Beyond the Solar System

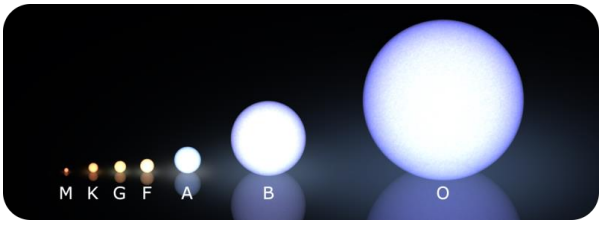
Life Cycle and Classification of Stars

Classification

- Scientists can classify stars based on their temperature and color.
- Stars with low temperatures are typically red, warmer stars are orange or yellow, and extremely hot stars are blue or white.
- There is a system of classification where a temperatures and color ranges are grouped into classes.
- A **Hertzsprung - Russell diagram** plots stars based on their brightness and temperature.

Study Tip

Think of the flames coming from a stovetop. When they are getting warmer, its color will change from a dull red when it is cool into a blue



The different classes of stars are determined by color and temperature.

The Life of a Star

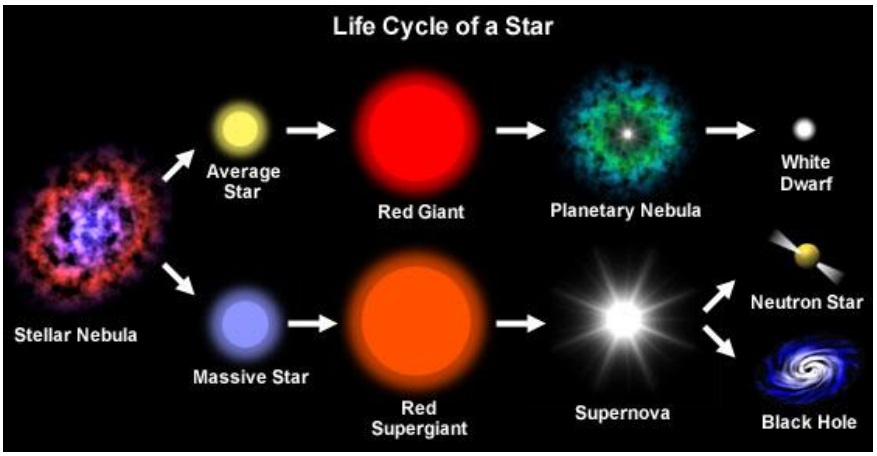
- Stars are first born in a cloud of gas and dust, known as a **nebula**.
- A **main sequence star** is a star that is able to sustain itself through nuclear fusion. Most stars are main sequence stars for a majority of their lives.
- The more massive a star is, the more hydrogen it must burn in order to prevent gravitational collapse.

From a Red Giant

- As a star grows older and uses up more of its hydrogen, it starts forming heavier atoms and starts to cool down. This larger, cooler star turns red in color and is called a **red giant**. From here, there are several ways that a star's life could end.
- Eventually, a red giant will run out of helium in its core, thus stopping fusion.
    - Some stars collapse under gravity, compressing itself into a small, white core called a **white dwarf**.
- If a star is very massive, it instead becomes a **red supergiant** when it runs out of helium.
    - Unlike a regular red giant, fusion continues to occur even after the hydrogen and helium runs out, thus producing extremely heavy atoms such as iron.
    - When there are no more elements that a star can fuse, the core collapses due to gravity, and creates a violent explosion called a **supernova**.
        - A supernova has so much energy that it creates heavy elements such as gold, silver, and uranium. All elements with an atomic number greater than Lithium were formed by nuclear fusion in stars.

From a Red Giant (cont.)

- After a supernova, if the leftover core's mass is less than four times the mass of the Sun, a **neutron star** forms.
  - A neutron star is much heavier than the Sun, but only a few miles in diameter.
- If the leftover core's mass is more than 5 times the mass of the Sun, a **black hole** forms.
  - A black hole is so dense that not even light can escape it.



Concept Check

- What are the different ways to classify stars?
- What determines which stages of life a star goes through?
- Can you identify the differences between the formation of a red giant and a red supergiant?