

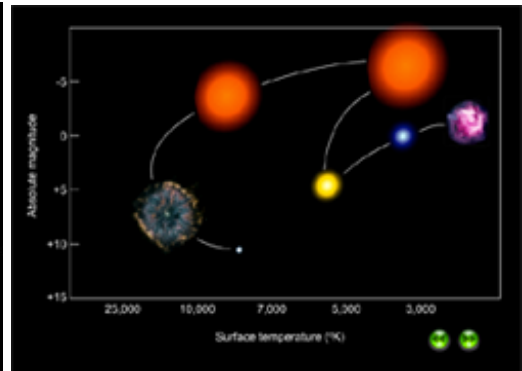
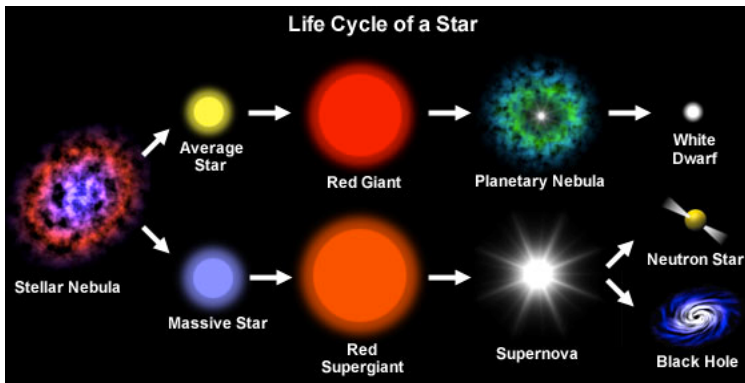


An average star (like our Sun), goes through a life cycle of birth, youth, mid-life, old age, and death

- > **Sun**: mid-life stage
  - « 5 billion years old
  - « 5 billion years left to live

## 5 Stages of a Star's Life

- outlined on the **H-R Diagram**



## **Stage 1: NEBULA STAGE**

- Huge clouds of gas and dust between stars called **nebula** are the birth place of stars
  - > 70% Hydrogen Gas
  - > 28% Helium & 2% other elements
- The cloud probably came from an exploded star called a **supernova**

## **Stage 2: Proto-Star STAGE**

- Each nebula is about 25 ly across and begins to be pulled together by gravitational compaction into a *more and more dense cloud*
- The nebula will begin to glow as a red **protostar** due to the heat

### **Stage 3: Main Sequence (Stable Star) STAGE**

- As gravity pulls the protostar tighter and tighter, it will get hotter and hotter
- When the star reaches a temp. of 10,000,000 C, **NUCLEAR FUSION** begins

## NUCLEAR FUSION

- Process which turns **Hydrogen into Helium** and creates a huge amount of energy
  - > Same process which fuels the Hydrogen bomb
- Once it begins, it is a stable main sequence star and will stay that way for billions of years
- Our **Sun** will be a main sequence star for about 10 billion years

## **Stage 4: Red Giant or Supergiant STAGE**

- When the star has "burned" most of its Hydrogen, nuclear **FUSION OF HELIUM** will begin
  - > A much hotter process
  - > Star expands into a *red giant* or a *super red giant*
- Our **Sun** will expand into a red giant in about 5 billion years and melt the Earth

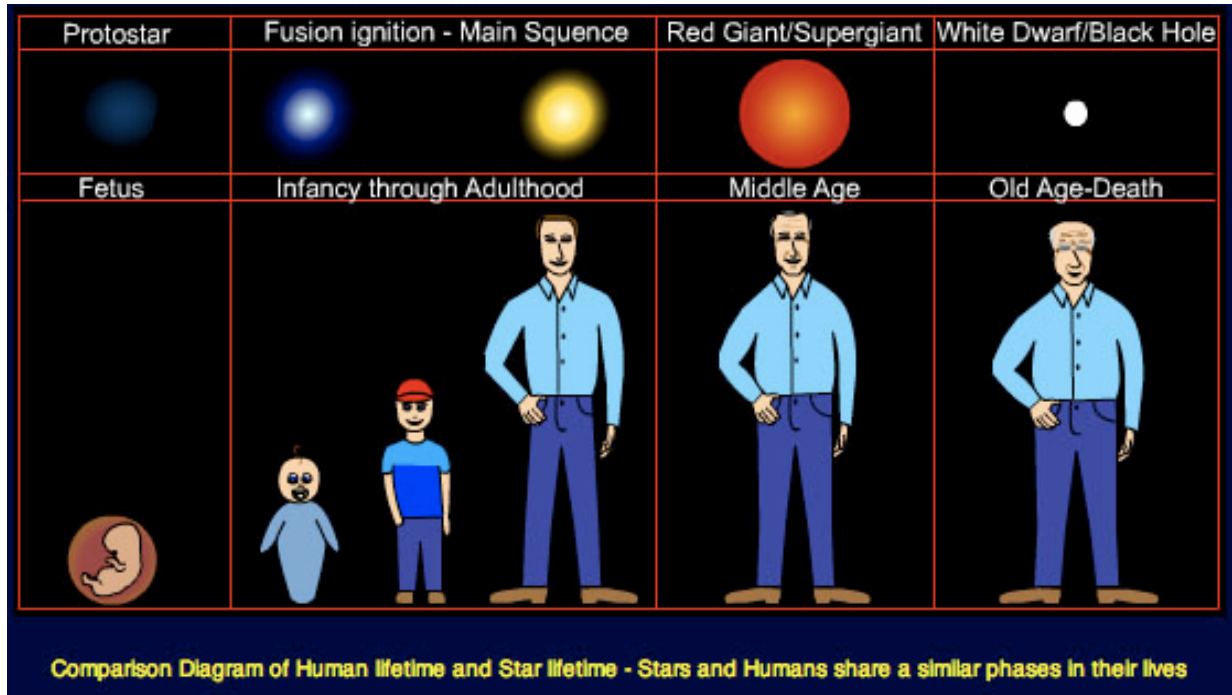


## **Stage 5: White Dwarf STAGE**

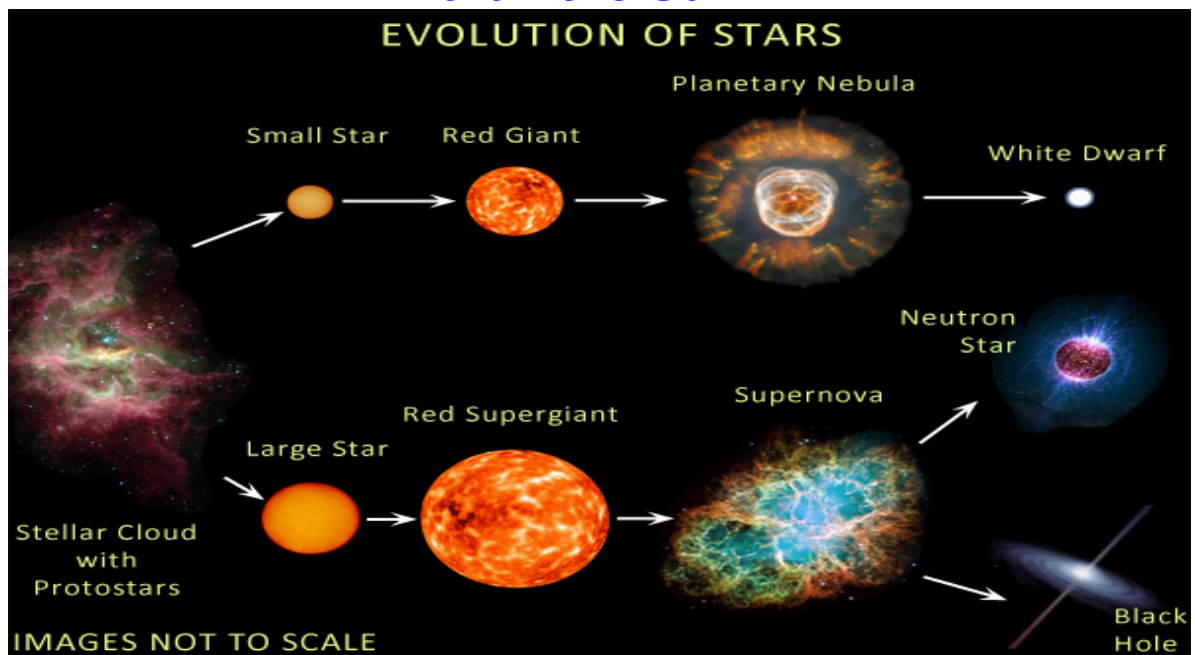
- After burning as a red giant for a few million years, the star will use up all of its fuel and shrink into an Earth-sized white dwarf
- During shrinking, it may illuminate the outer layer of gases briefly creating a planetary nebula

- It will glow dimly for about a billion years then fade into a **brown or black dwarf**
  - > This is dark remains of a burnt out star
- Occasionally, the white dwarf will flare into a **brighter nova** but fade in a few days back into the white dwarf

# Stellar Evolution Notes



## Massive stars will end their lives very differently than the Sun



## Supernovas

- Massive stars will not fade into a white dwarf, but will explode as a violent supernova
- In a supernova, there is fusion of **Carbon into Iron** which will quickly create both an explosion and implosion of matter

## Neutron Stars

- The core of a "small" supernova will form a neutron star which is made of just neutrons
- These stars are very small, spin very fast, and are very dense
- Some neutron stars produce beams of radiation that are "heard" by radio telescopes and are called pulsars

## Black Holes

- In very large stars, the supernova creates an area of matter so dense at its center that is called a **black hole**
  - > So dense it won't let light escape
- We can't see black holes, so we examine the pattern of x-rays given off as matter is pulled into the black hole
- The center of Milky Way= massive black hole

# **HOMEWORK:**



Create 5 Test Questions from today's notes

> Include:

» 5 Multiple Choice