars or black holes.



Nucleosynthesis

- Dying stars can be a factory where new elements form. Stars produce all naturally occurring chemical elements beyond helium.
- Only massive stars produce elements heavier than iron; the Sun cannot.

Stellar Remnants

White Dwarfs – remains of low-mass and medium stars. Extremely small with densities greater than any known material. Can be no larger than the Earth.

Neutron Stars – thought to be the remnants of supernova events. Electrons are forced to combine with protons to produce neutrons.

Supernovae – explosion of a massive stars which produce a spinning neutron star that appears to give off pulses of radio waves called a **pulsar**.

Black Holes – dense objects with gravity so strong light can not escape.

