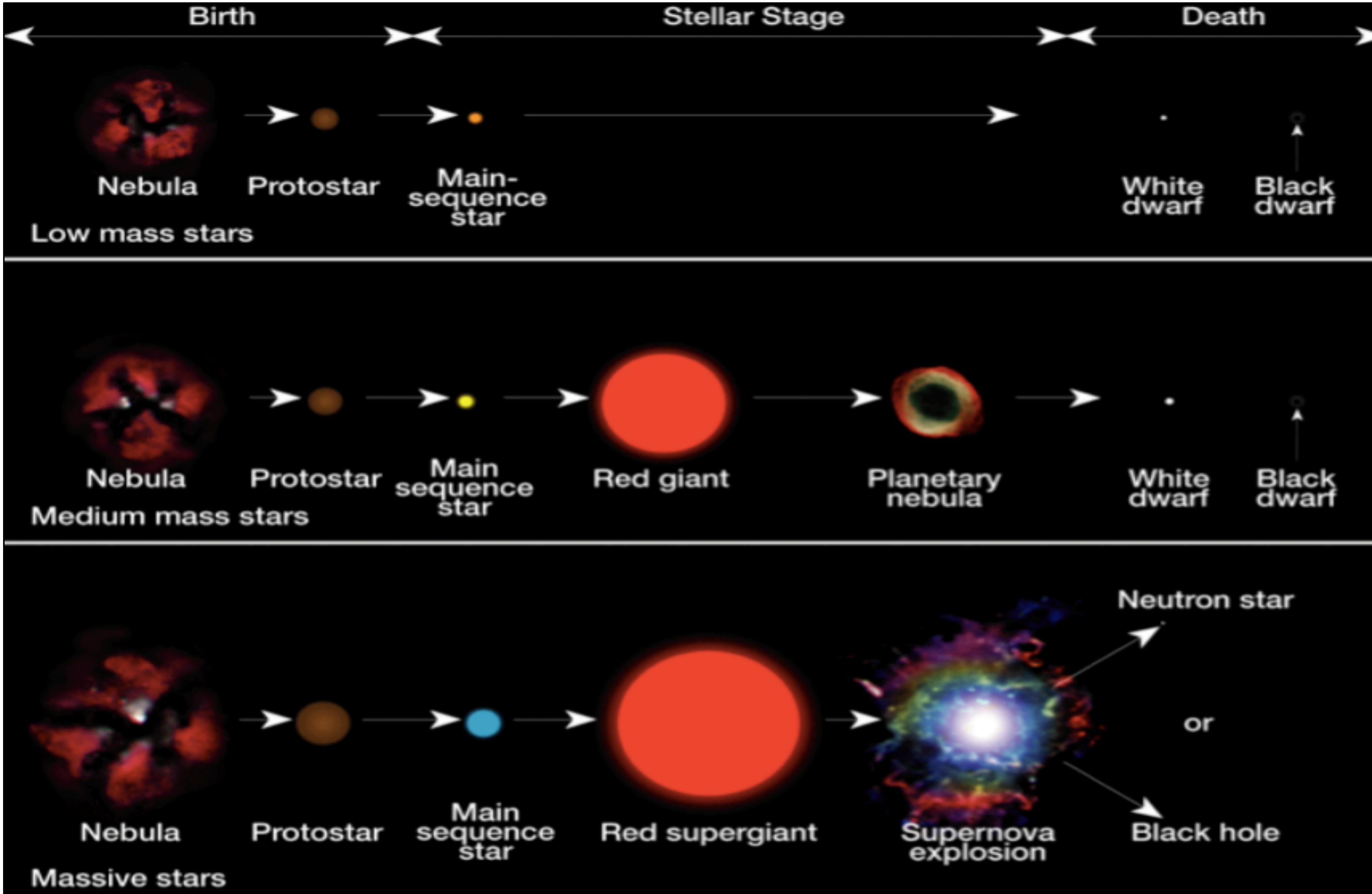
Station 1: Life Cycle of a Star



What To Do At This Station?

You are responsible for:

- Drawing an image and labeling each box from the star life cycle image
- Include a caption/notes for each box (a characteristic or fact)
  - If you'd like to take more detailed notes, please do so on the back of the sheet.

Key for Lifecycle Boxes & Arrows

- Key = Low Mass Stars
  - Have longer life spans than high mass stars
  - Burn their fuel more slowly
  - Outline all top boxes RED, connect w/RED arrows
- Key = Medium Mass Stars
  - Outline all middle boxes ORANGE, connect w/ORANGE arrows
- Key = High Mass Stars
  - Have shorter life spans than low mass stars
  - Burn their fuel more quickly
  - Outline all bottom boxes BLUE, connect w/BLUE arrows

Stellar Nebula

- Birthplace of stars; dark, cool, cloud of dust and gas
  - Nebular theory: creation of solar system
- Cloud condensed by passing stars or supernova explosion
- Stars glow when hydrogen fuel is burned (aka nuclear fusion)
- As stars age, H fused to He, C, Fe & other heavier elements to increase star's density

Protostar

- Initial contraction → 1 million years
  - Temperature increases → long wavelength red light
- Developing star not yet hot enough to engage in nuclear fusion
- When core has reached 10 million Kelvin, pressure initiates nuclear fusion of hydrogen
  - STAR IS BORN!

An artist's rendition of a protostar

Main Sequence Stars

- Remains in this stage until death
- Internal gas pressure struggles with force of gravity
- Fusion continues for a few billion yrs. → provides enough outward pressure to keep star stable
- Stars age @ different rates:
  - Ex: Hot/massive/blue: shorter life cycle
- Longest stage of life cycle (90% of life cycle)

- 90% of stars in our galaxy, including the Sun, are in the main sequence stage and stay there for most of their 'lives'

Red Giant/Red Supergiant

- Zone of hydrogen fusion in star continually moves outward→ leaving behind a helium core→ hydrogen used up
  - Fusion occurring in outer shell but not inner
- Pressure is unbalanced→ core contracts (hotter)
  - Heat radiates throughout star and expands→ surface cools as size increases (red in color b/c of cool temps. ~3,000-5,000 K


Sun
Aldebaran

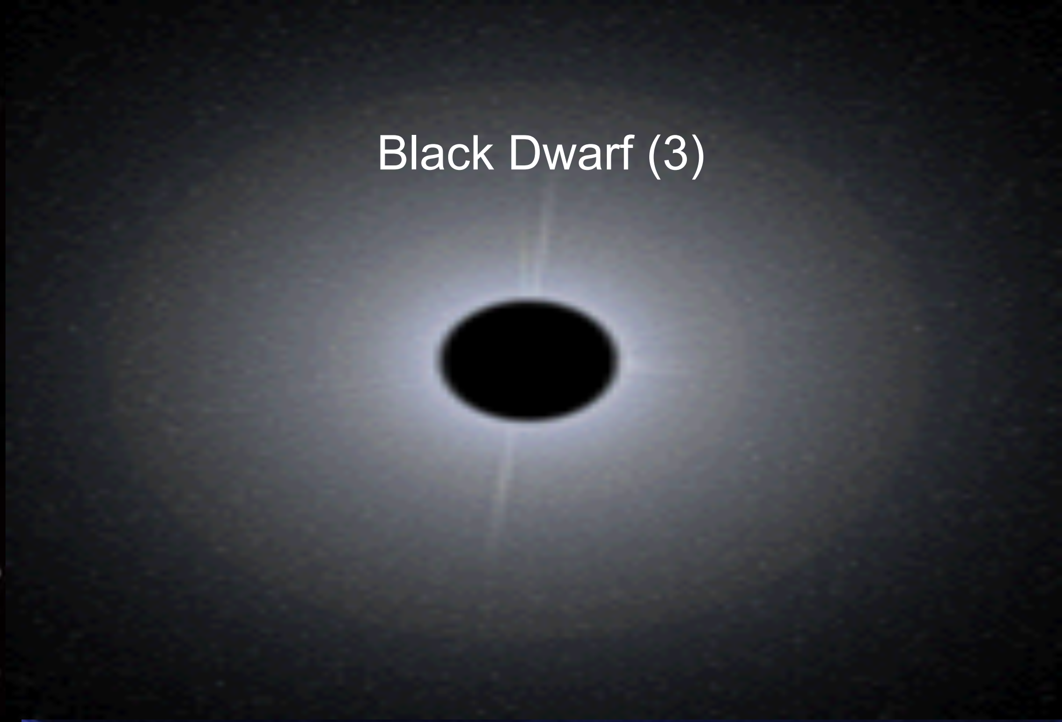
Death of a *Low* Mass Star

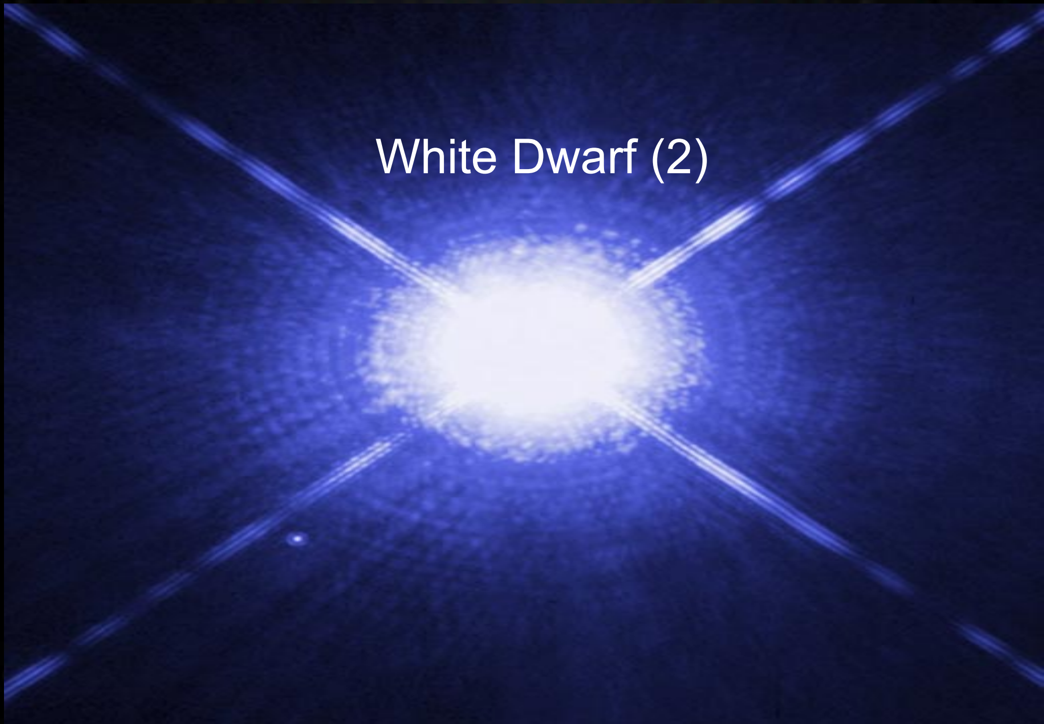
- Stars less than one half the mass of the Sun
- Consume fuel slowly
- Never reaches high enough temps. or pressures to fuse He→ never evolve into Red Giants
- White Dwarf [as dense as the Sun but as big as the Earth]
  - Last of remaining fuel burns
  - Core of heavy elements shrinks in size
  - No longer fuse elements→ slowly cools
    - Most stars in our galaxy will end as white dwarfs
- Black Dwarf [is a cooled white dwarf→ no longer emits light]
  - No remaining fuel, stops burning
  - Just a core of leftover matter

Death of a *Medium* Mass Star

- Planetary Nebula
  - Gas is used up
  - Star condenses & outer atmosphere blows off
- White Dwarf
  - Last of remaining fuel burns
  - Core of heavy elements shrinks in size
- Black Dwarf
  - No remaining fuel, stops burning
  - Just a core of leftover matter


Planetary Nebula (1)


Black Dwarf (3)

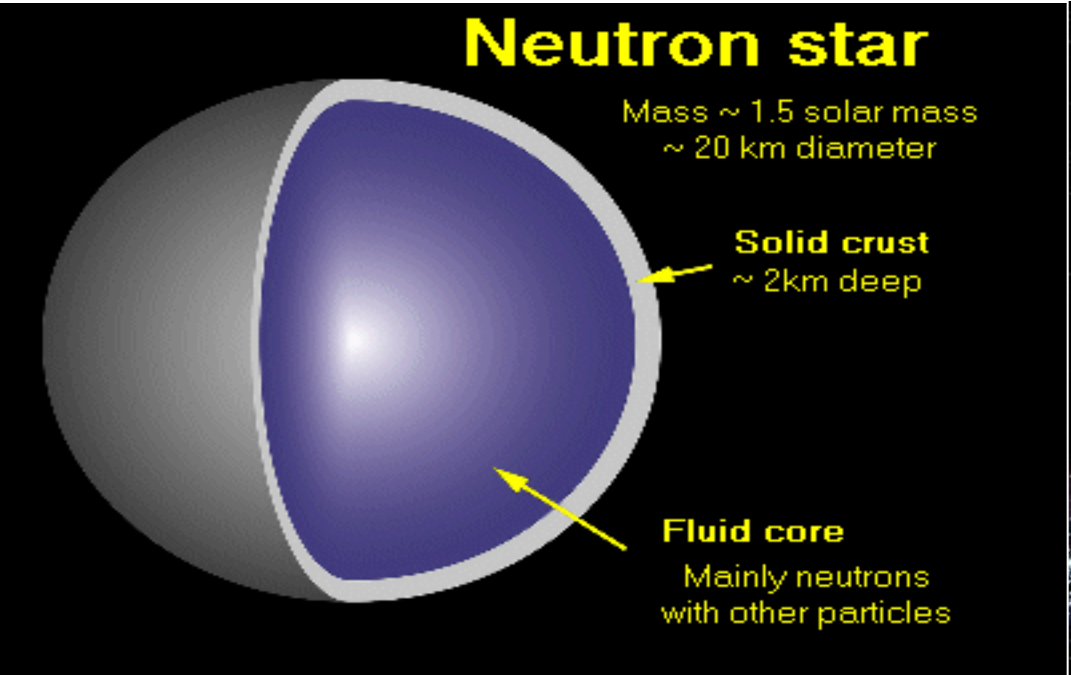

White Dwarf (2)

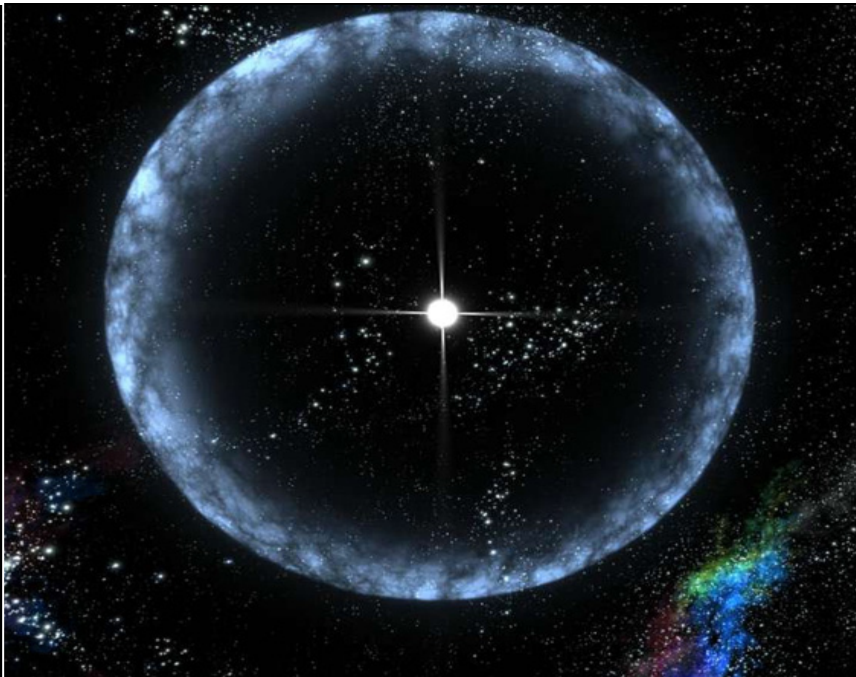
Death of a *High* Mass Star

- Supernova
  - Gas used up, triggers violent collapse of RSG
  - Collapse triggers a huge explosion
    - shockwaves can condense distant nebulae=new stars!
- Final fate of star determined by mass of star:
  - 1.4 - 3 solar masses forms Neutron star-20 km in diamater!
    - Equal to a tsp. on Earth weighing 1 billion tons
    - *Label arrow on top branch*
  - Greater than 3 solar mass collapses to form Black hole
    - *Label arrow on bottom branch*

The end of a High Mass Star…

- If 1.4 - 3 solar masses: Neutron star (shell)
  - 20 km in diameter (small)
    - Equal to a teaspoon on Earth weighing 1 million tons (very dense)
    - Composed of mainly neutrons
  - Dense core can't support self, collapses





The end of a High Mass Star…

- If leftover core is +3 solar masses: Black hole
  - Collapse so great all matter (even light!) is pulled in
  - Nothing can escape gravitational pull (no light so can't be seen)
    - ➢ Can be detected by radiation from the light