

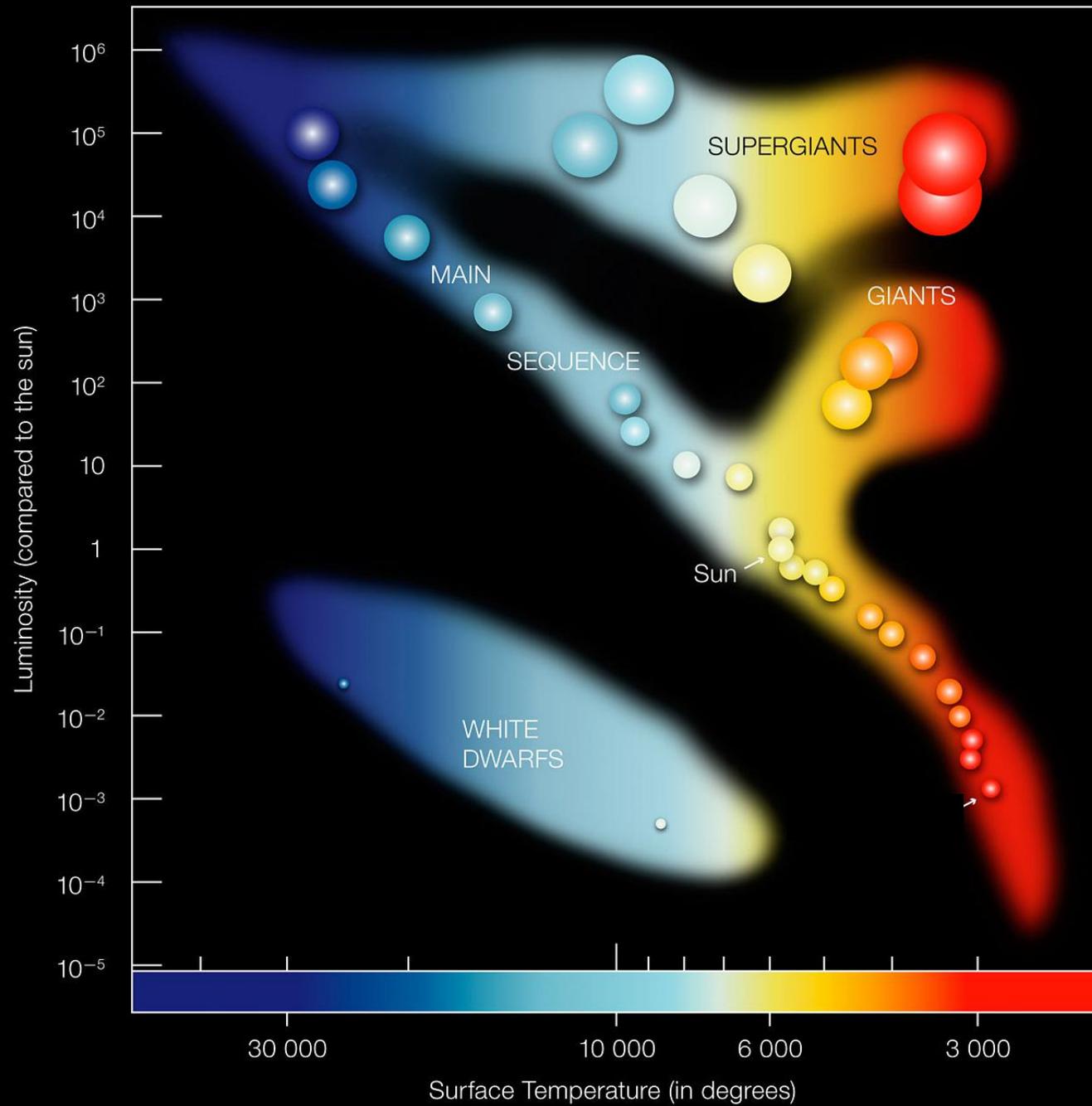
**Cosmic Connections:
An Introduction to Astronomy
and
Maine's Magnificent Night
Skies**

Midcoast Senior College
Russell F. Pinizzotto, Ph.D. (Russ)

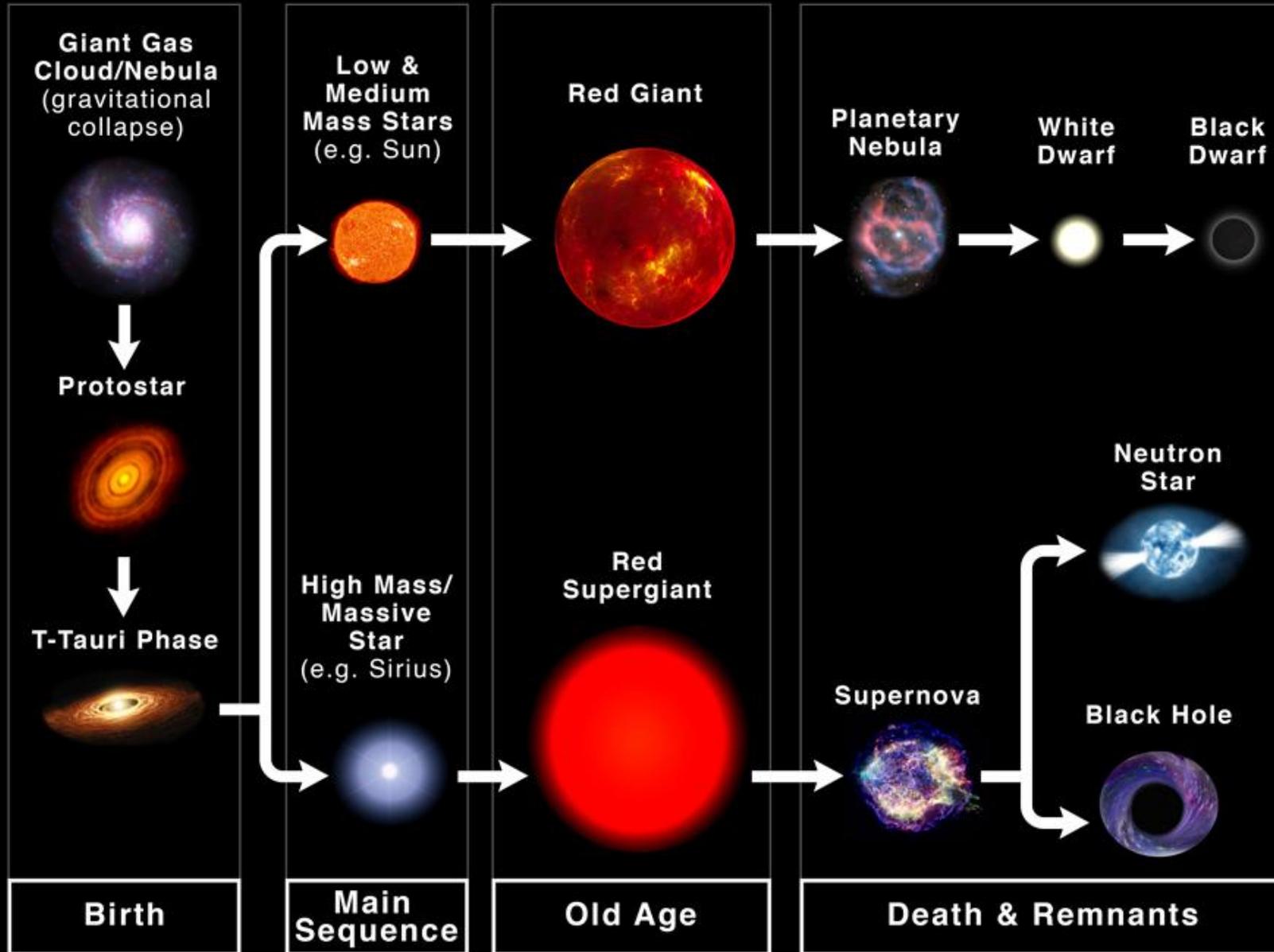
Unit 10

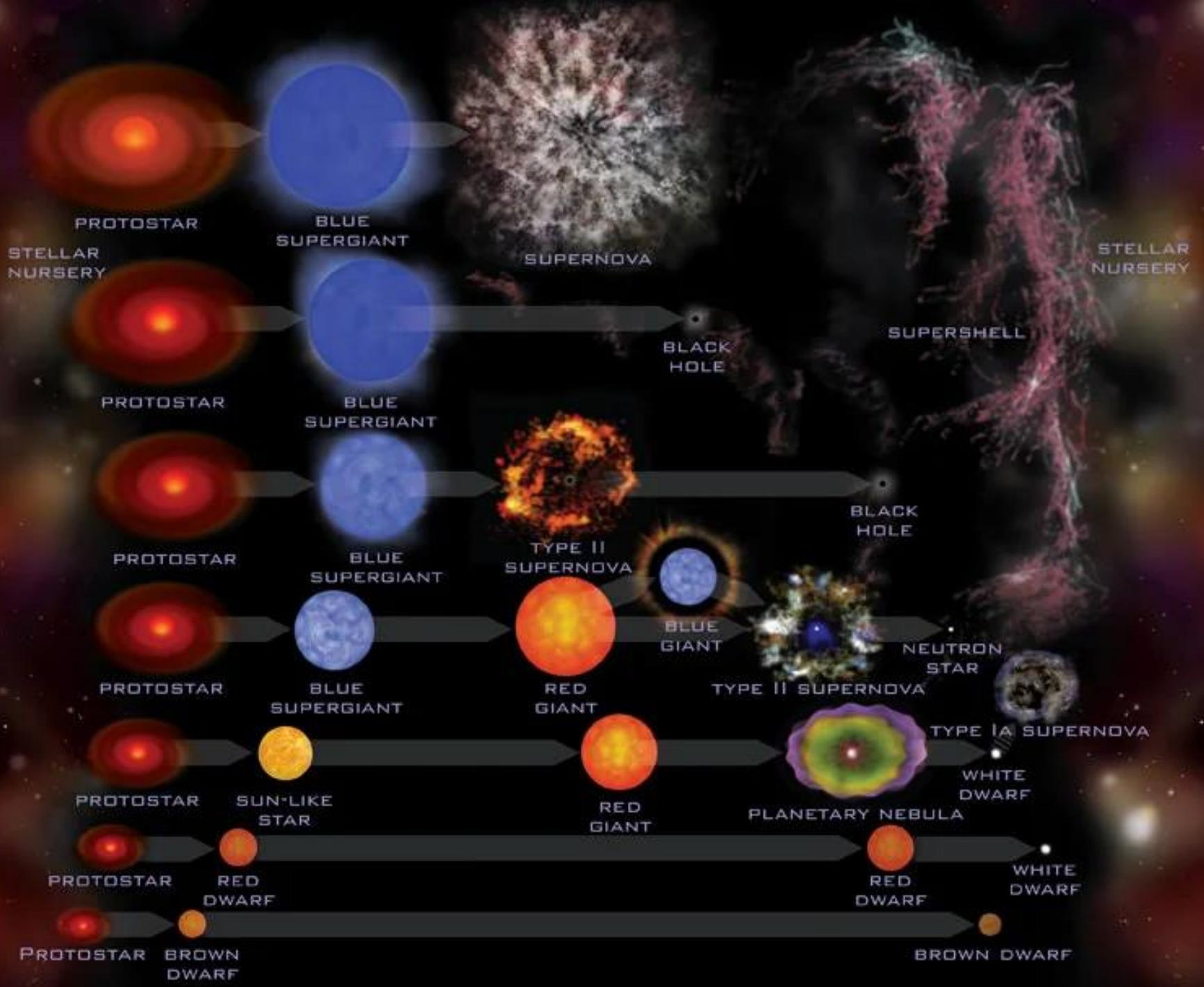
The Life and Death of Stars





Life Cycle of a Star







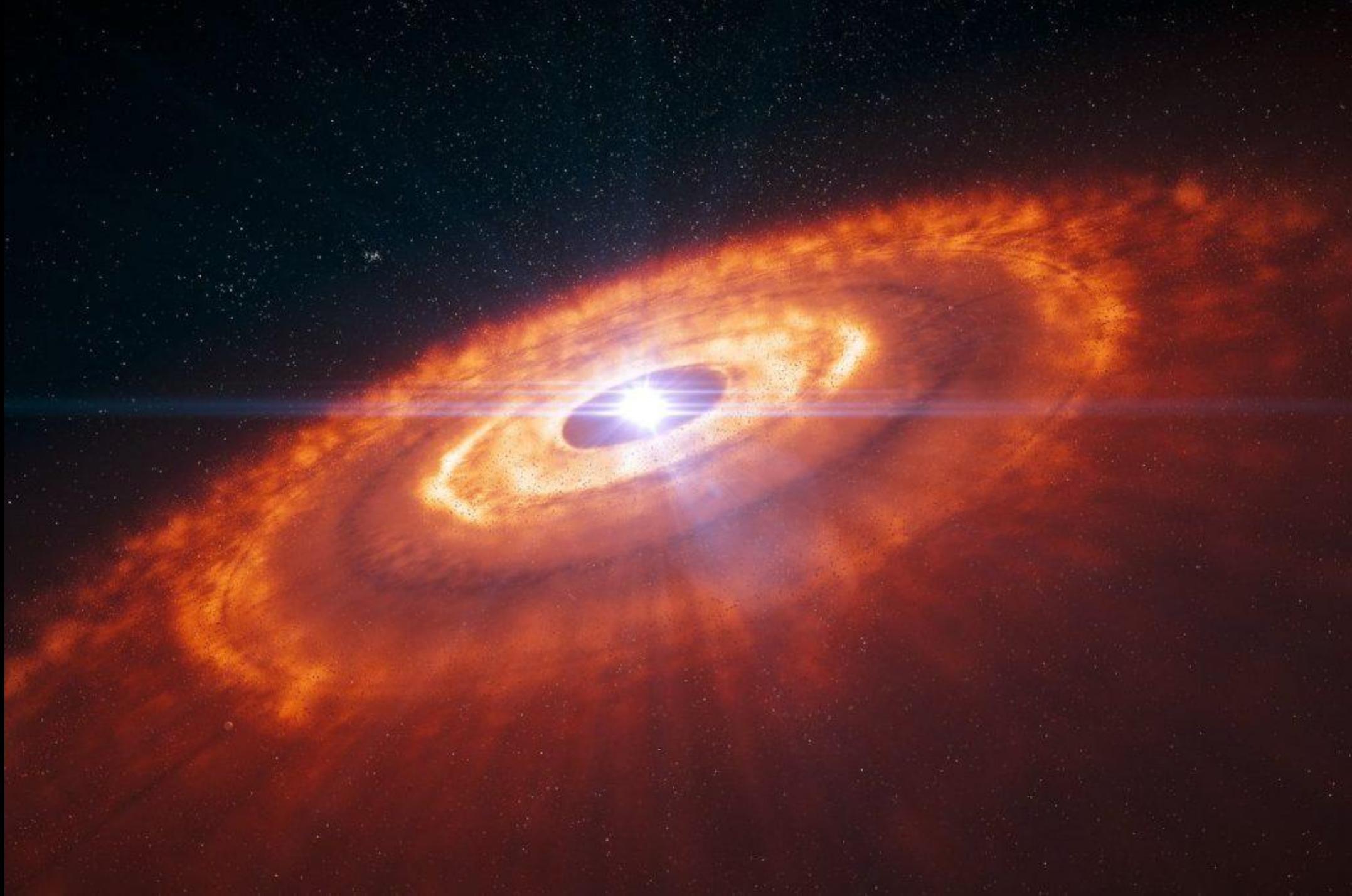




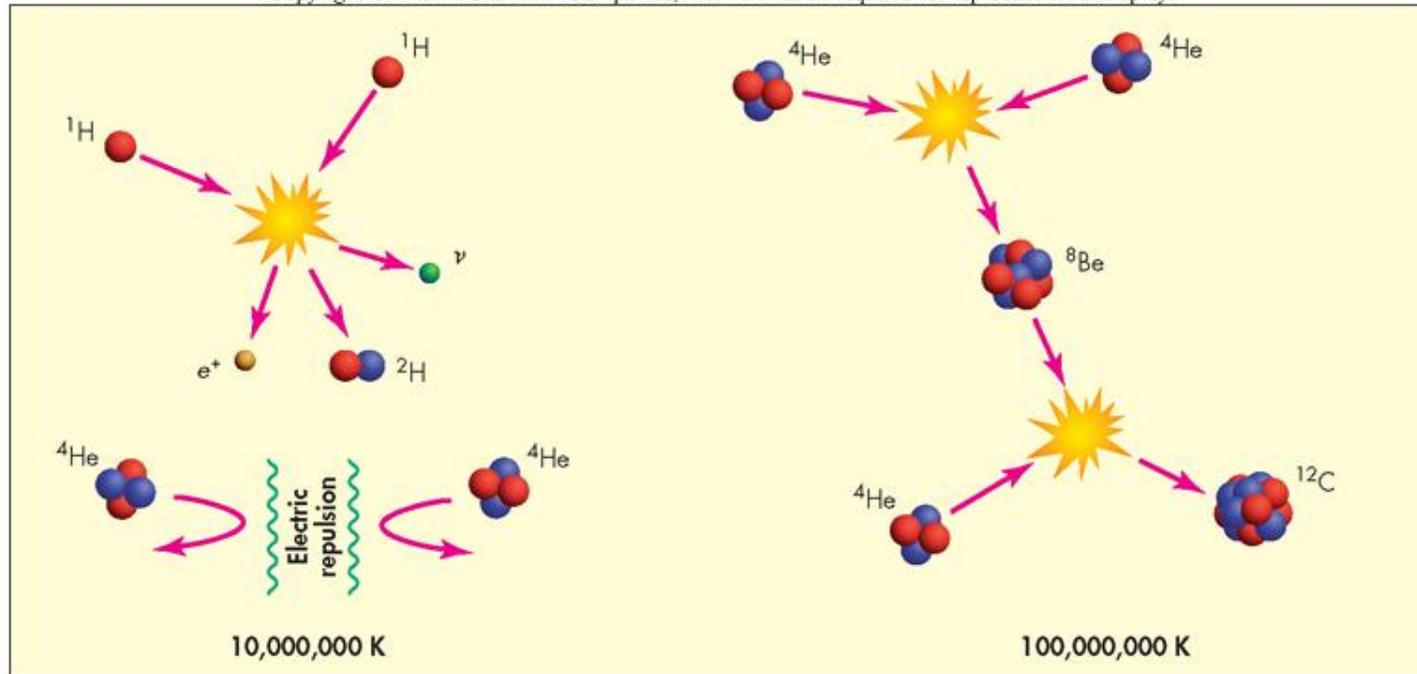
Protostar Formation

JWST

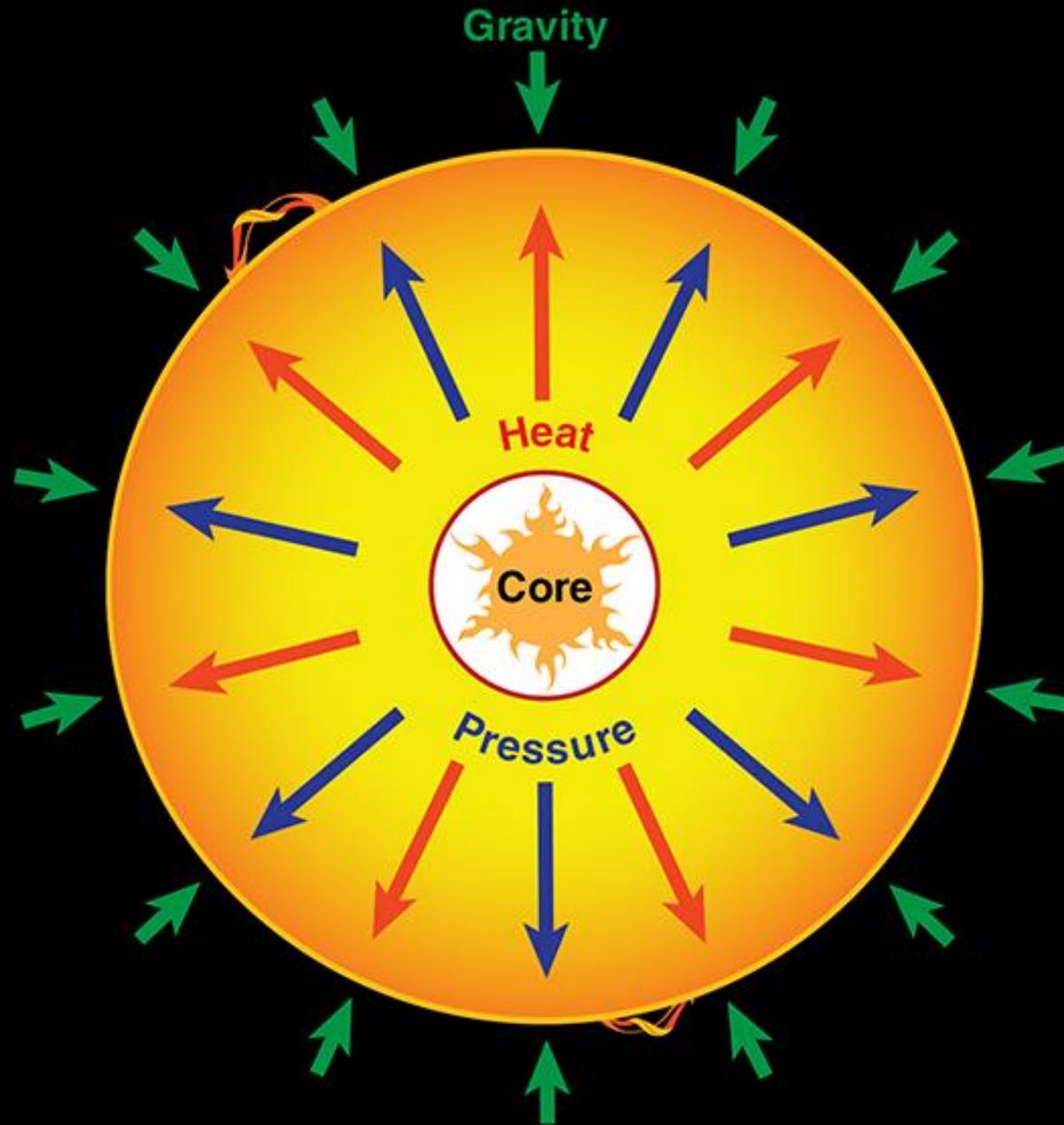


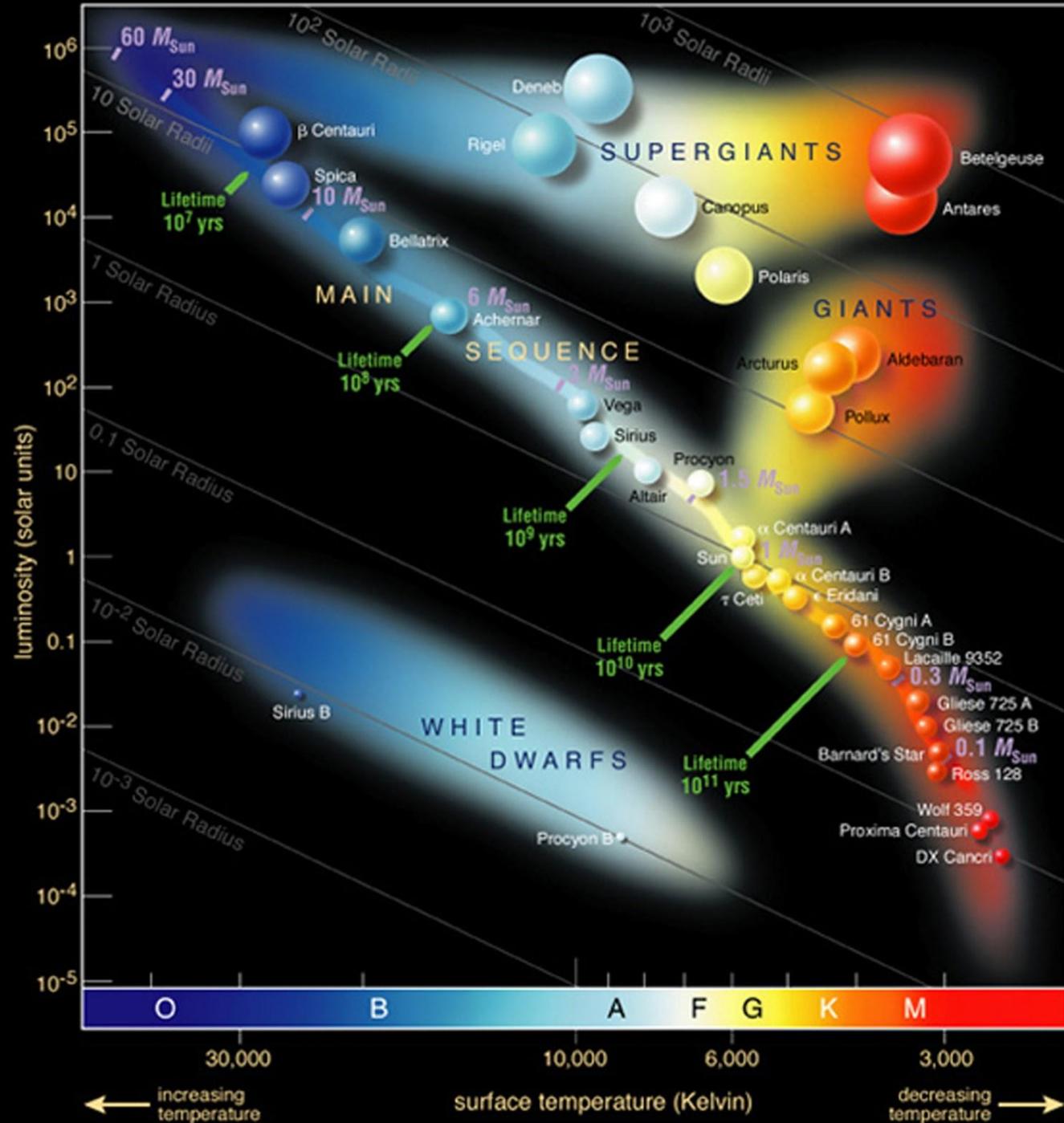


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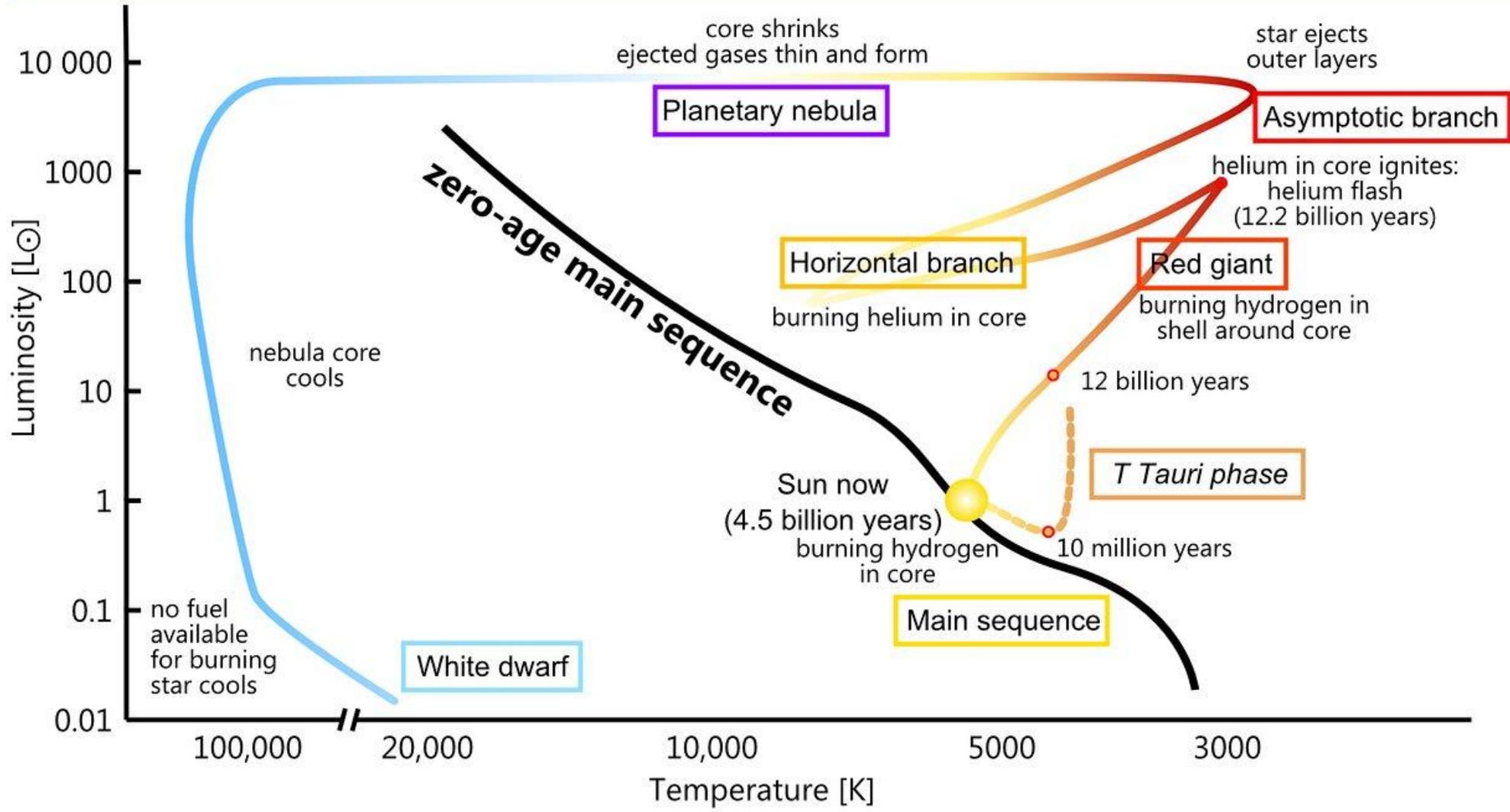
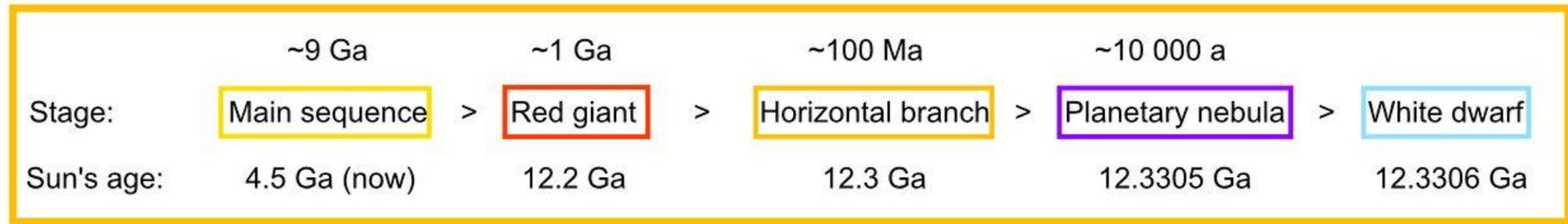


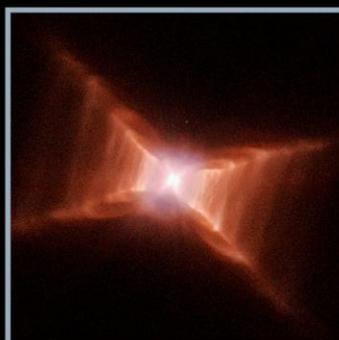
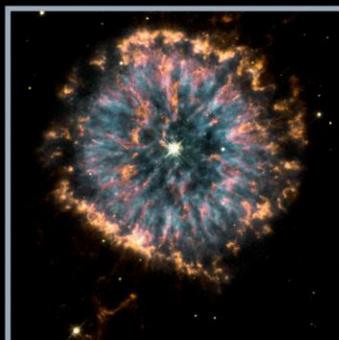
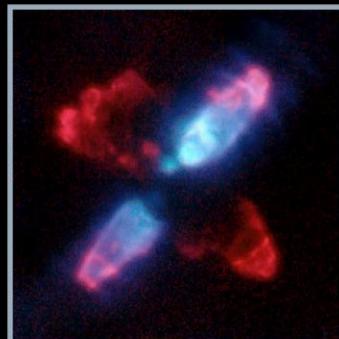
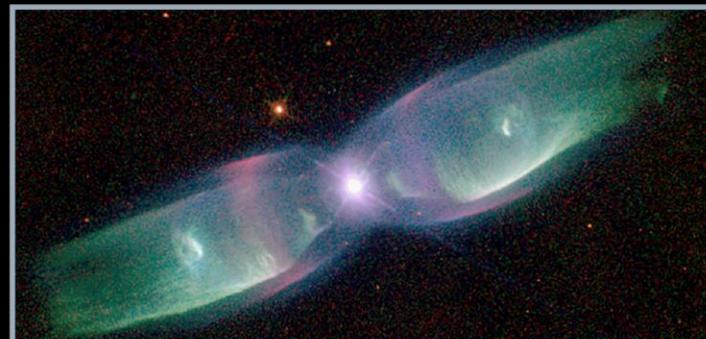
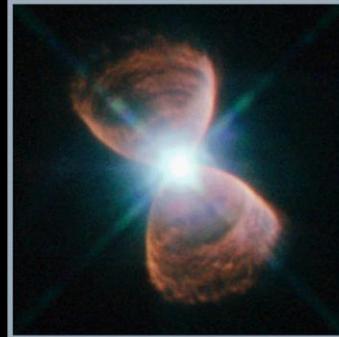
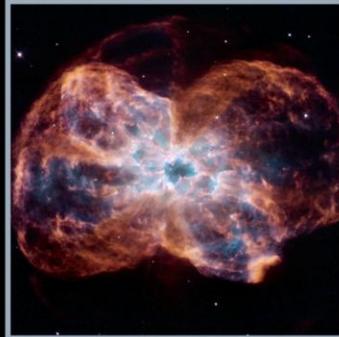
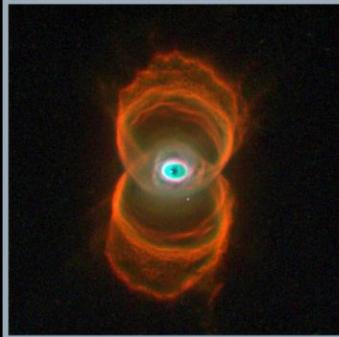
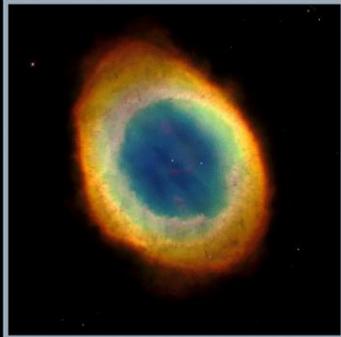
What holds a star together?

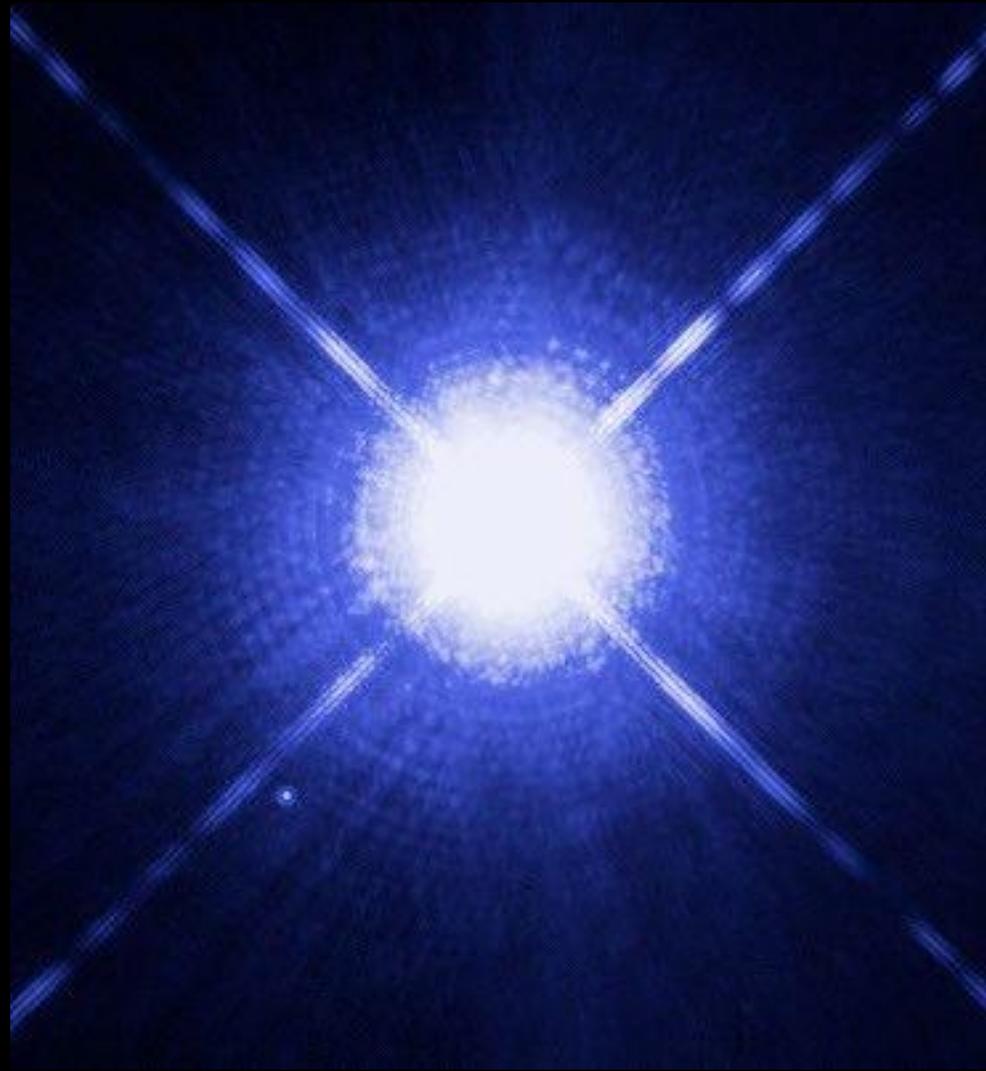




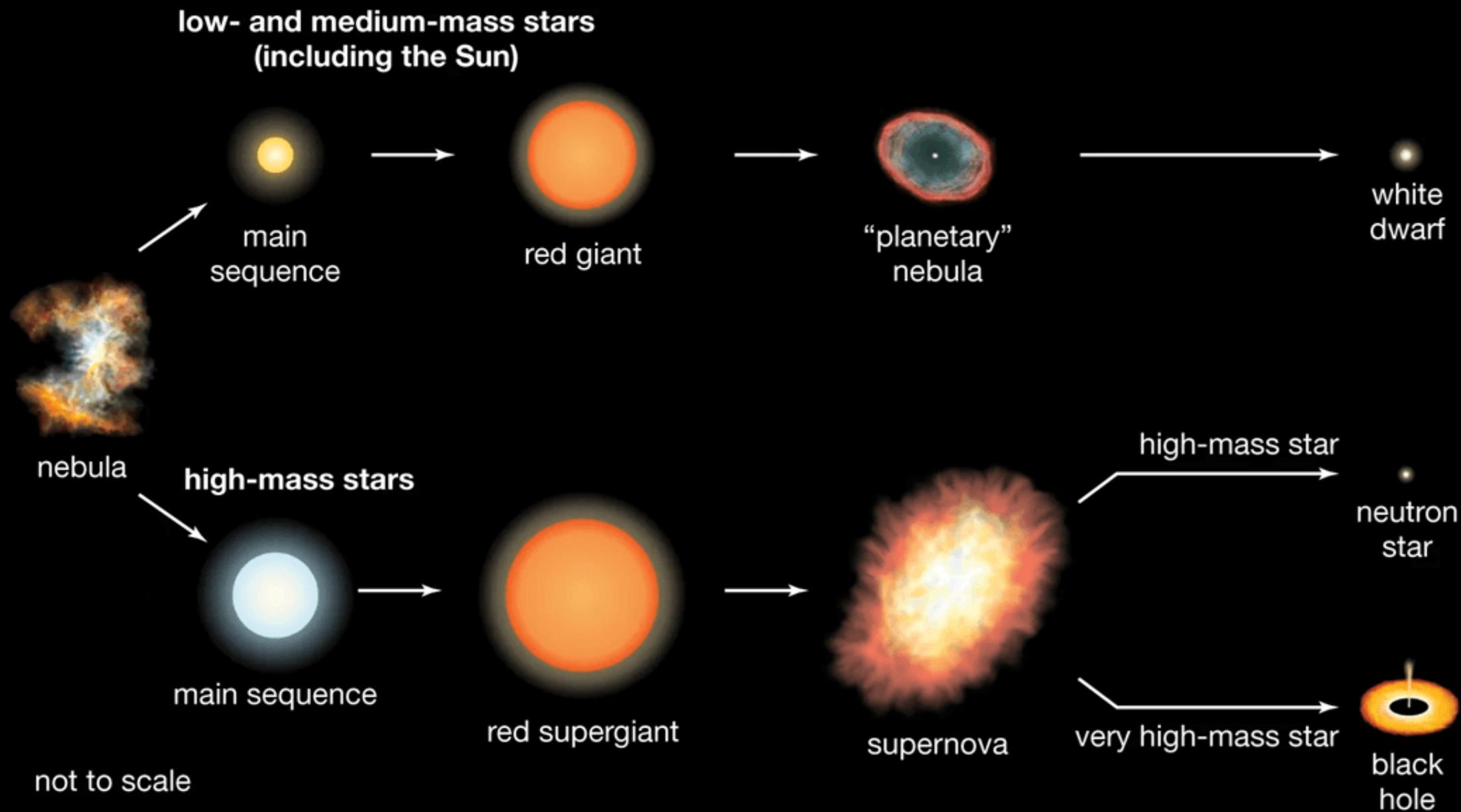
← increasing temperature surface temperature (Kelvin) decreasing temperature →

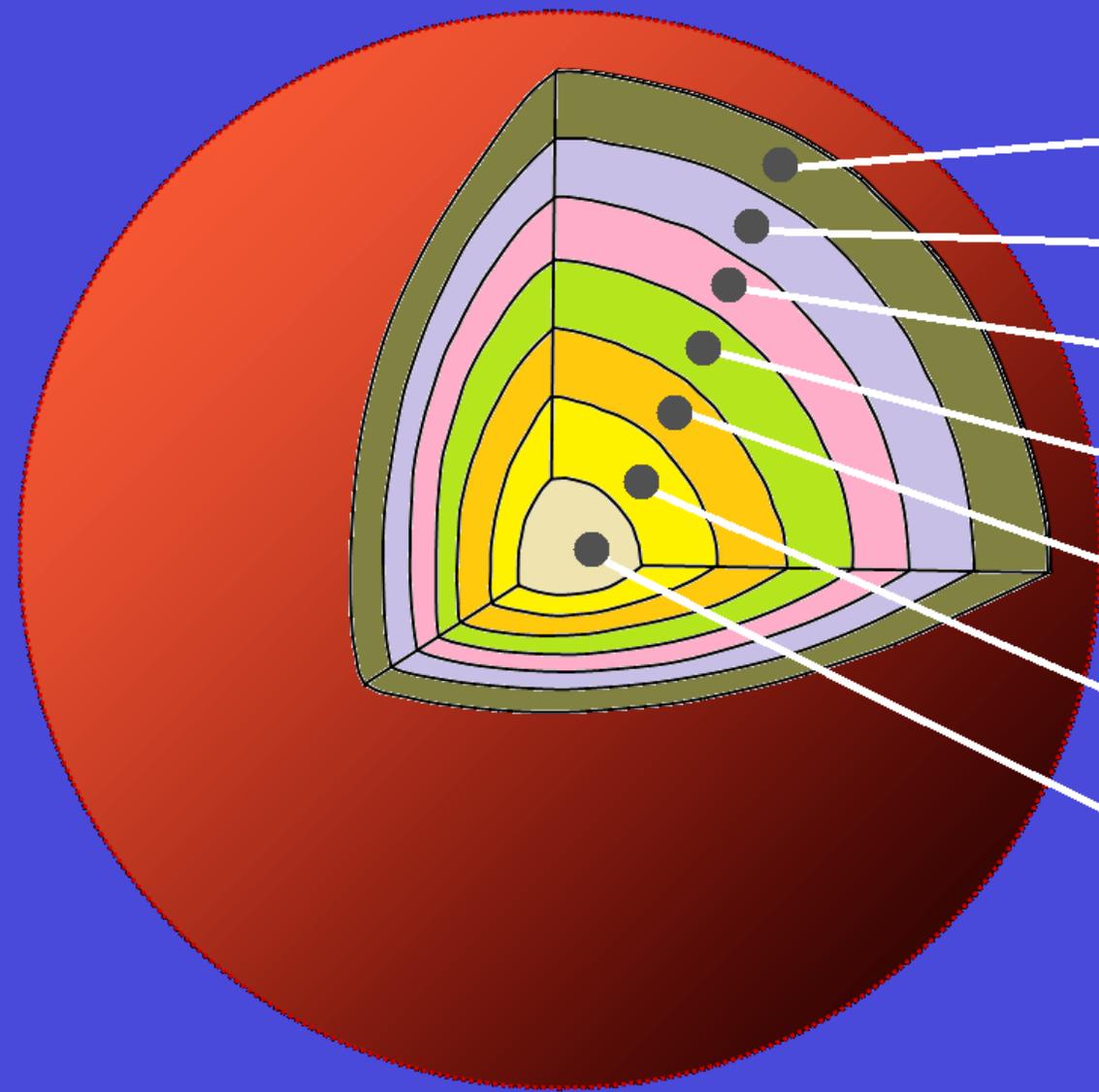






Stellar evolution





Hydrogen, Helium

Helium, Nitrogen

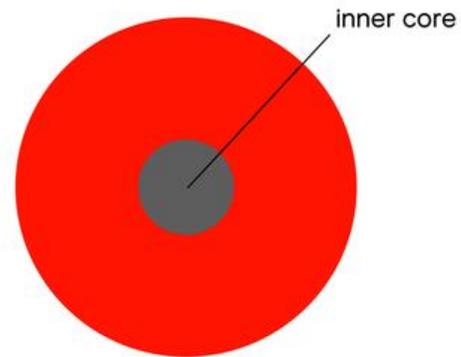
Helium, Carbon, Neon-22

Oxygen, Carbon

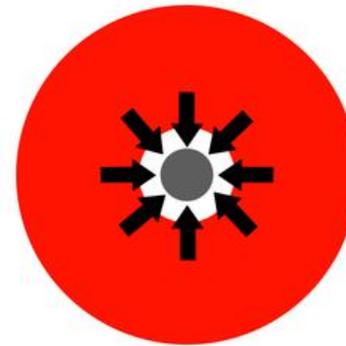
Oxygen, Neon, Magnesium

Silicon, Sulfur

Nickel, Iron (inert core)



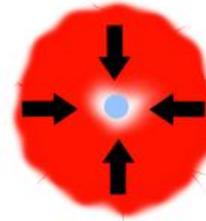
massive star



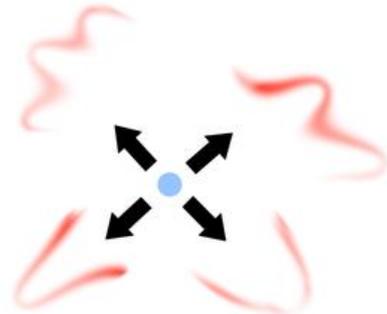
Inner core implodes under gravity



Gravity smashes electrons and protons together, forming neutrons, and releasing a shower of neutrinos. Outer layers slosh violently from standing accretion shock instability.



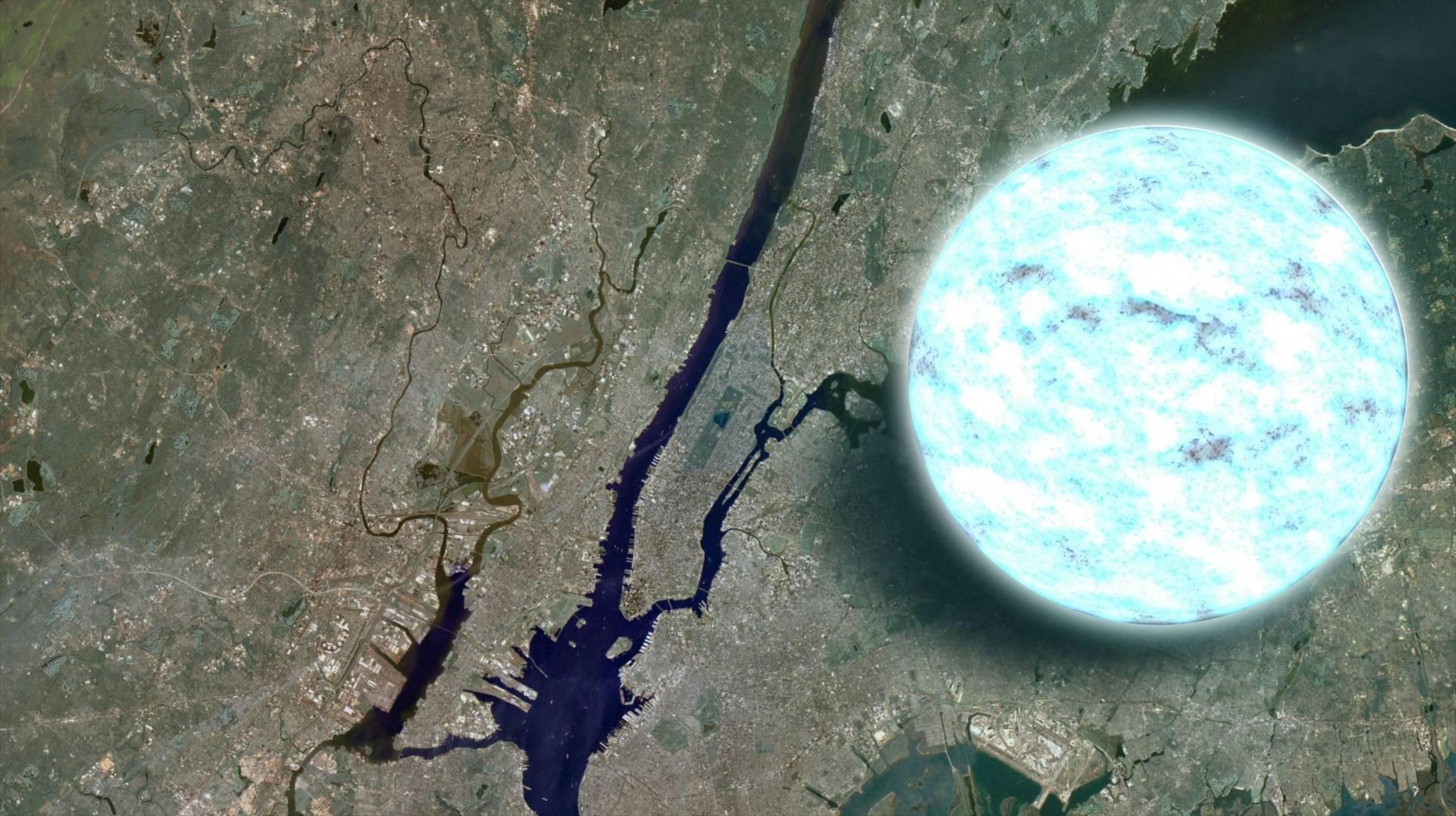
Outer layers implode and collapse onto the inner core at 25% the speed of light.

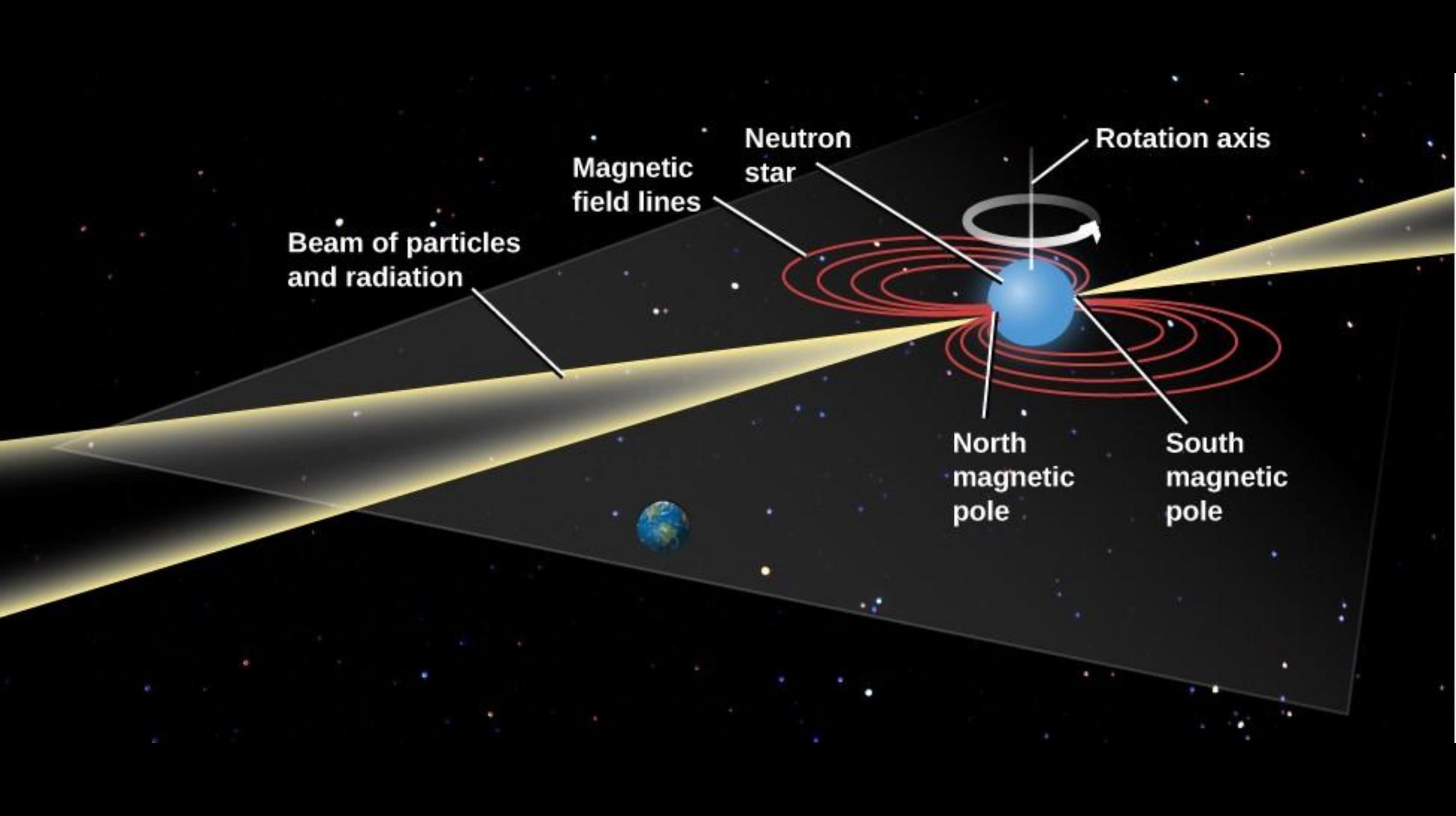


Outer layers bounce off the dense core, creating a supernova.



The resultant free core is a neutron star.





Beam of particles
and radiation

Magnetic
field lines

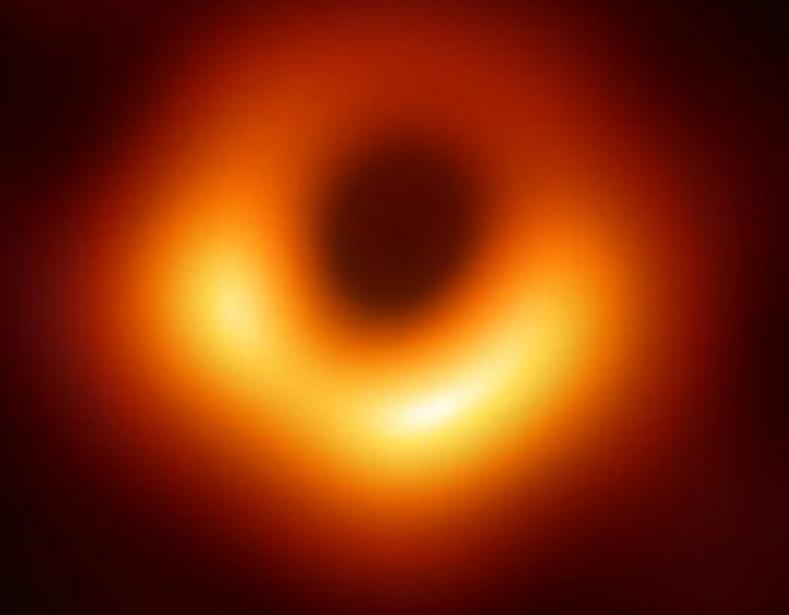
Neutron
star

Rotation axis

North
magnetic
pole

South
magnetic
pole



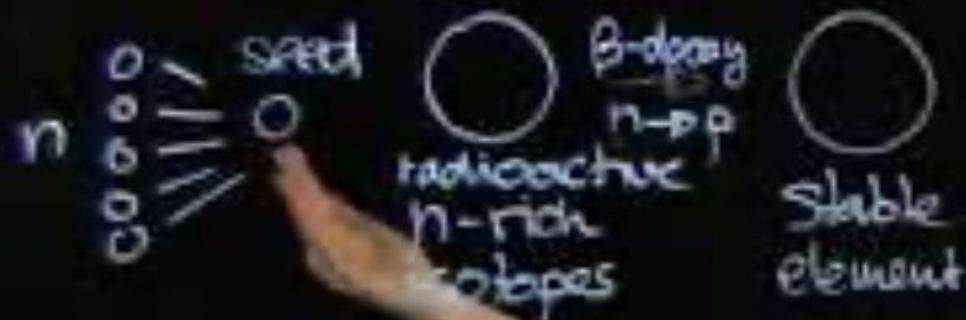


The elements heavier than iron are formed in supernova explosions through the r-process, the rapid capture of neutrons.

<https://www.youtube.com/watch?v=lBoPosKEFYc>

Formation of the heaviest elements

n-capture process



- Slow n-capt. evolved red giants
~10,000 yrs → Pb
- rapid n-capt.
1-2 sec

