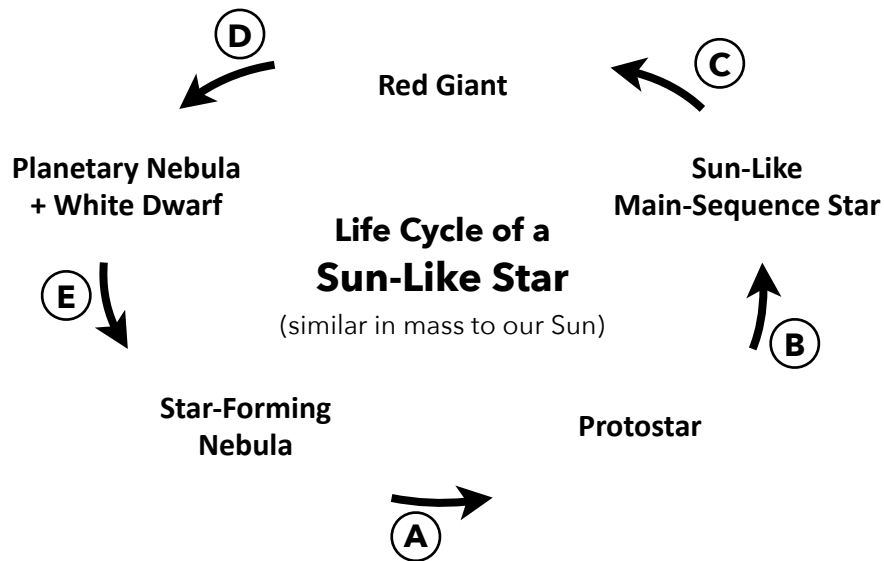


Life Cycle of Stars: Stages and Transitions **Answer Key**

projects.wwtambassadors.com/star-life-cycle



Protostar Gravity compresses protostar. When temperature and density of core is high enough, deuterium fusion can start. (Gravity also draws more gas and dust onto outside of protostar. A disk may form around protostar to form planets.)

Role of gravity: density of core is high enough, deuterium fusion can start.
(Gravity also draws more gas and dust onto outside of protostar. A disk may form around protostar to form planets.)

Role of fusion: Deuterium fusion heats up inside of protostar and increases outward pressure.

Balance of gravity and fusion: Radiation pressure created by deuterium fusion in the core can counteract the inward force of the gravity, and the protostar can remain stable for some time.

What causes **transition (B)**?

Eventually, gravity compresses the core until the temperature and density are high enough to fuse H to He.

Sun-Like Main-Sequence Star

Role of gravity: Gravity compresses core and keeps temperature and density high enough to fuse H->He.

Role of fusion: Hydrogen -> Helium fusion allows star to shine.

Balance of gravity and fusion: Star stays in balance while H->He fusion happens in core.

Star-Forming Nebula

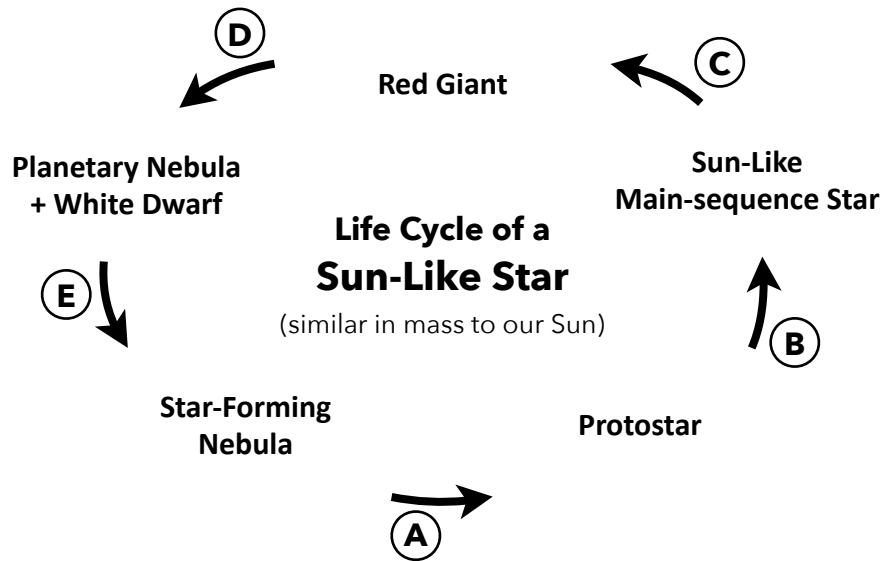
Role of gravity: Draws together gas and dust left behind by previous generations of stars into a large cloud. Denser parts of cloud contract due to gravity.

Role of fusion: None during this stage.

Balance of gravity and fusion: No fusion reactions stop gravity from compressing the gas and dust (which increases temperature, pressure, and density in the core).

What causes **transition (A)**?

Gravity's compression eventually increases the temperature and density enough to trigger deuterium fusion in the core of the gas and dust clump, forming a new protostar.



What causes **transition C**?

Hydrogen in the core of the star runs out and fusion stops.

Gravity takes over and compresses the core until temperature and density are high enough to fuse He→C.

Red Giant

Role of gravity: Compresses star until H→He fusion ignites in shell around core and He→C fusion ignites in core.

Role of fusion: H→He fusion in shell triggers expansion and cooling of star to become a red giant. Energy from fusion in core and shell makes star shine.

Balance of gravity and fusion: Star stays in balance while fusion in core and shell is ongoing.

What causes **transition D**?

Helium in the core of the star runs out and fusion stops.

Gravity takes over and compresses the core.

Planetary Nebula + White Dwarf

Role of gravity: Compresses core until it becomes a white dwarf. (Stellar winds blow the outer layers of the star away to form the nebula.)

Role of fusion: None.

Balance of gravity and fusion: Fusion plays no role here. Another process (quantum physics) stops complete collapse of star under gravity.

What causes **transition E**?

Stellar winds can blow away the planetary nebula gas and dust (which include elements fused over the star's lifetime).

Eventually, the gas and dust may aggregate into a new star-forming region.