Unit 103
Stellar Evolution: Star's Life Cycle

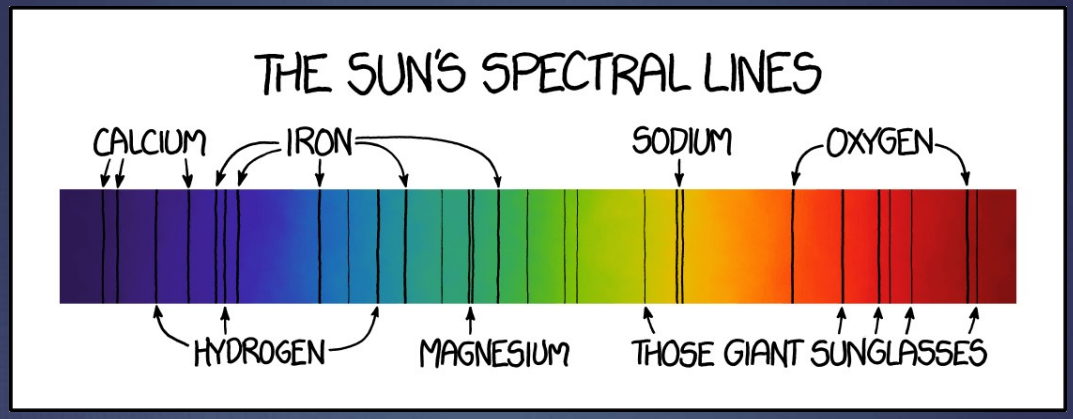
Goal:

- Create a diagram to help you understand how Stars lives lead to elements we have on Earth.

Brain Starter:

- How do we know what's in a Star?

How do we know what's in a Star?



Electromagnetic emission and absorption spectra are used to determine:

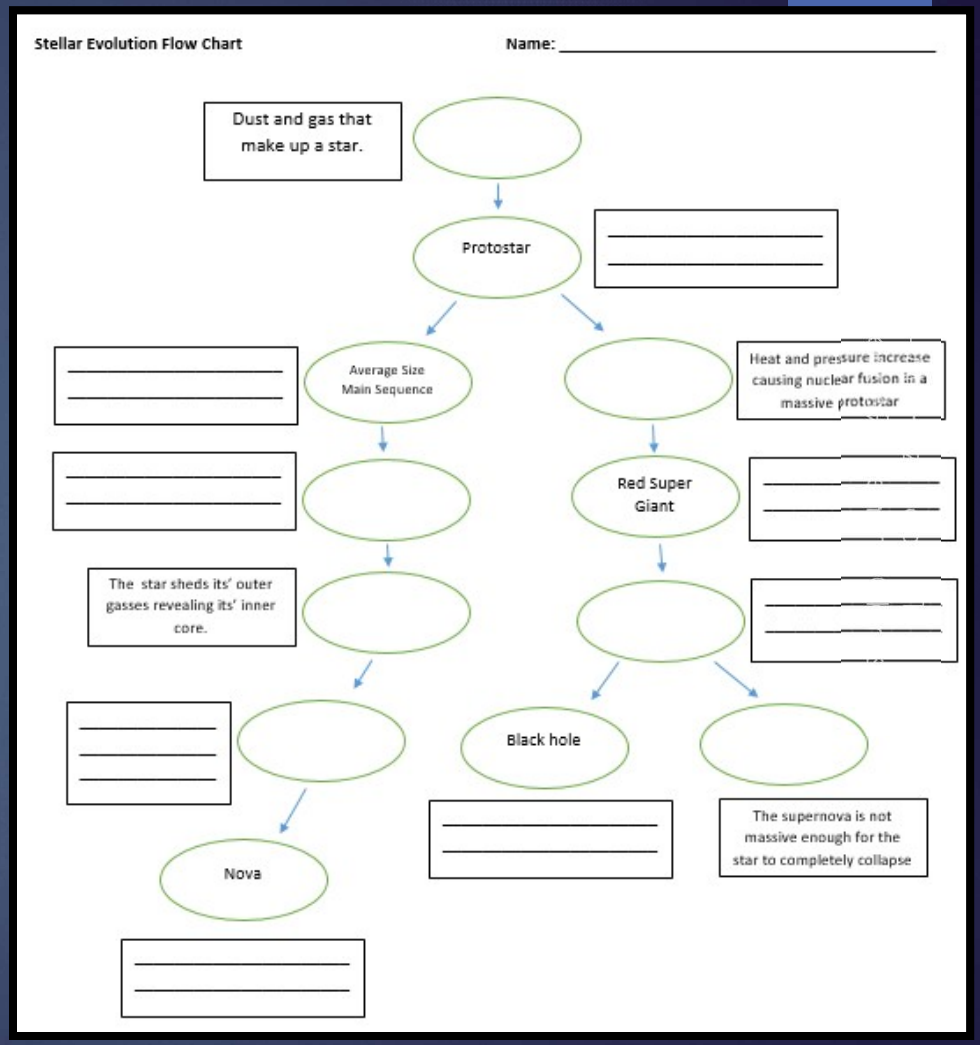
- a star's composition and,
- motion and distance (Doppler & Hubble)

Stellar Evolution Flow Chart

- Fill out digital version

OR

- Create your own to match the slides and your note-taking style



So, what is a star?

- A hot ball of gas
- Hydrogen fusing into helium at its core.
- Hydrogen gone?
  - Fuse helium
  - Make carbon, oxygen, iron and nickel.
- Battle between gravity and gas pressure
  - Known as equilibrium
  - Crucial to understand how stars live and die.

Hydrogen fusion

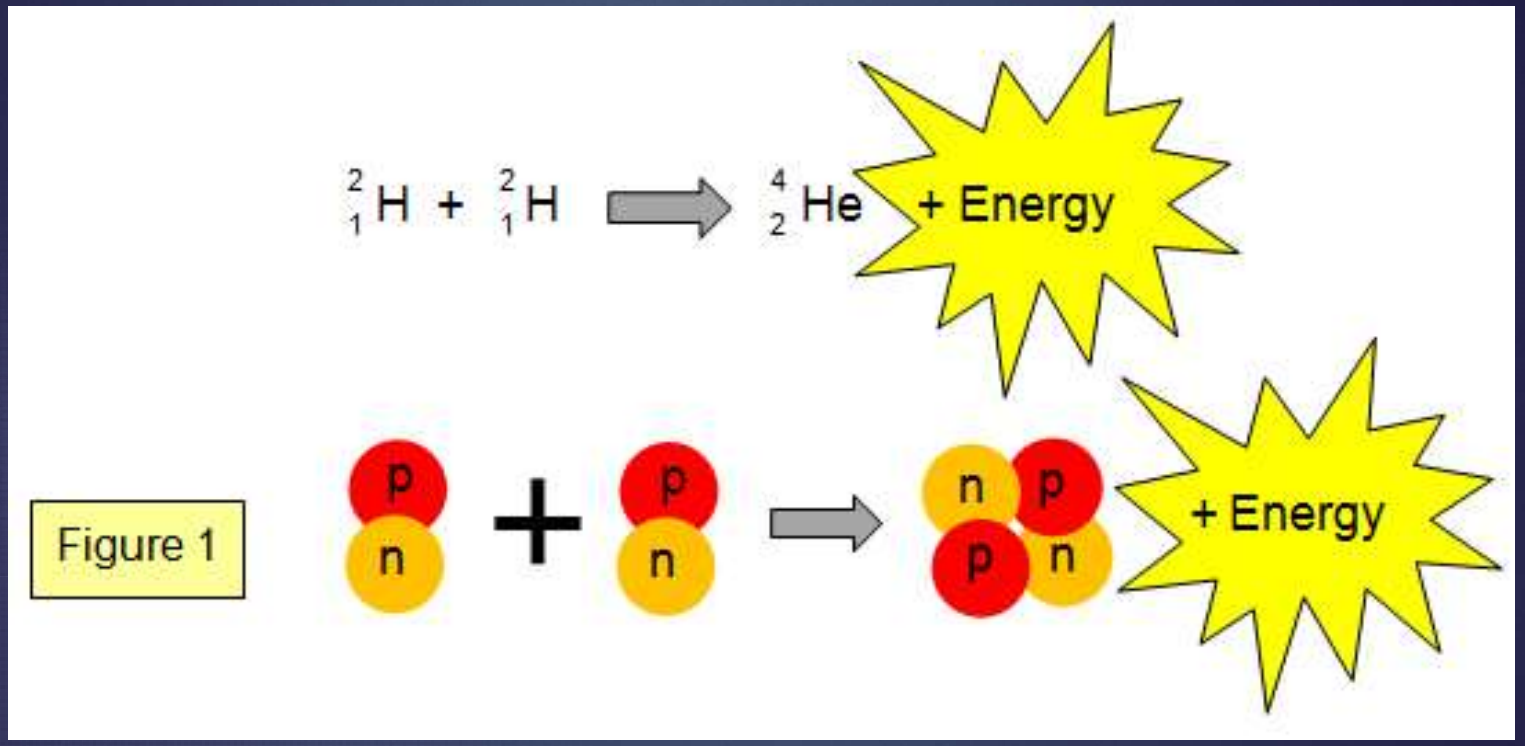


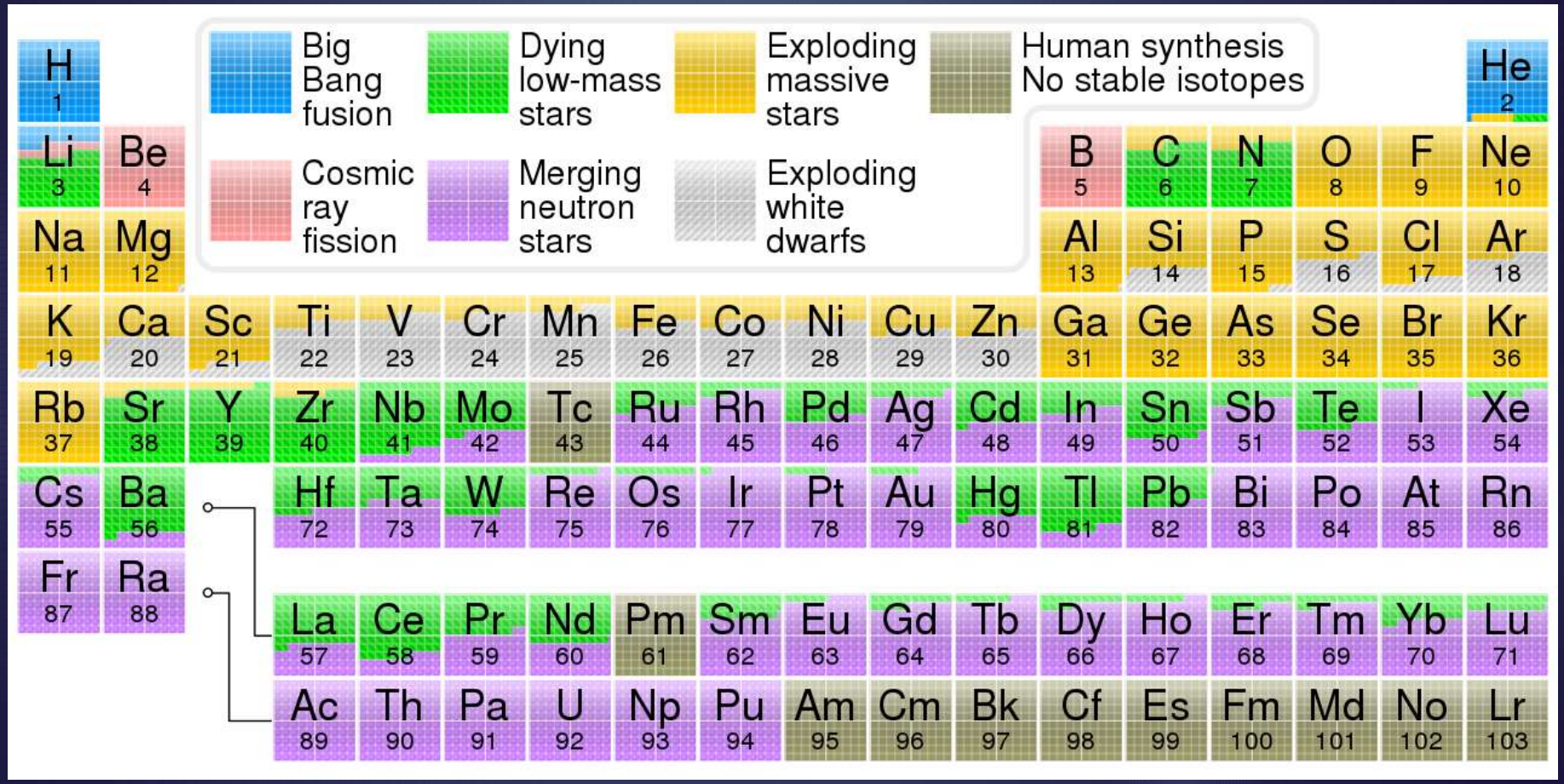
Figure 1

nu·cle·o·syn·the·sis

/ˌn(y)o͞oklēōˈsinTHəsəs/

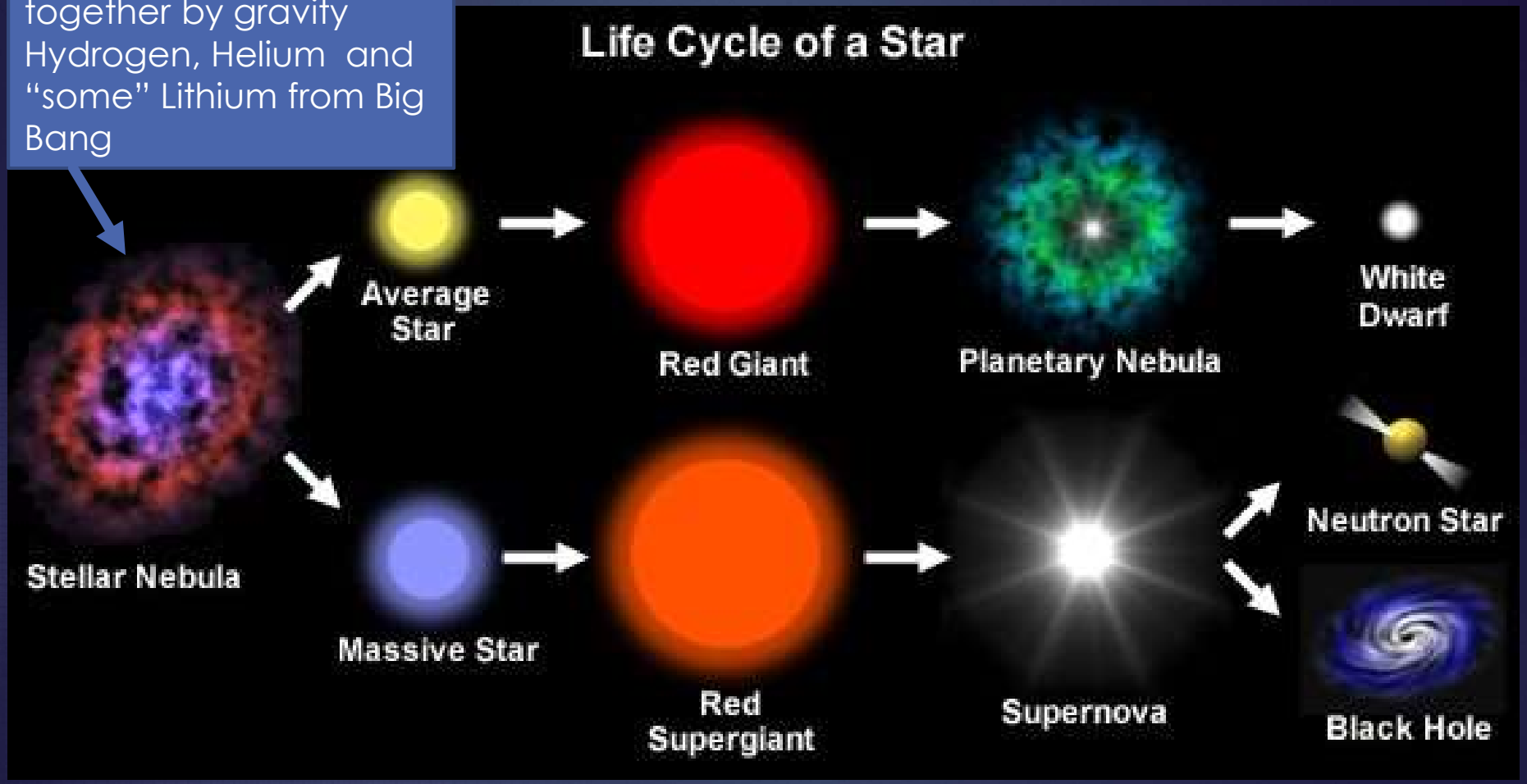
noun **ASTRONOMY**

the cosmic formation of atoms more complex than the hydrogen atom.



Summary of a Star's "Life Cycle"

Gas and dust; Comes together by gravity Hydrogen, Helium and "some" Lithium from Big Bang



Stellar Evolution Flow Cha

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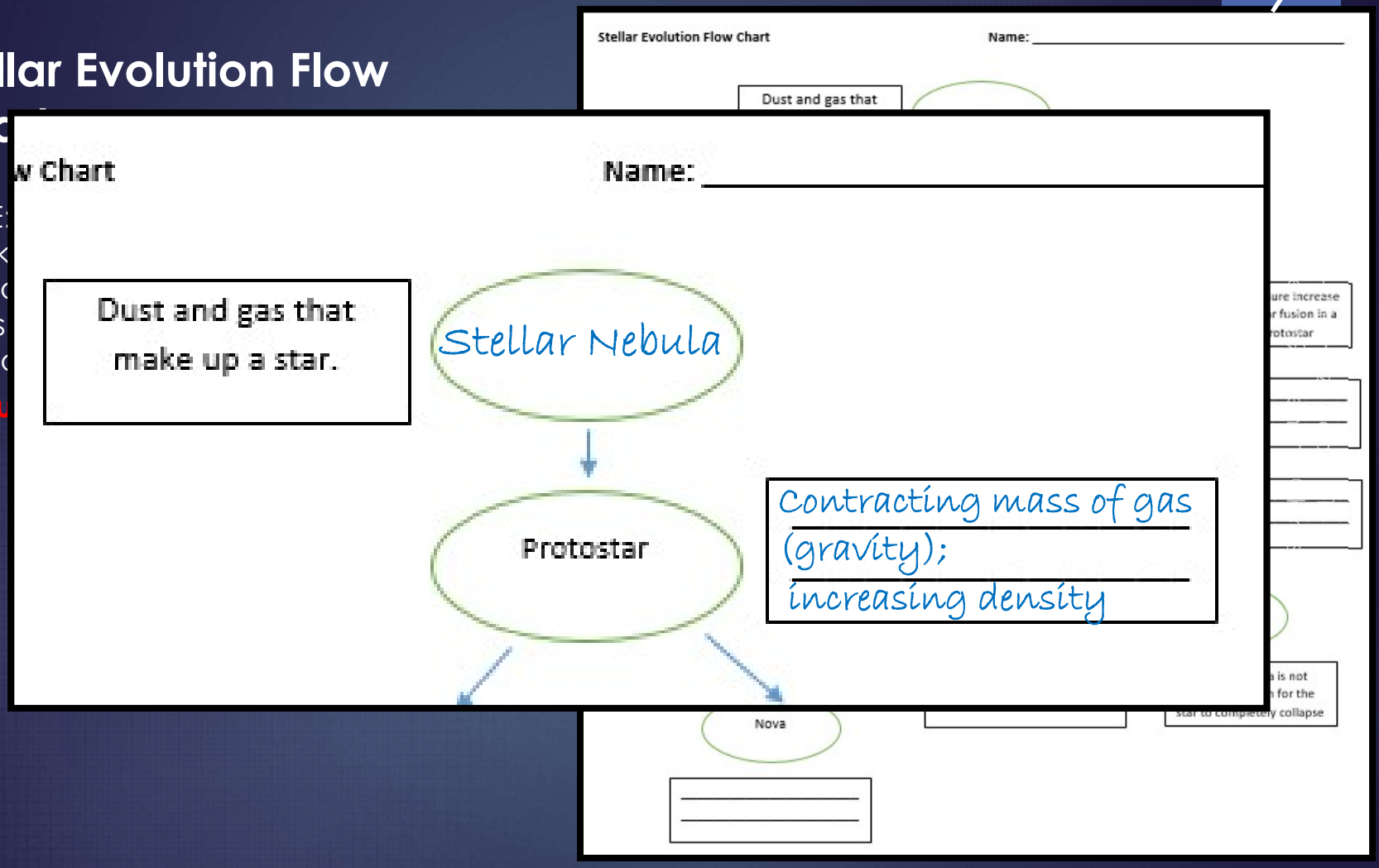


v Chart

Name:

Dust and gas that make up a star.

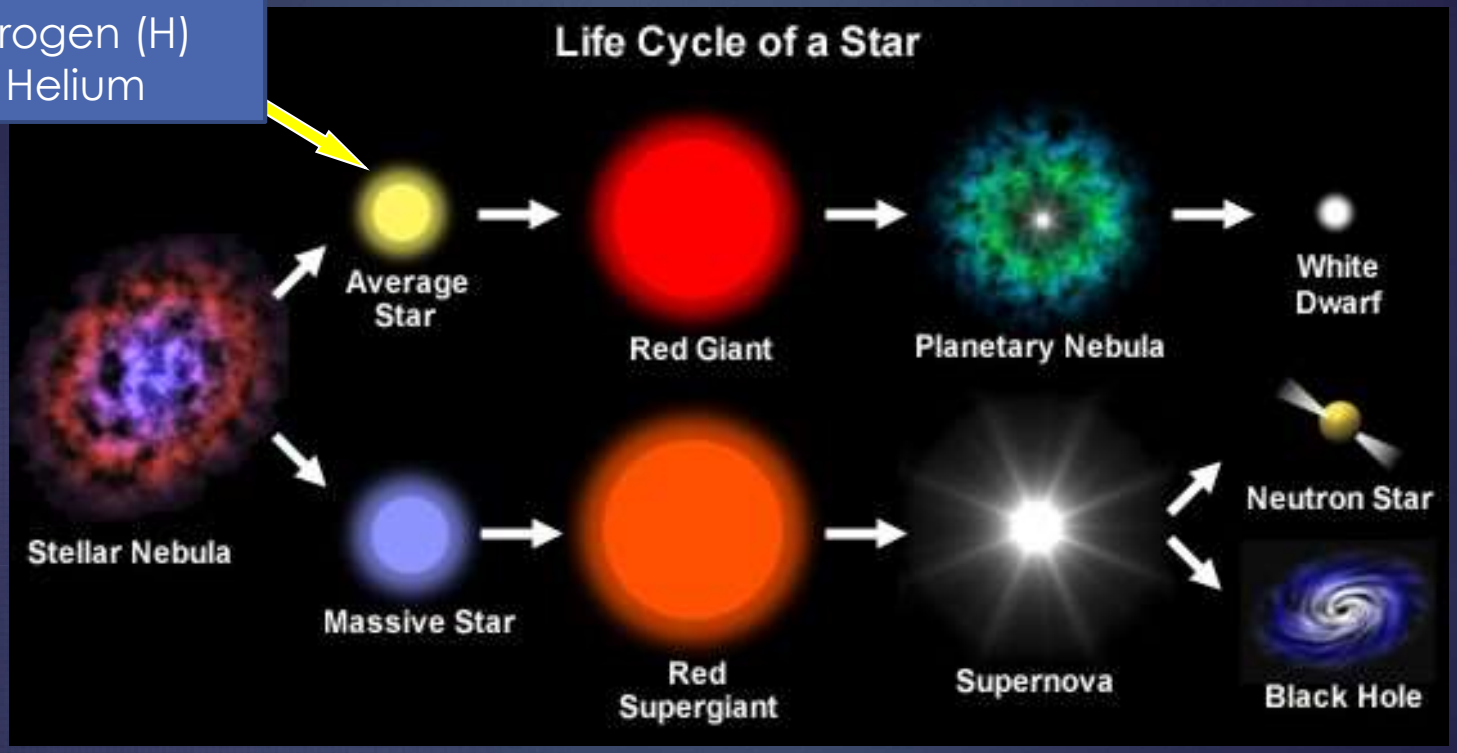
Stellar Nebula

Protostar

Contracting mass of gas (gravity); increasing density

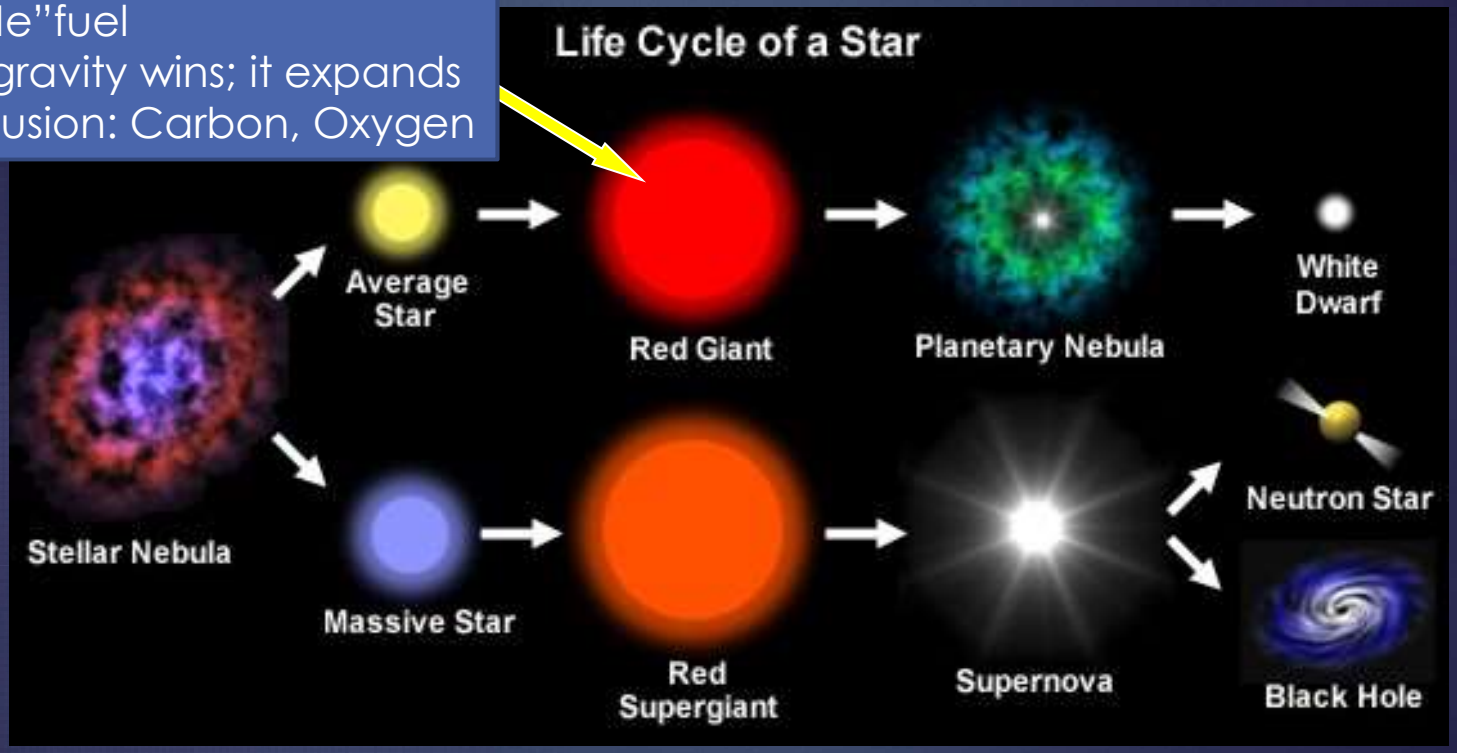
Life Cycle of a Star

Main sequence
– 98% of stars
– our sun
– Fusion Hydrogen (H) into Helium



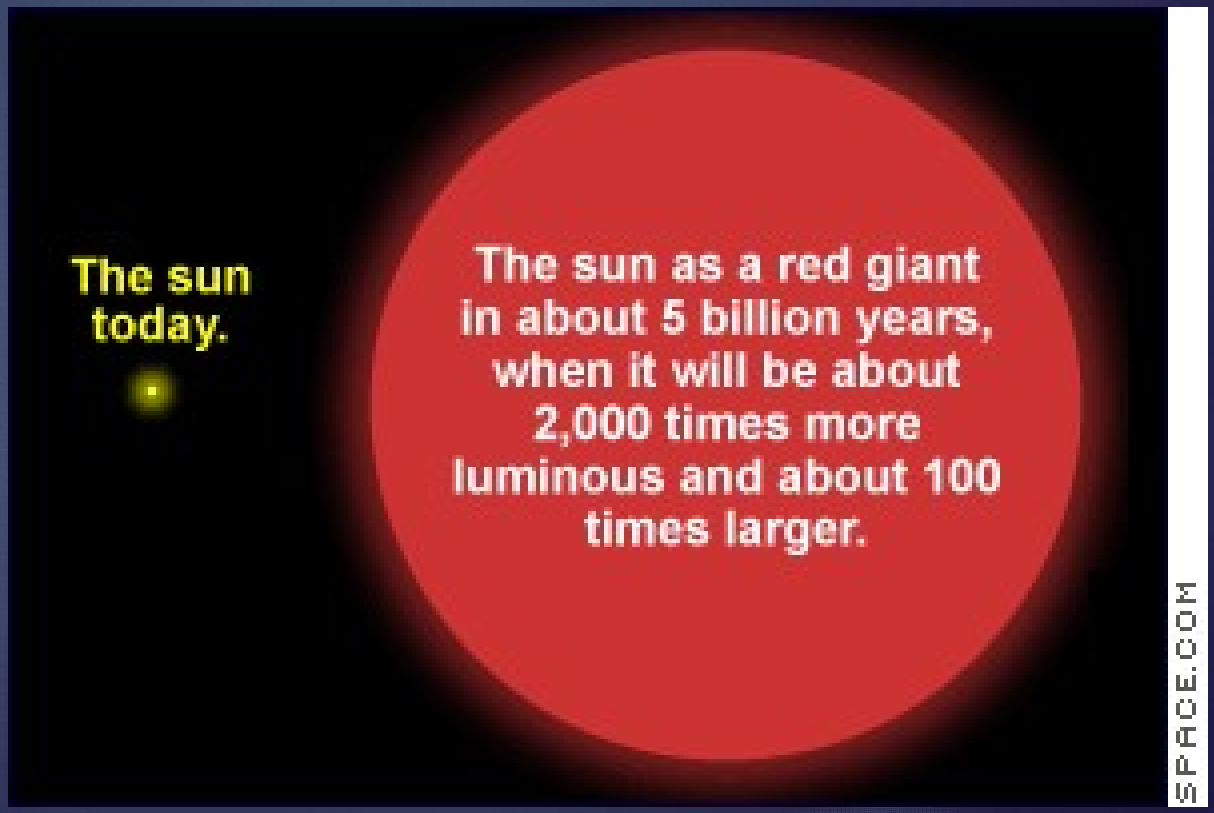
Life Cycle of a Star

-Runs out of "H" and "He"fuel
– gravity wins; it expands
- Fusion: Carbon, Oxygen

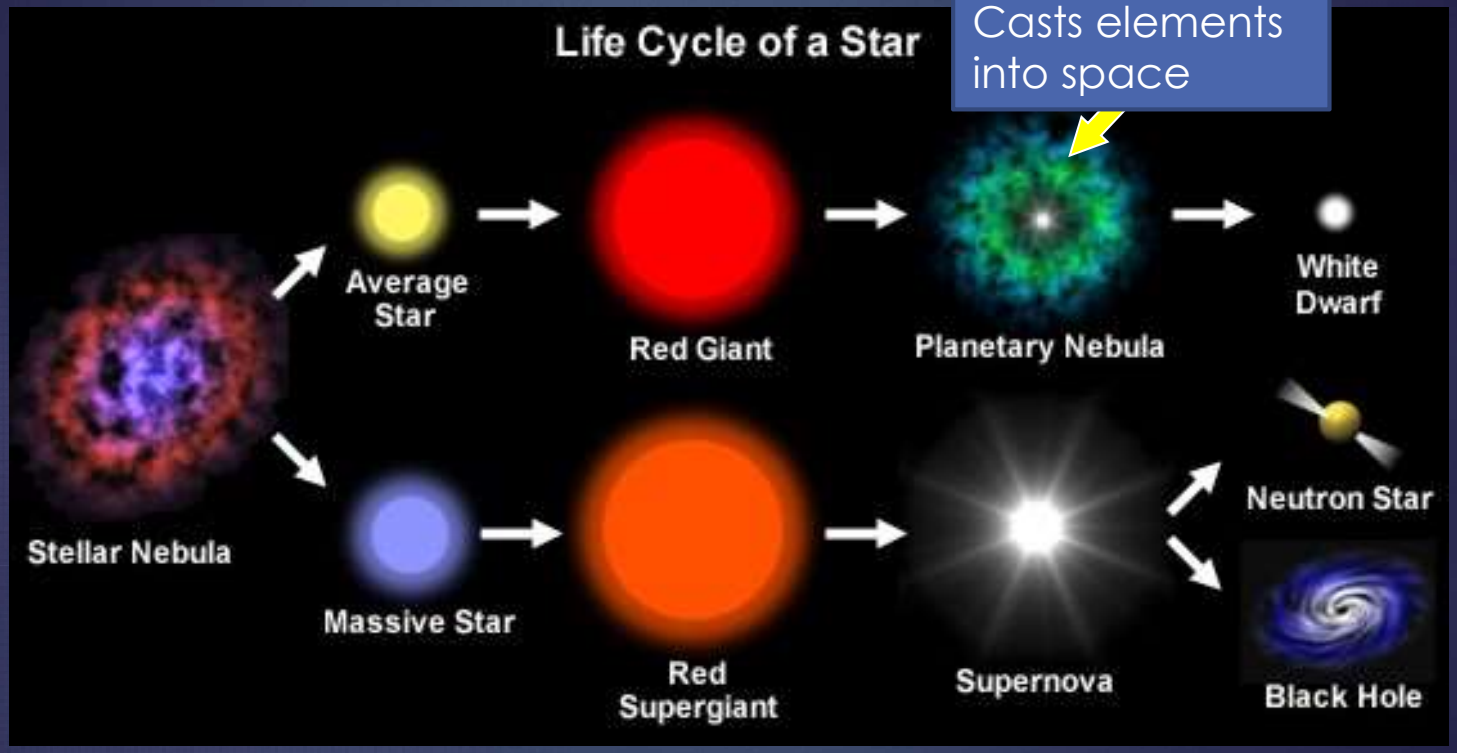


Vocab Review

- Red Giant – a large reddish star late in it's life that converts helium into **carbon** or **oxygen**

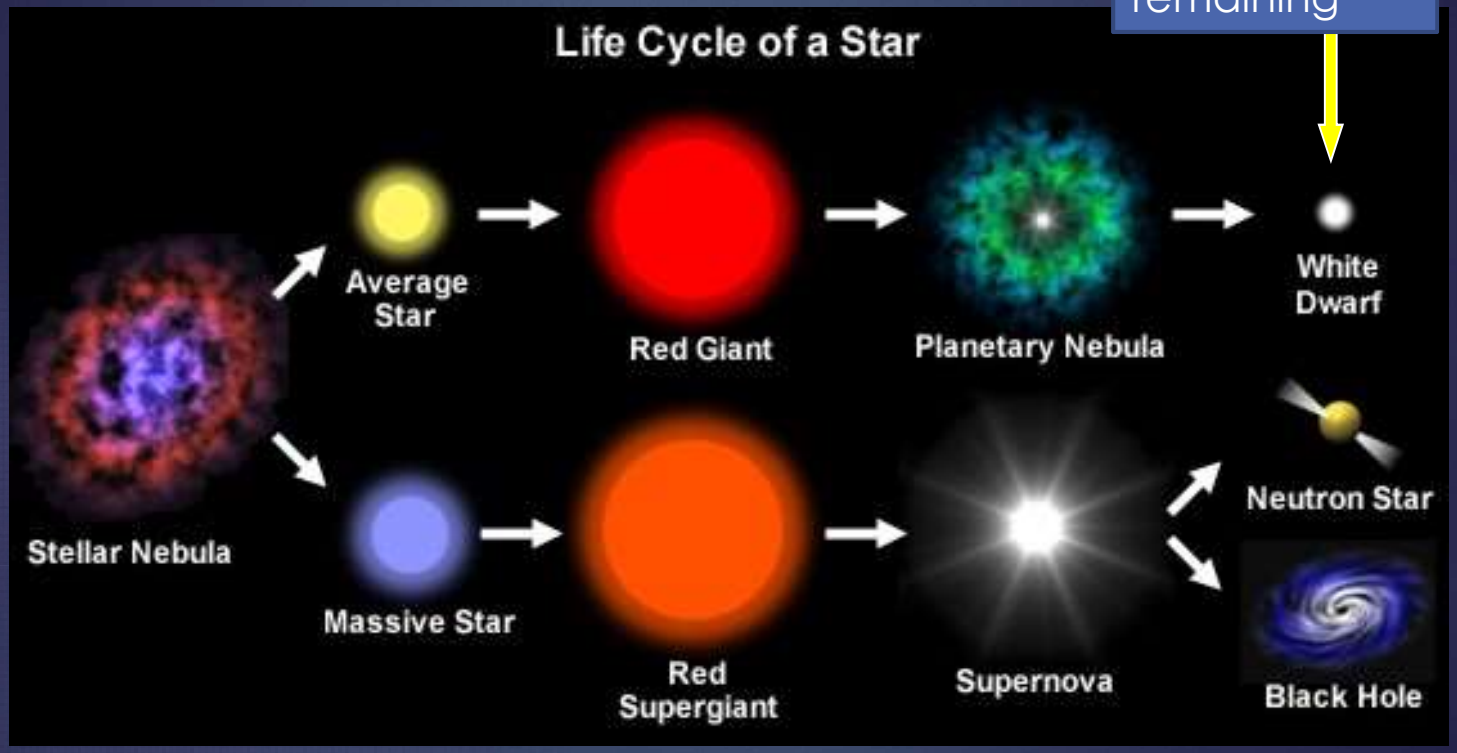


Life Cycle of a Star



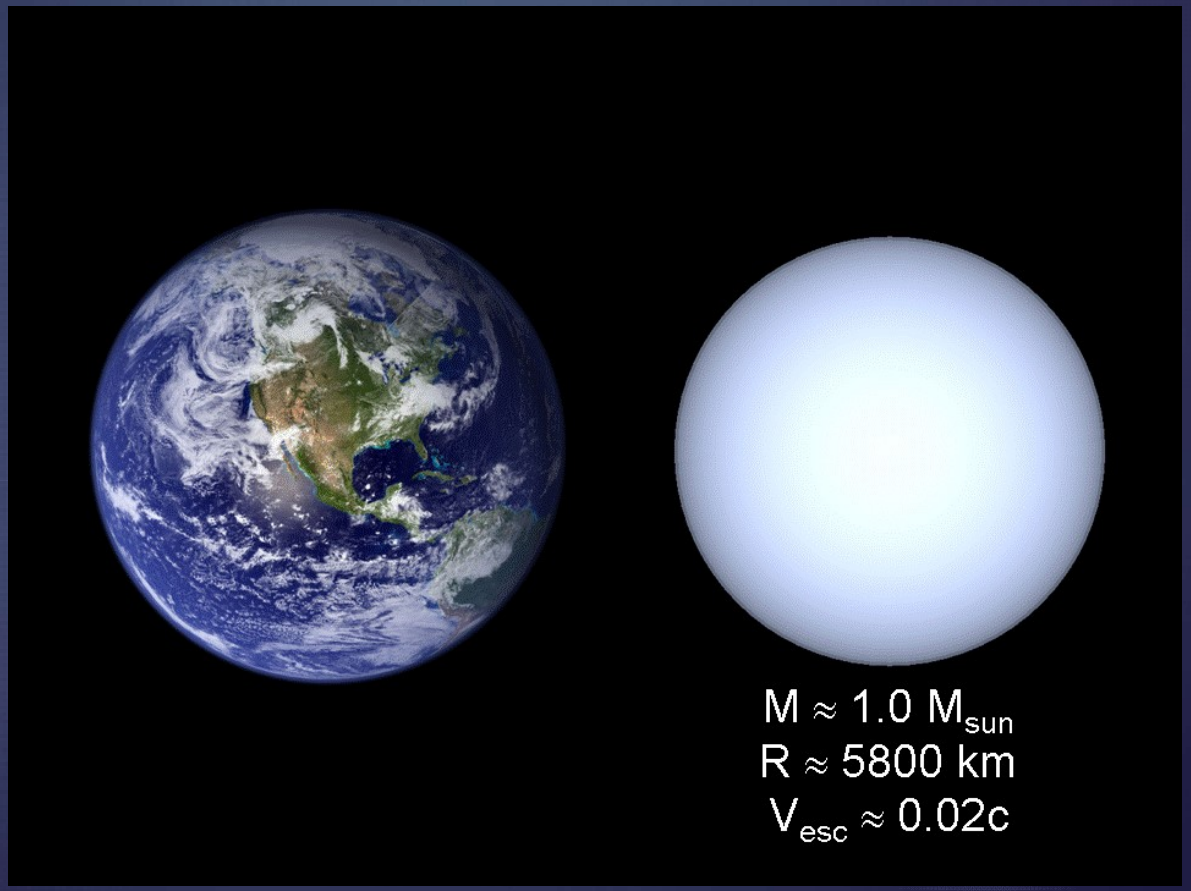
Life Cycle of a Star

dense core remaining



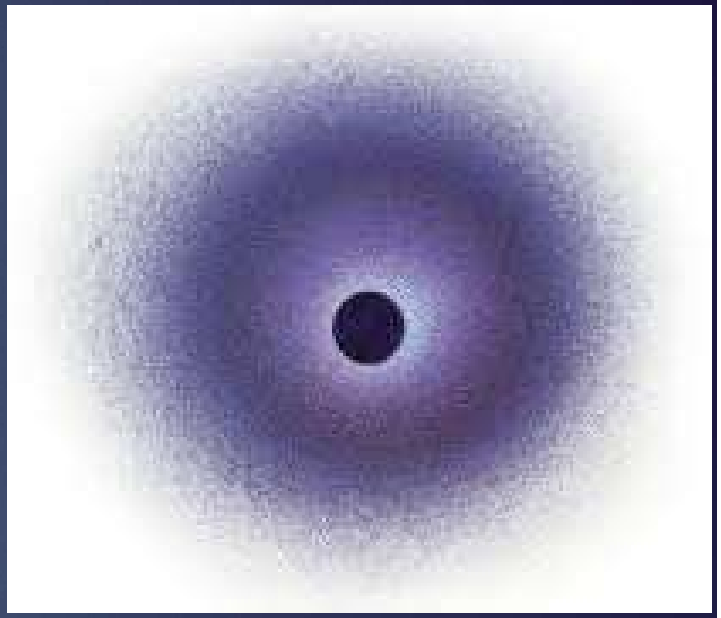
Vocabulary Review

- White Dwarf – a small, dense star that remains after a red giant converts all of its helium into **carbon** or **oxygen**

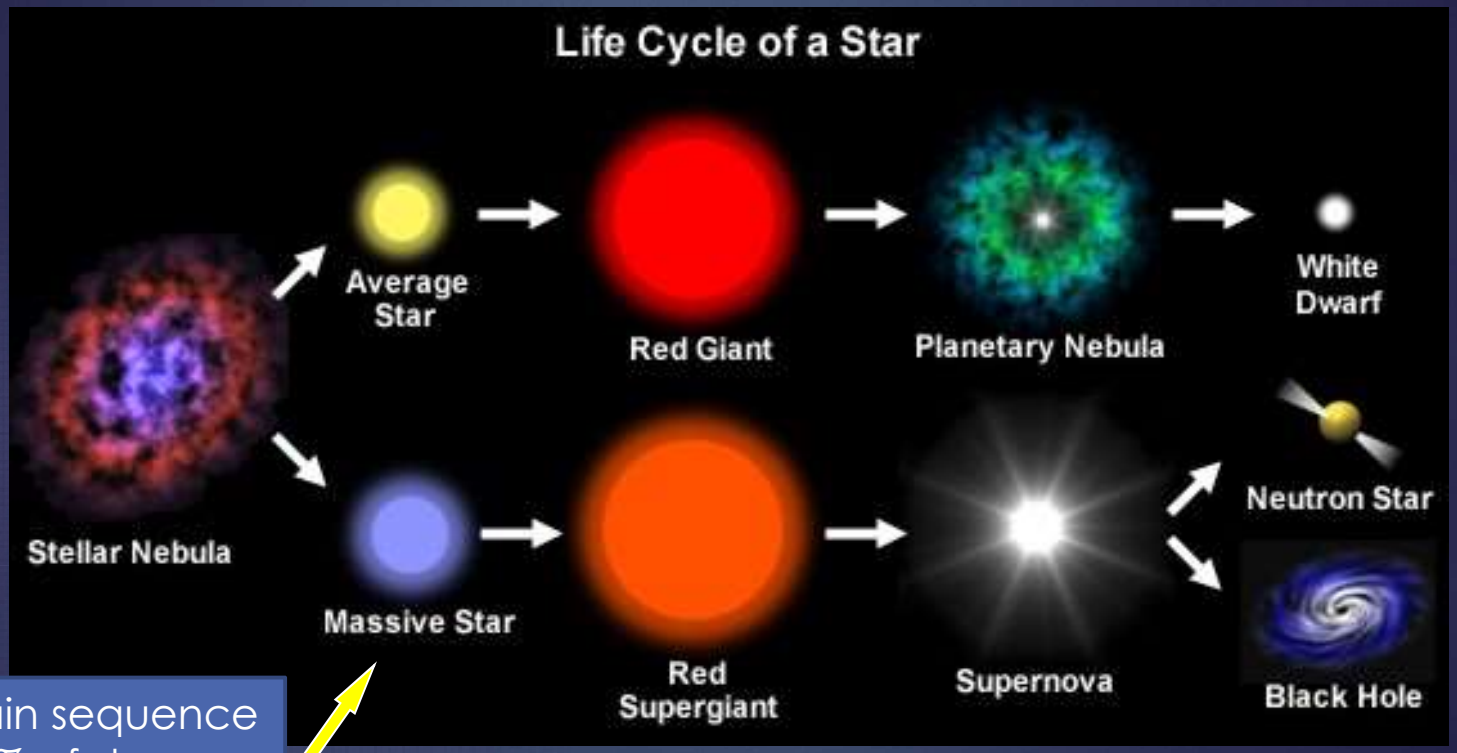


Black Dwarf

- When a white dwarf cools and no longer emits significant heat or light.
- Tens to hundreds of billions of years to cool
- The Universe hasn't been around that long
  - the oldest stars: 10 - 20 billion years old
- Therefore there are no black dwarfs yet, but there will be in the future.

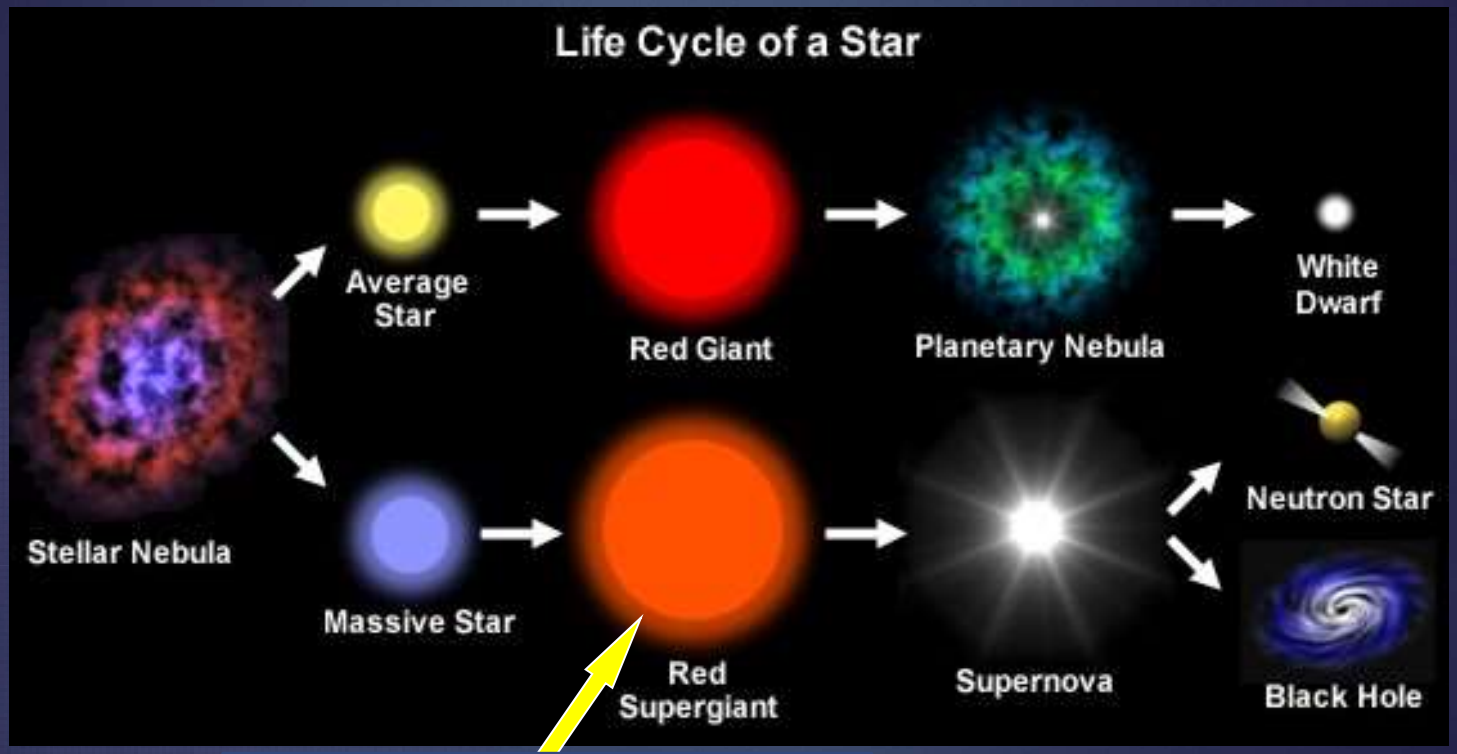


Life Cycle of a Star



Main sequence – 2% of stars – Fusion Hydrogen (H) into Helium

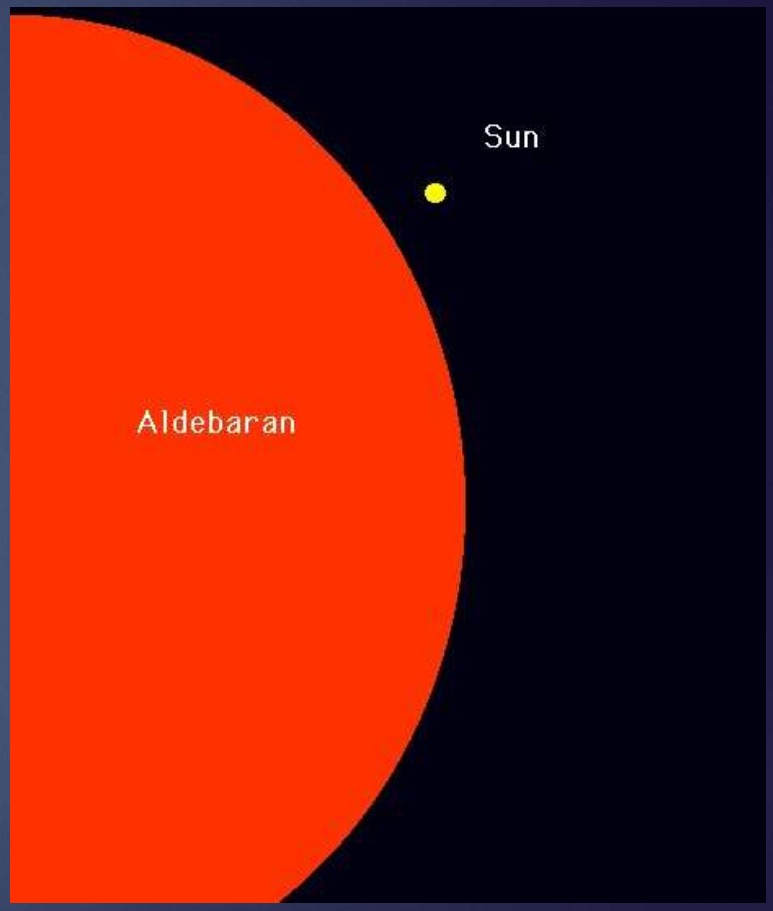
Life Cycle of a Star



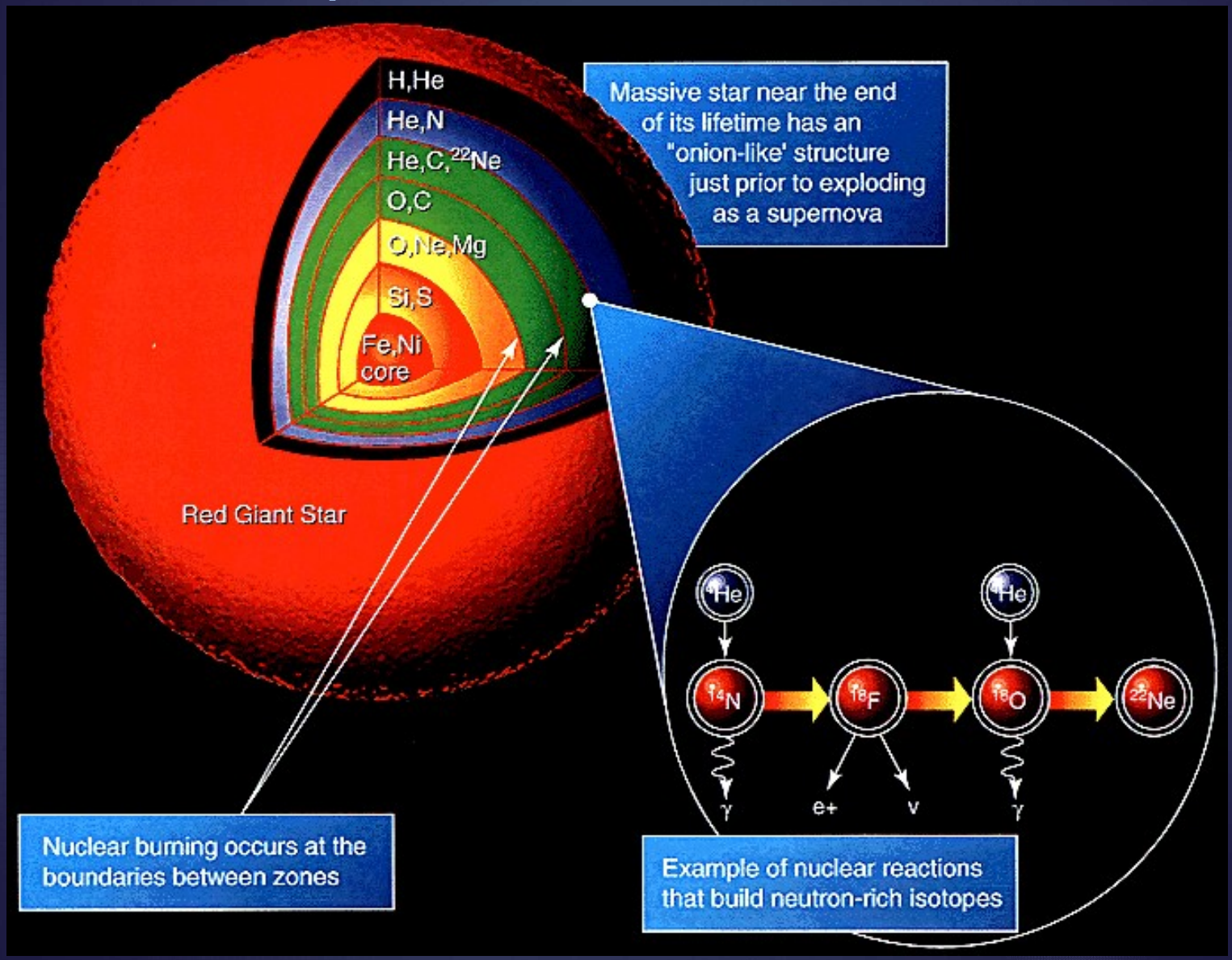
Helium fuses to Iron and Nickel
- Runs out of fuel
– gravity wins

Vocab Review

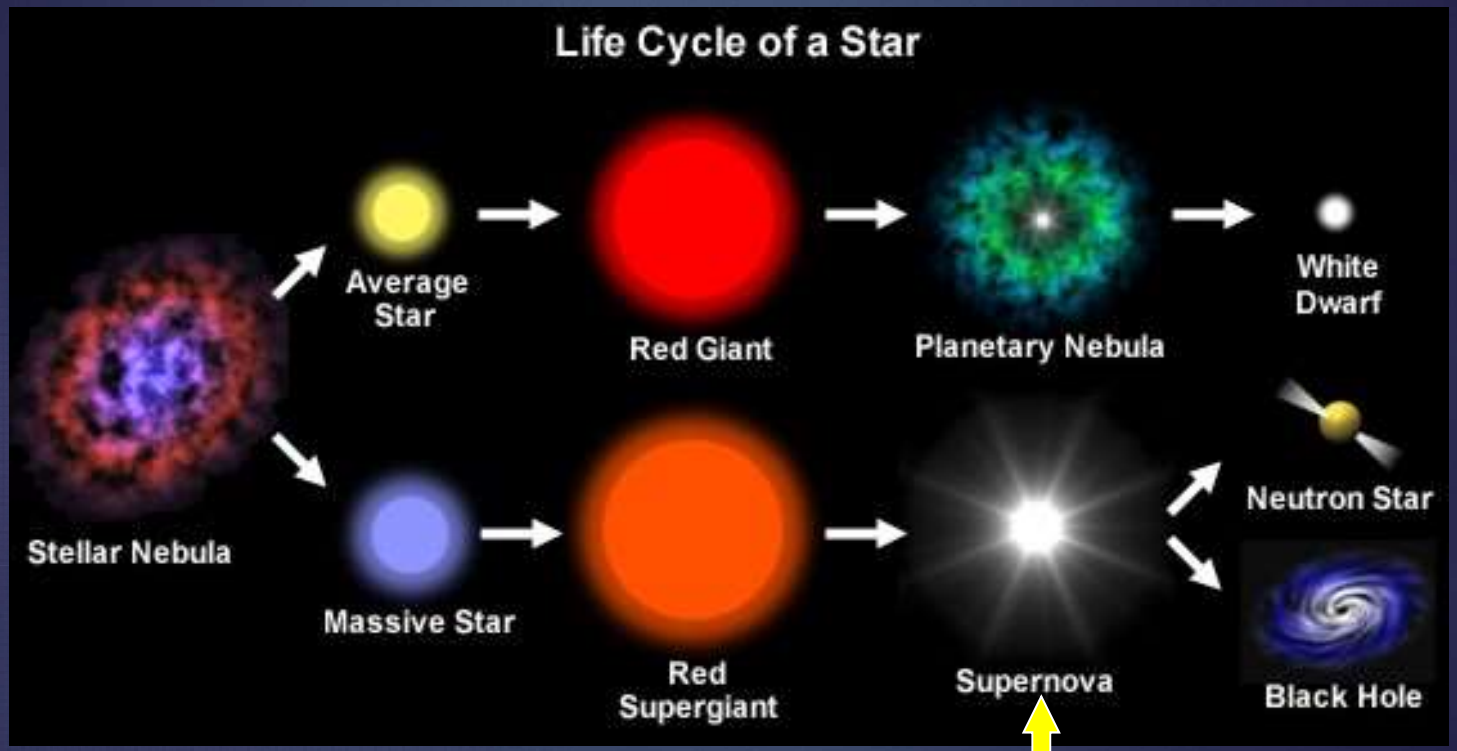
- Red Supergiant -
- a large star late in its life cycle
- converts its helium into iron and nickel



Red Super Giant



Life Cycle of a Star



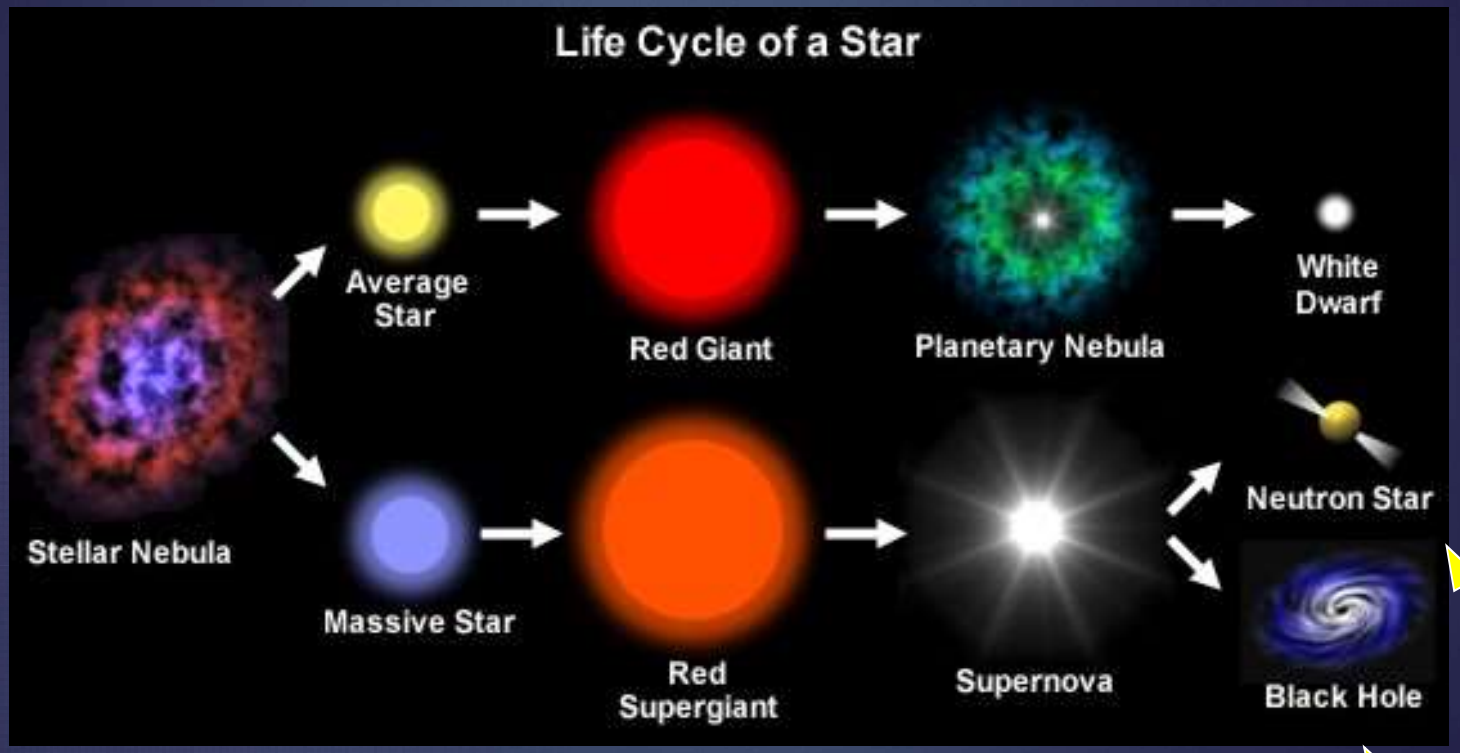
- Implodes under gravity
- Expands …like an explosion
- Elements Larger than Iron!!!

Supernova

- These have been observed!
- Supernova explosions are relatively rare events in our own galaxy, happening once a century or so on average.
- In 1987, there was a supernova explosion in the Large Magellanic Cloud, a companion galaxy to the Milky Way. Supernova 1987A,

  which is shown below:

Life Cycle of a Star



dense core remaining

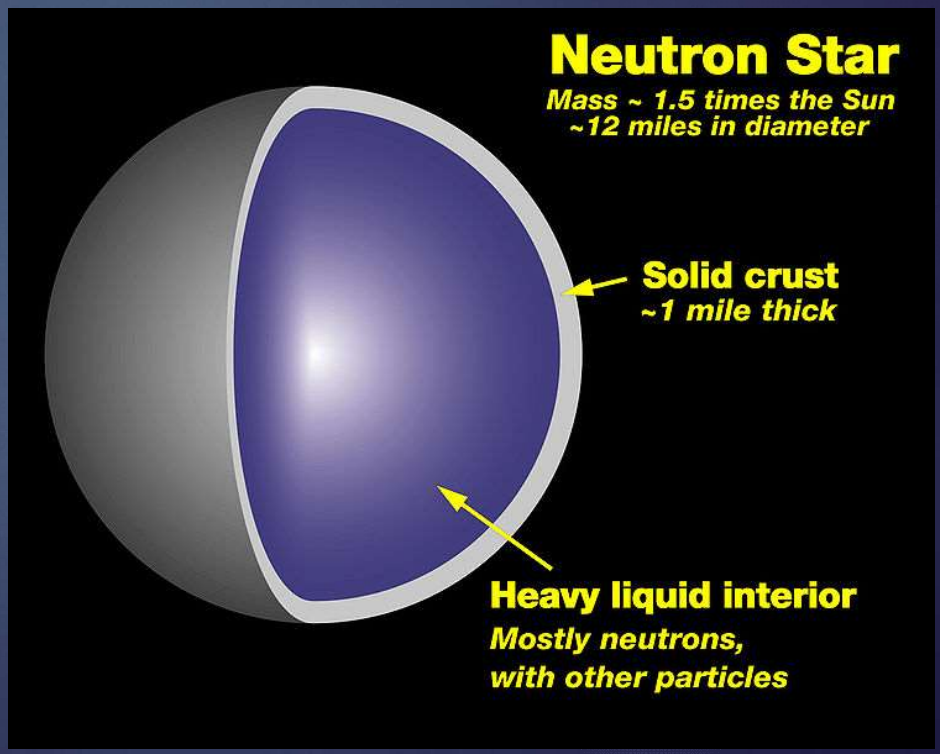
Two pathways

- There are two possible results of the supernovas:
  - Neutron Star

  or
  - Black hole

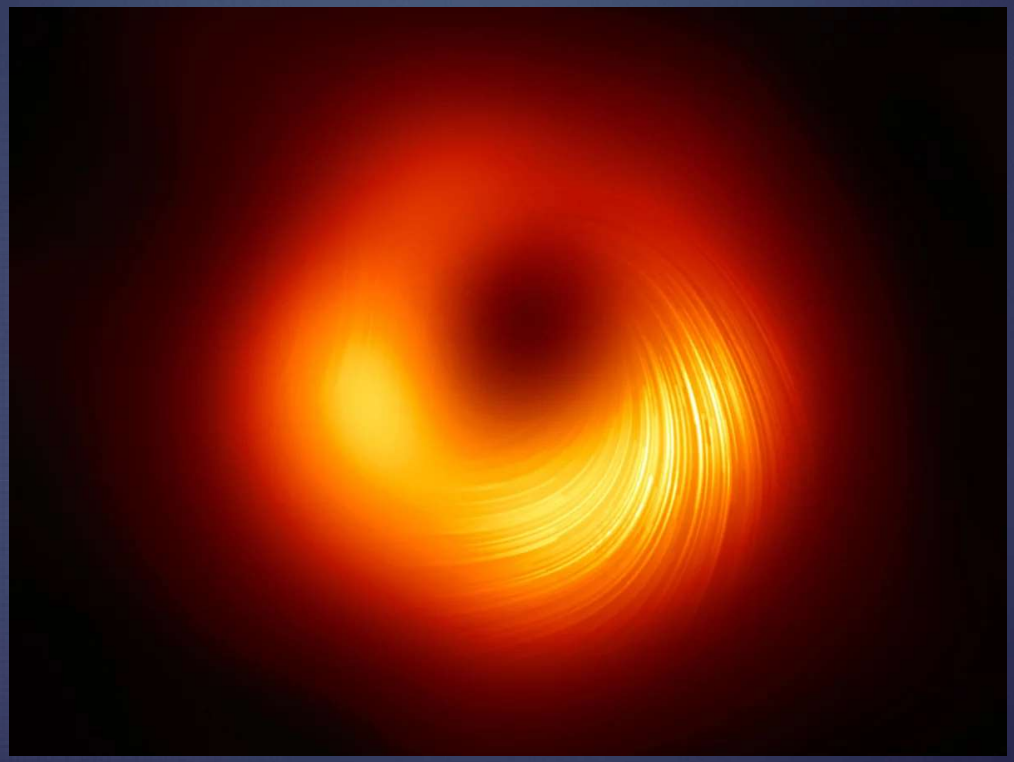
Vocab Review

- Neutron Star – a small, dense dead star that can remain after a supernova



Vocab Review

- Black Hole - Extremely massive and dense object; Light cannot escape its gravity



The Event Horizon Telescope collaboration, which released the world's first image of a black hole in 2019, unveiled a new view on Wednesday showing how the object at the center of the M87 galaxy looks in polarized light.
EHT Collaboration

March 2021:
Messier 87 Black Hole

Summary of a Star's "Life Cycle"