THE INTERNATIONAL ACADEMIC CENTER FOR EXCELLENCE

ACE Study Resource – ASTR 1310

Syllabus

To search for your course syllabus, follow these instructions.

1. Visit the following website: https://info.tamiu.edu/
2. Input your course (ex: ASTR 1310) into the "Search" box and make sure you are in the current term (ex: Fall 2023). Click "Search."
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4. Click on "Syllabus" under your course and the file will automatically download. You are done!

Textbooks

Required: Fraknoi, A., Morrison, D., & Wolff, S.C. (2016). Astronomy. OpenStax Rice University.

This text is a free download for the electronic version. See https://openstax.org. https://openstax.org/details/books/astronomy#student-resourcessection

Key Concepts

Module 10. Stars and the HR Diagram

- Luminosity: The amount of energy radiated from the surface of the star each second. (The innate/natural brightness of a celestial object). Also known as: Absolute Brightness.
- Parallax is the apparent shift of near stars due to the motion of Earth around the Sun. (the father the star, the smaller the parallax).
- Formation of stars:
    - Stars condense out of large interstellar gas clouds (mostly hydrogen but sometimes helium).
    - Protostars: A forming star that has not reached the point for sustained fusion in its core.

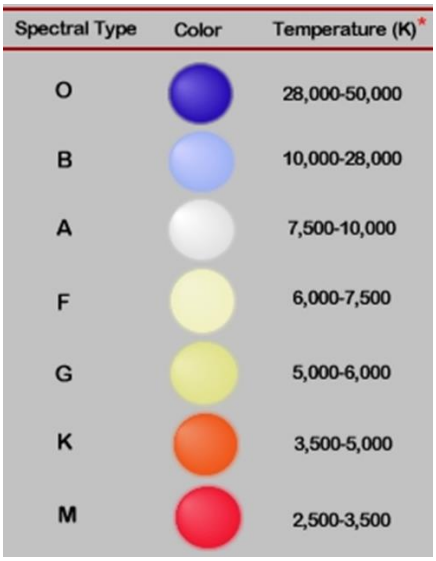
Arrange the following steps of star formation in the correct sequence:

- The protostar will blast away gas and dust and a star will remain by the nuclear fusion of hydrogen to helium.
- The protostar will become extremely hot, so hydrogen will begin fusing to helium.
- The disturbance causes clumps to form and pull gas inwards.
- The collapsing clump begins to rate and become flatter (turns to a disc of the gas and dust).
- Clouds of gas and dust are disturbed by the gravity of an interstellar event.
- When the disc rotates faster, more material is pulled inwards and creates a hot and dense protostar.

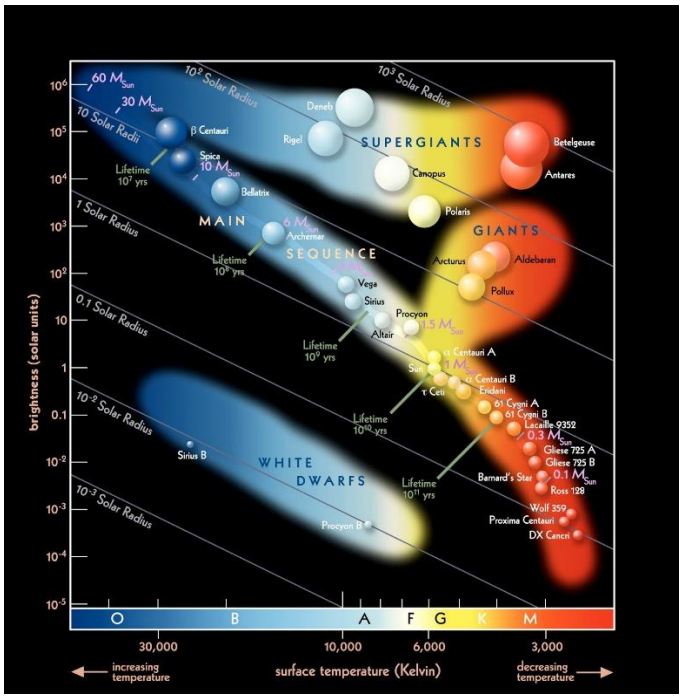
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

(When finished, see answer key below)

- Spectral Class: The surface temperature of a star is the main thing that determines its color. (The cooler stars are red, the hotter stars are blue)
    - The most common colored star: Red
    - There are a few Supergiant stars (Red or blue).
    - Then, less yellow/white stars (Our Sun).



- The H-R (Hertzsprung-Russel) Diagram shows the relationship between a star's temperature and its luminosity.
    - The luminosity of a star lays on the vertical axis
    - The spectral class/temperature lays on the horizontal axis.



- This means that very hot and luminous stars are depicted on the upper left of the diagram. And cooler and dimmer stars are located on the lower right of the diagram (red stars)
- The main sequence is the diagonal curve on the diagram. This is where stars spend the majority of their lifetimes.
- As shown in the green text on the diagram, bigger stars will have a shorter lifetime. This is because they burn their fuel faster than smaller stars (like the Red Dwarfs which can live for up to a trillion years).
- Our Sun is a type G star, and its lifetime is 10 billion years (10^{10})

Module 11. Life Cycle of Stars

- The main factor that determines a star's fate is its **mass**.
- Stars are divided in three groups:
    - Low-mass Stars: Less than 2x the size of the Sun. Our Sun is also a low mass star.
    - Intermediate Stars: 2x – 8x the size of our Sun.
    - High-mass Stars: 8x – 50x the size of our Sun or greater.

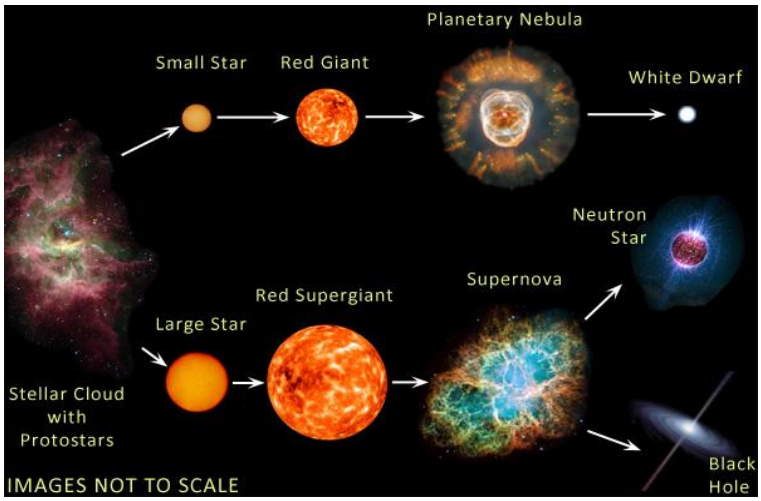
- When a low-mass star reaches its final stage of life:
    1. First, the star will run out of fuel in its core. Meaning there will be little hydrogen left for it to fuse into Helium.
    2. The star will not resist the pull of gravity, causing it to shrink. Layers will compress, and temperatures will rise due to pressure.

3. While the core shrinks, the outer layer will expand, forming a Hydrogen Shell. The star has grown in size and become a red subgiant.
4. Once the star/giant reaches 100 million degrees, it will begin fusing Helium into Carbon.
5. This process will go on until the star is 100 times its original size, and 1000 more luminous. It is now called a Red Giant Star.
6. The outer layer composed of thin gas will begin shedding its layers and slowly convert into a **planetary nebula**.
7. After this process, a white core will remain which is very hot and the size of Earth, known as a **White Dwarf.**

- When a high mass star reaches its final stage of life:
  1. The first 3 stages of a high-mass star's death are the same as a low-mass star (Up to the red giant phase).
  2. Then, the star can't hold back the force of gravity. So, the core will collapse causing a massive explosion, also known as a supernova.

     Supernova: The explosion of a star. It is the largest explosion that takes place in space.
  3. The size of what remained from this explosion will determine its final fate.
     - For medium sized (1.4 – 3 times the size of the Sun): A **neutron star** will be formed.
     - For larger sized (more than 3 times the size of our Sun: The core is crushed in an implosion and a **black hole** will be formed.

*The illustration below shows the different stages and evolution of the stars.



Practice and Application:

Below are practice problems to reinforce your knowledge of key course concepts.

1. When a low mass star dies, what will remain?
   a) A Neutron Star
   b) A red subgiant
   c) A White Dwarf
   d) A blackhole

2. The larger the star, the shorter its lifetime
   a) True
   b) False

3. The main thing that determines a star's fate is:
   a) Its temperature
   b) Its mass
   c) Its brightness
   d) Its color

4. A high-mass star will end up being a _____ or a _____ when it dies at the end of its lifetime.
   a) Black hole; Neutron Star
   b) Neutron Star; White Dwarf
   c) Planetary Nebula; White Dwarf
   d) Red Giant; Black hole

5. When a star is dying, the fusion that used to happen in the core will now be happening in the shell at a way faster pace.

   (Helium shrinks -> Hydrogen shrinks)

   This is called:

   a) The Helium Shell
   b) The CNO process
   c) The proton-proton cycle
   d) The Hydrogen Shell.

(When finished, see answer key below)

Answer key:

Formation of Stars:

1. Clouds of gas and dust are disturbed by the gravity of an interstellar event.
2. The disturbance causes clumps to form and pull gas inwards.
3. The collapsing clump begins to rate and become flatter (turns to a disc of the gas and dust).
4. When the disc rotates faster, more material is pulled inwards and creates a hot and dense protostar.
5. The protostar will become extremely hot, so hydrogen will begin fusing to helium.
6. The protostar will blast away gas and dust and a star will remain by the nuclear fusion of hydrogen to helium.

Quiz:

1. C
2. A
3. B
4. A
5. D