**Course: Earth, Astronomy and Space**

**Grade: 12** **Academic Year: 1st Semester, 2020-2021**

**Course Code: SC30161** **Instructor: Mr. Elmar Rubio**

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## Topic: The Galaxies

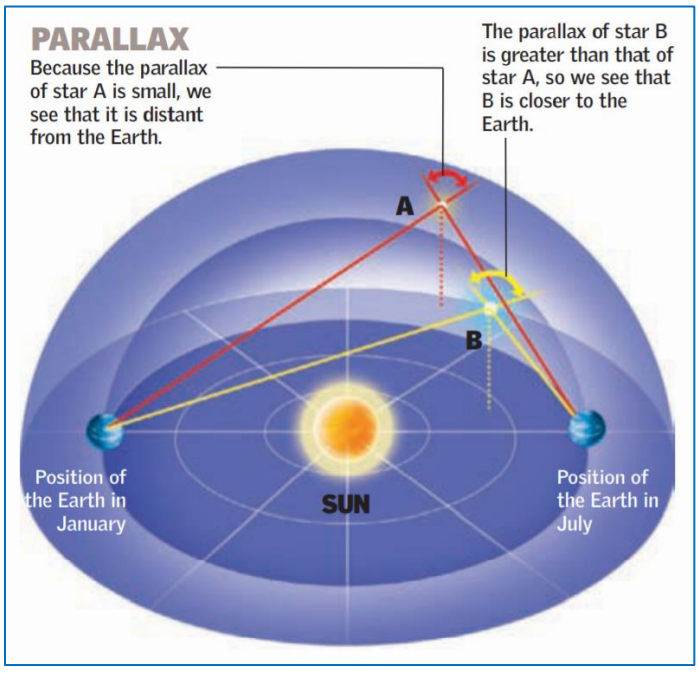
The universe is populated on a grand scale by strands of superclusters surrounding vacant areas. Sometimes the galaxies collide with each other, triggering the formation of stars. In the vast cosmos, there are also quasars, pulsars, and black holes. Thanks to current technology, we can enjoy the displays of light and shadow that make up, for example, the Eta Carinae Nebula, which is composed of jets of hot, fluorescent gases. Although not all the objects in the universe are known, it can be said without a doubt that most of the atoms that make up our bodies have been born in the interior of stars.

### Luminous

For a long time, stars were a mystery to humans, and it was only as recently as the 19th century that astronomers began to understand the true nature of stars. Today we know that they are gigantic spheres of incandescent gas—mostly hydrogen, with a smaller proportion of helium. As a star radiates light, astronomers can precisely measure its brightness, color, and temperature. Because of their enormous distance from the Earth, stars beyond the Sun only appear as points of light, and even the most powerful telescopes do not reveal any surface features.

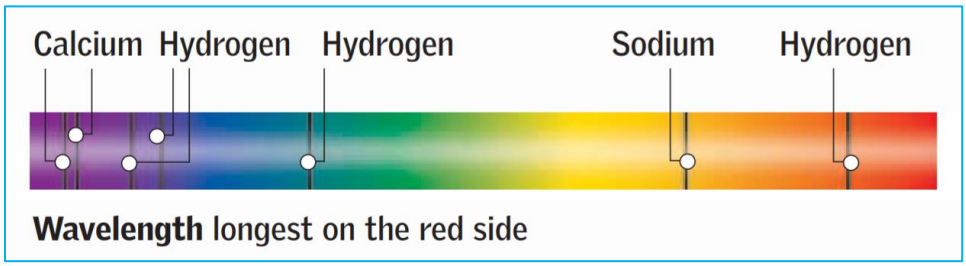
### Measuring Distance

When the Earth orbits the Sun, the closest stars appear to move in front of a background of more distant stars. The angle described by the movement of a star in a six-month period of the Earth's rotation is called its parallax. The parallax of the most distant stars is too small to measure. The closer a star is to the Earth, the greater its parallax.



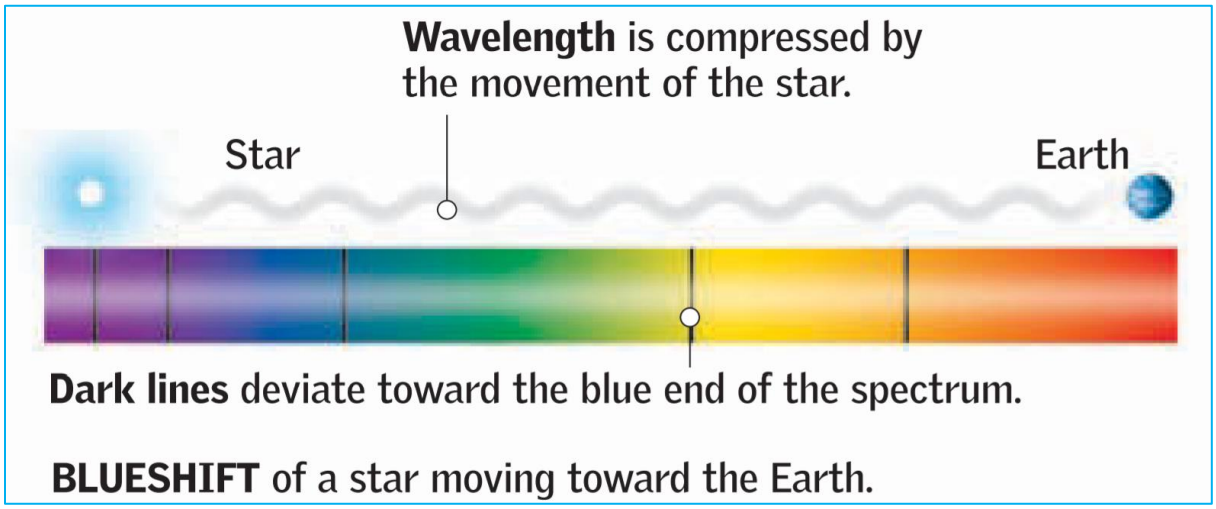
## Spectral Analysis

The electromagnetic waves that make up light have different wavelengths. When light from a hot object, such as a star, is split into its different wavelengths, a band of colors, or spectrum, is obtained. Patterns of dark lines typically appear in the spectrum of a star. These patterns can be studied to determine the elements that make up the star.



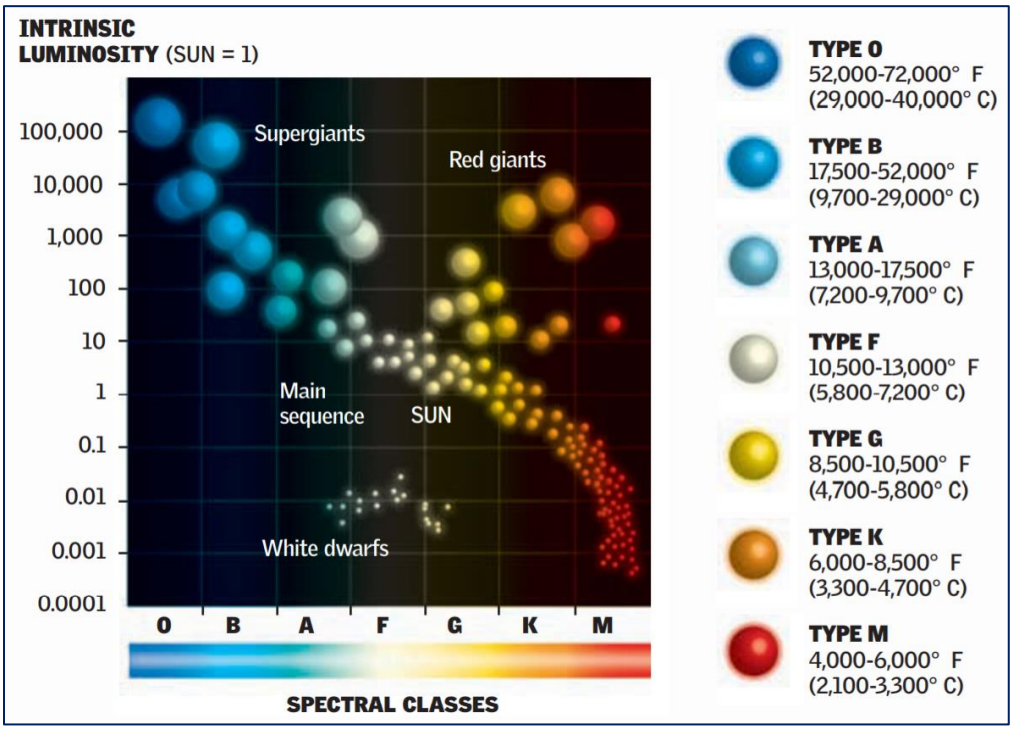

## DOPPLER EFFECT

When a star moves toward or away from an observer, its wavelengths of light shift, a phenomenon called the Doppler effect. If the star is approaching the Earth, the dark lines in its spectrum experience a blueshift. If it moves away from the Earth, the lines experience a redshift.



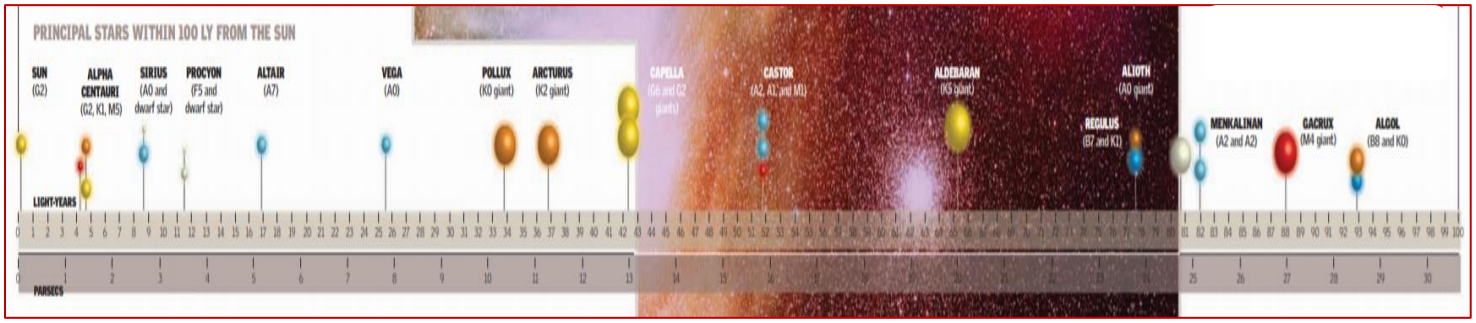
## Hertzsprung-Russell (H-R) Diagram

The H-R diagram plots the intrinsic luminosity of stars against their spectral class, which corresponds to their temperature or the wavelengths of light they emit. The most massive stars are those with greatest intrinsic luminosity. They include blue stars, red giants, and red supergiant. Stars spend 90 percent of their lives in what is known as the main sequence.




## Light-years and Parsecs

In measuring the great distances between stars, both light-years **(ly)** and parsecs **(pc)** are used.
A **light-year** is the distance that light travels in a year— 5.9 trillion miles (10 trillion km).
A **lightyear** is a unit of distance, not time.
A **parsec** is equivalent to the distance between the star and the Earth if the parallax angle is of one second arc.
A *pc is equal to 3.26 lightyears*, or 19 trillion miles (31 trillion km).



**Stellar Evolution**

Stars are born in nebulae, which are giant clouds of gas (mainly hydrogen) and dust that float in space. Stars can have a life span of millions, or even billions, of years. The biggest stars have the shortest lives, because they consume their nuclear fuel (hydrogen) at a very accelerated rate. Other stars, like the Sun, burn fuel at a slower rate and may live some 10 billion years. Many times, a star's size indicates its age. Smaller stars are the youngest, and bigger stars are approaching their end, either through cooling or by exploding as a supernova.

**Nebula**

A CLOUD OF GAS AND DUST collapses because of gravitational forces. In doing so it heats up and divides into smaller clouds. Each one of these clouds will form a protostar.

**95% of stars –** end their lives as white dwarfs. Other (larger) stars explode as supernovae, illuminating galaxies for weeks, although their brightness is often obscured by the gases and dust.

***Small star*** *– Less than 8 solar masses*

**Life Cycle of a Star**

The evolution of a star depends on its mass. The smallest ones, like the Sun, have relatively long and modest lives. Such a star begins to burn helium when its hydrogen is depleted. In this way, its external layers begin to swell until the star turns into a red giant. It ends its life as white dwarfs, eventually fading away completely, ejecting remaining outer layers, and forming a planetary nebula. A massive star, because of its higher density, can form elements heavier than helium from its nuclear reactions. In the final stage of its life, its core collapses and the star explode. All that remains is a hyperdense remnant, a neutron star. The most massive stars end by forming black holes.

***Massive star*** *– More than 8 solar masses*

1. PROTOSTAR – A protostar has a dense, gaseous core surrounded by a cloud of dust.
2. STAR – A star is finally born. It fuses hydrogen to form helium and lies along the main sequence.
3. RED SUPERGIANT – The star swells and heats up. Through nuclear reactions, a heavy core of iron is formed.
4. SUPERNOVA – When the star can no longer fuse any more elements, its core collapses, causing a strong emission of energy.

5.1 NEUTRON STAR – If the star's initial mass is between eight and 20 solar masses, it ends up as a neutron star.

5.2 BLACK HOLE If the star's initial mass is 20 solar masses or more, its nucleus is denser and it turns into a black hole, whose gravitational force is extremely strong.

**Self-Assessment Questions:**

Part 1. Answer the following questions.

1. Explain how the formation of stars trigger?

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2. Explain how the current technology helps to explore the vast cosmos? Give one example.

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3. In 19th century, astronomers began to understand the true nature of stars. What element does a gigantic sphere of incandescent gas mostly composed of?

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4. What are the factors to measure the star that most astronomers consider? Why these factors are being considered?

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5. What is PARALLAX?

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Part 2. Fill in the blank.

**1.** The electromagnetic waves that make up light have different……..

**2.** The …… of dark lines typically appear in the spectrum of a star.

**3.** When a star moves toward or away from an observer, its wavelengths of light shift, a phenomenon called the ……

**4.** If the star is approaching the Earth, the dark lines in its spectrum experience a……

**5.** If it moves away from the Earth, the lines experience a …….

**6.** The ……plots the intrinsic luminosity of stars against their spectral class, which corresponds to their temperature or the wavelengths of light they emit.

**7.** The most massive stars are those with greatest ……...

**8.** ……*(True/False)* The blue stars, red giants, and red supergiant are most massive stars.

**9.** ……*(True/False)* Stars spend 60 percent of their lives in what is known as the main sequence.

**10.** ……(True/False) Wavelenght is compressed by the movement of the stars.

Part 3. Answer the following:

…….1. The distance that light travels in a year— 5.9 trillion miles (10 trillion km).

…….2. Units used in measuring the great distances between stars.

…….3. It is the equivalent to the distance between the star and the Earth if the parallax angle is of one second arc.

…….4. It is a unit of distance, not time.

…….5. They are born in nebulae, which are giant clouds of gas (mainly hydrogen) and dust that float in space.

…….6. The size of the stars that have the shortest lives, because they consume their nuclear fuel (hydrogen) at a very accelerated rate.

…….7. The size of the stars that are youngest.

…….8. A star that burn fuel at a slower rate and may live some 10 billion years.

…….9. A process wherein stars are approaching their end.

…….10. The evolution of a star depends on.