
Dec 27-1:45 PM

**HS-ESS1-3** Students will communicate scientific ideas about the way stars, over their life cycle, produce elements.

Learning Targets

HS-ESS1-3.1 I can explain the properties of light including speed, wavelength, and frequency.

HS-ESS1-3.2 I can distinguish between absolute magnitude and apparent magnitude.

HS-ESS1-3.3 I can differentiate between the properties of stars, including apparent magnitude/luminosity, temperature, and color.

HS-ESS1-3.4 I can explain the life cycle of stars.

HS-ESS1-3.5 I can explain how elements are produced over the life cycle of stars.

vocabulary

**astronomy**-the scientific study of celestial objects, space, and the physical universe as a whole.

**luminosity**-the amount of light a star emits from its surface

**absolute magnitude**- actual brightness of a star

**apparent brightness/apparent magnitude**- how bright the star appears from your location

**wavelength** - - distance between successive crests of a wave (nm, nanometers)

**frequency** - the number of crests of a wave that move past a given point in a given unit of time

**Amplitude** - measures energy - measure from equilibrium to crest or trough

**Electromagnetic spectrum**

**light year - (lyr)** - the distance light travels in one year,

**Astronomical Unit - (AU)**- the distance from Earth to the sun.nebula

main sequence stars

red giant

supernova

neutron star

black hole

white dwarf

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timelapse

# ASTRONOMY

is the scientific study of celestial objects, space, and the physical universe as a whole.


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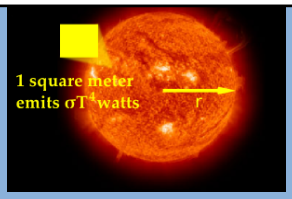
# Properties of Stars



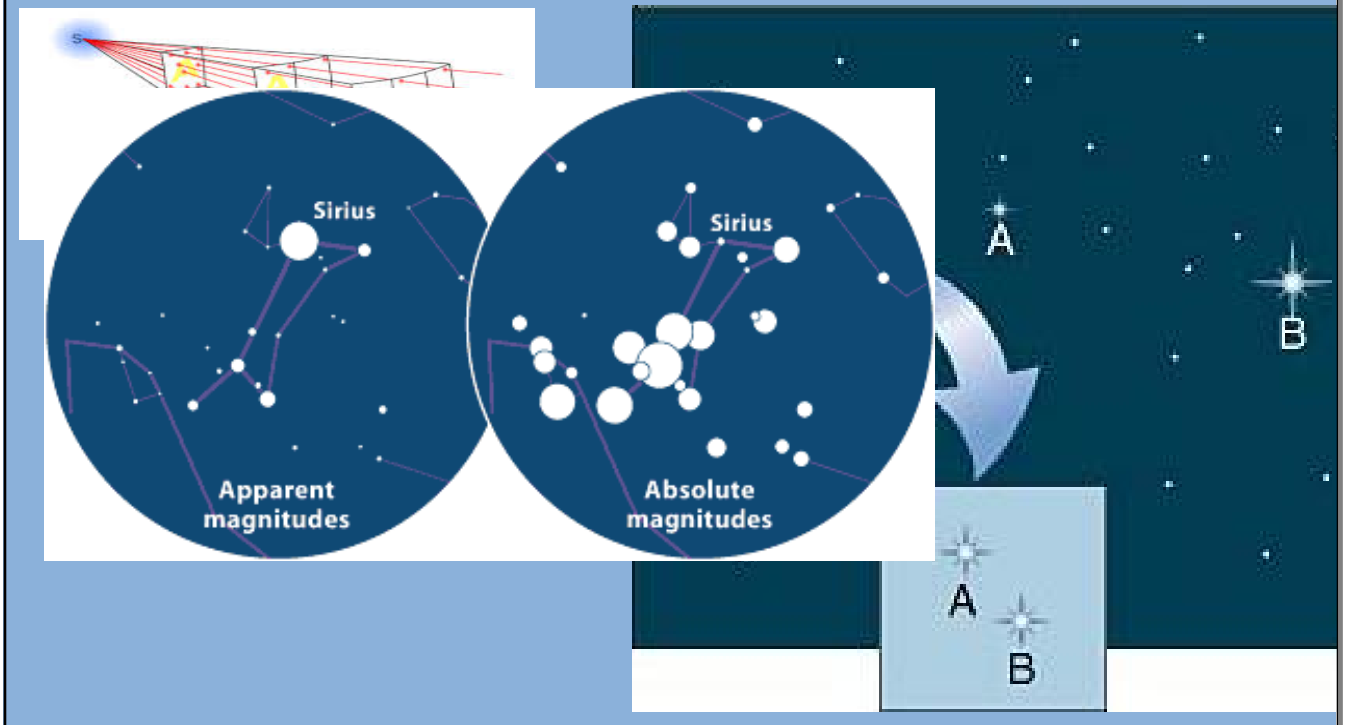

**Luminosity = Absolute magnitude** = actual brightness of a star

**Apparent brightness (apparent magnitude)** is how bright the star appears **from your location**.

(Appears)

The difference between these depends on **distance**.

Everyone will measure a different apparent brightness for the same star if they are all different distances away from that star.



## (HERTZSPRUNG-RUSSELL) HR DIAGRAM -

-Chart that allow us to classify stars in different stages of their life cycle.

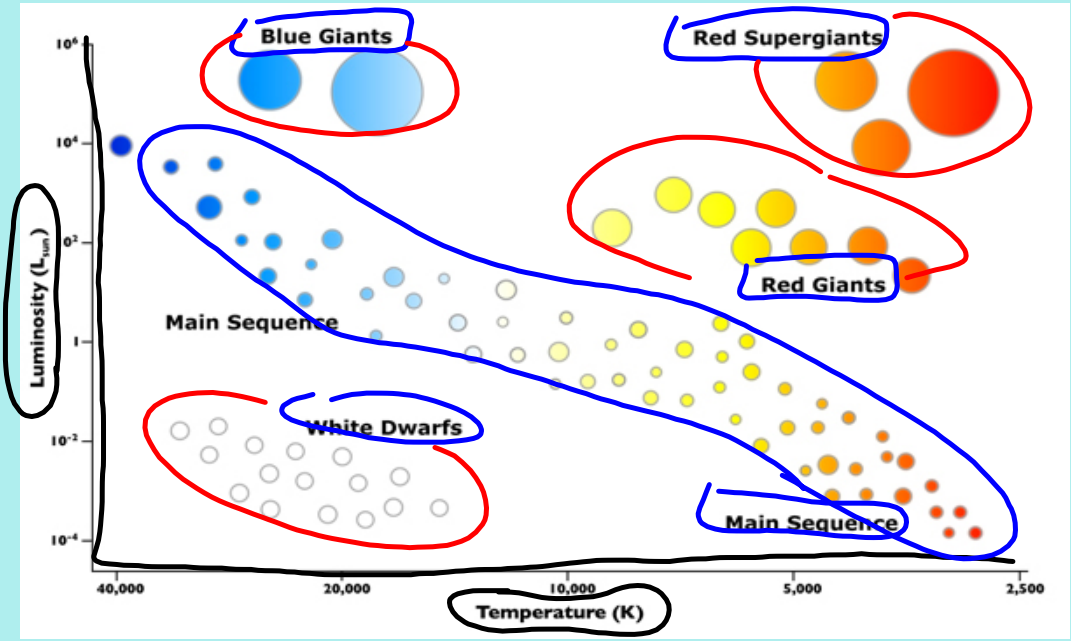
-shows us luminosity vs. temperature(corresponding color).

blue → white → yellow → red

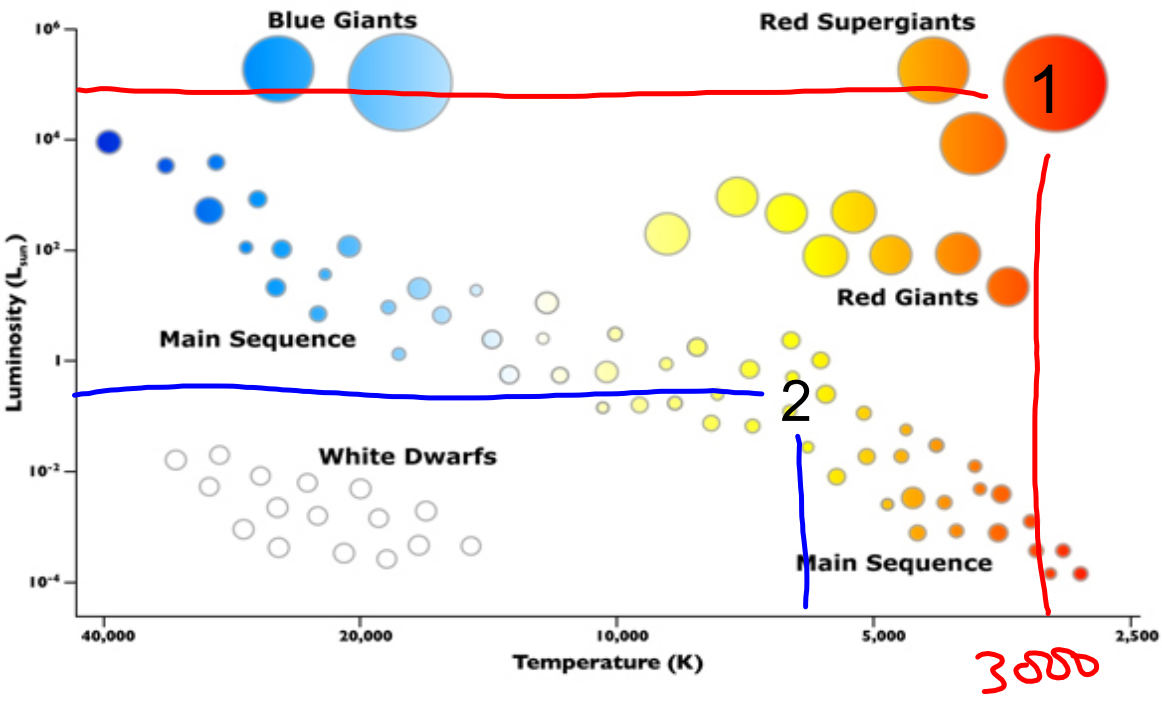
HOTTEST → HOT

smaller → larger

bright → brightest




**Temperature** affects **color**
**Size** affects **luminosity**




What is the temperature and luminosity of #1? #2?

T=3000K
Luminosity = $10^{5}$

T=6000K
Luminosity = $10^{-1}$

What is the color and type of each?

Red
Red Supergiant

yellow
main sequence

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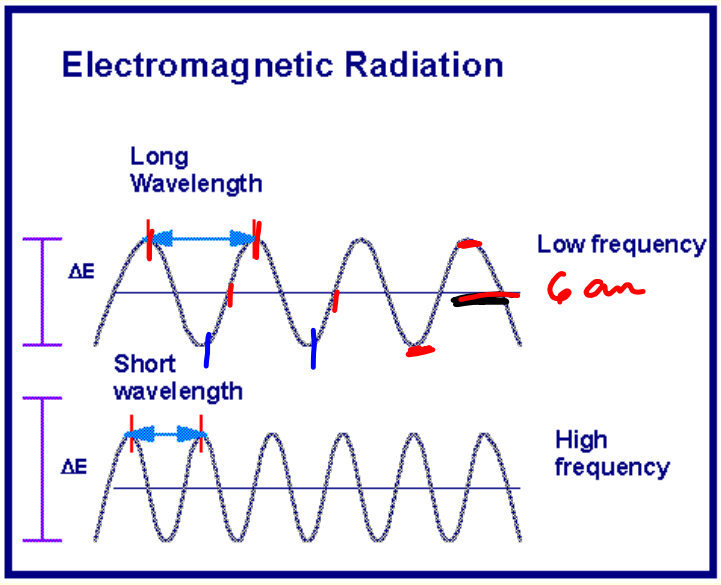
# Determining elements that make up stars:

**wavelength** - distance between successive crests of a wave (nm, nanometers)

**frequency** - the number of crests of a wave that moves past a given point in a given unit of time

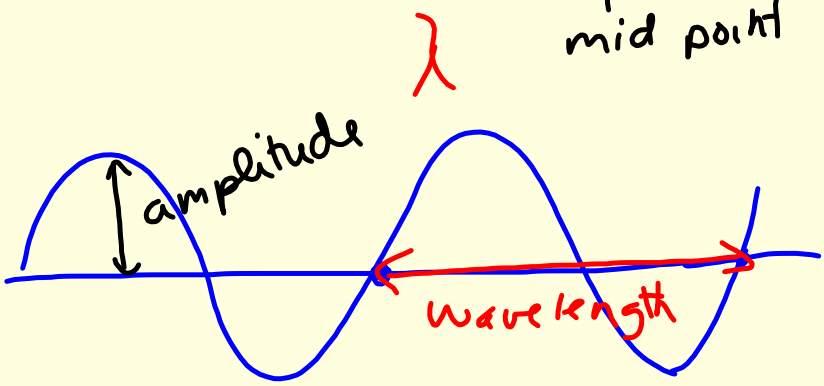
wavelength X frequency = speed of light ($3X10^8$ m/sec)




**Amplitude** - measures energy in a wave - measure from equilibrium to crest or trough

top bottom

mid point



## THE ELECTROMAGNETIC SPECTRUM

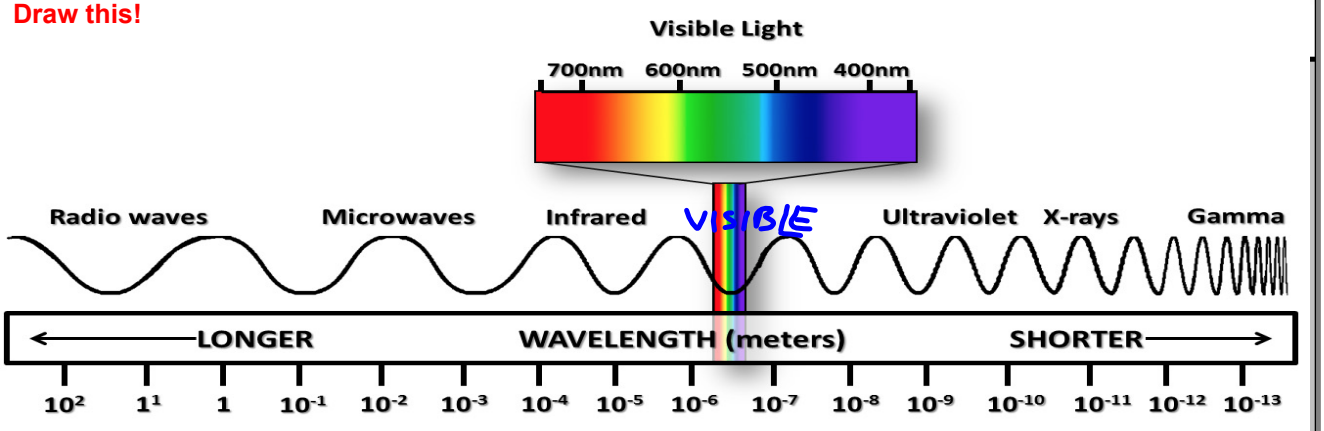
video

**All energy travels in waves.**

**Visible Light waves are the only part of the EM spectrum**

**The wave length reflects the type of energy**
**-longest wavelength = radio waves**
**-shortest wavelength = gamma waves.**


Draw this!

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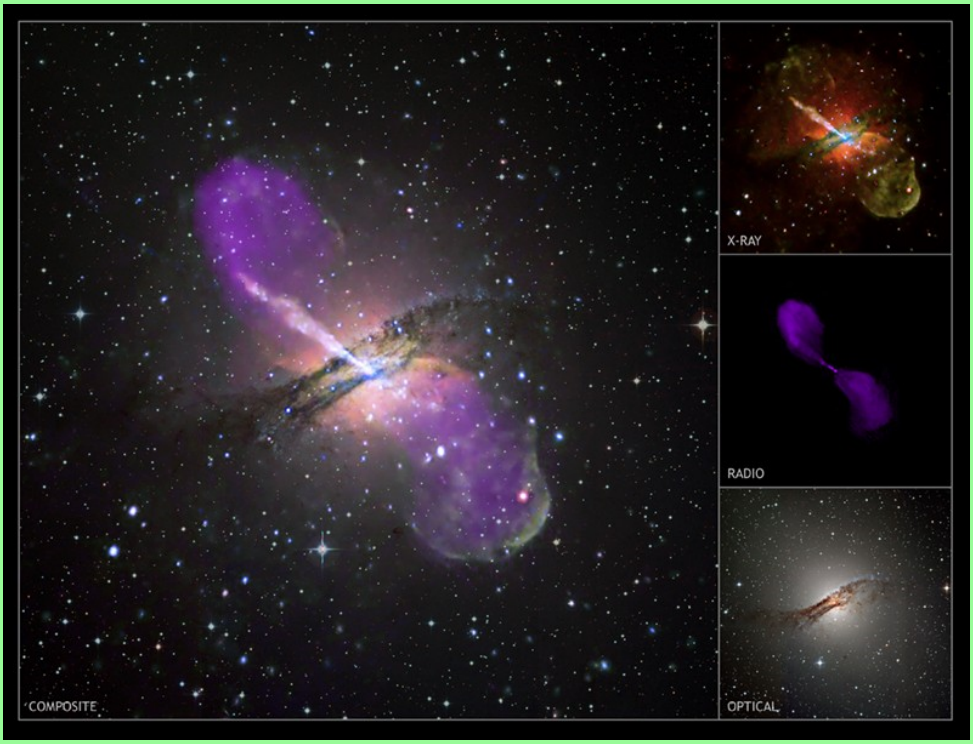
Application:

**Different types of telescopes can detect different wavelengths to construct images, from visible light to radio to x-ray images.**



STARS

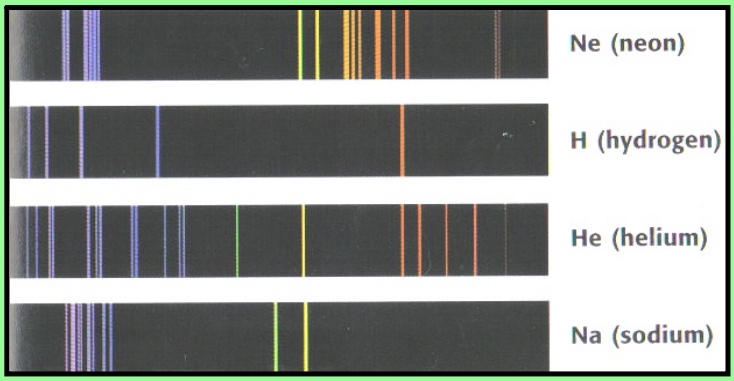
**Electromagnetic emission and absorption spectra** are used to determine a star's composition, motion and distance to Earth

Classified by their temperature/color:

Color indicates the surface temperature.
Red has a longer wavelength than blue & so it is cooler.

Star composition: (how we know what elements are in a star)

Different elements absorb various wavelengths of light, a star's composition can be determined with a spectrograph.



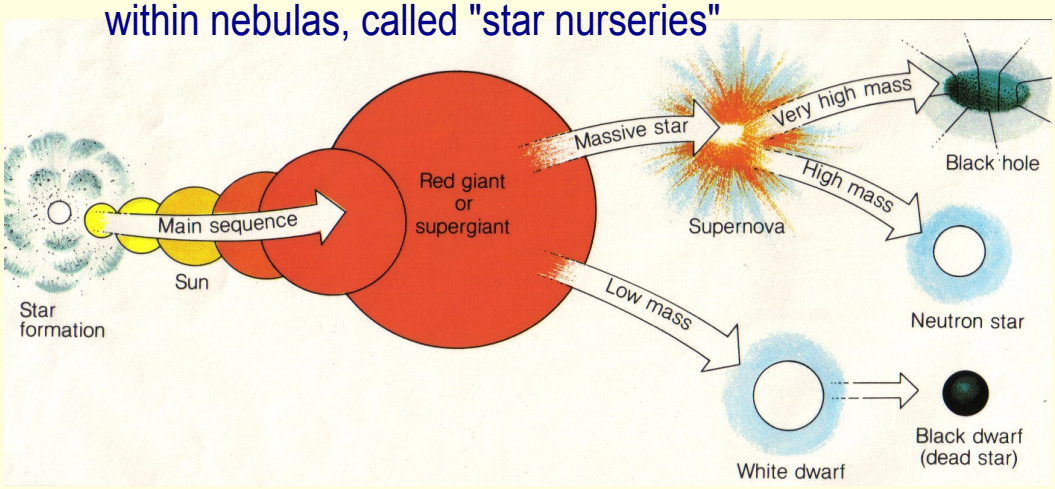

spectrograph activity

## THE LIFE OF STARS

Helium and a small amount of other light nuclei (i.e., up to lithium) were formed from high-energy collisions starting from protons and neutrons in the early universe before any stars existed.

**Stars are created**

from clouds of gas and dust within nebulas, called "star nurseries"




There is a correlation between a **star's mass and stage of development** and the types of elements it can create during its lifetime.

**The type of star depends on its mass during formation.**

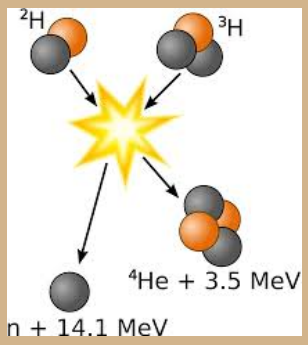
**Average mass stars** become "main sequence" stars.

**The higher the mass of a star,** the shorter its life because it burns through its fuel quickly.

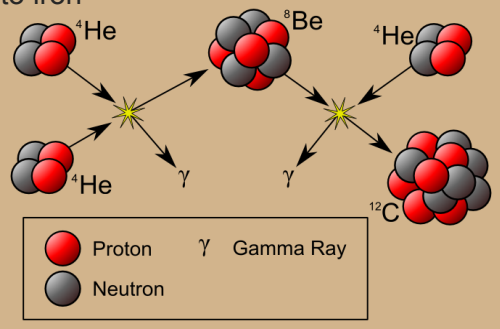
**Smaller mass stars** have much longer lives.

# Fusion creates new elements on stars

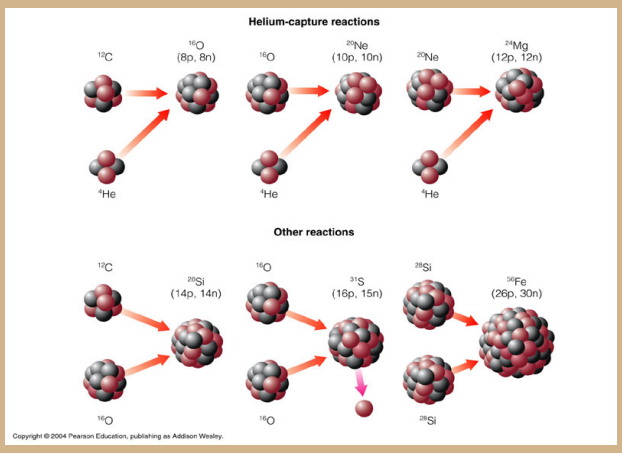
First, stars fuse hydrogen atoms into helium.




Then:
Helium atoms then fuse to create beryllium, then carbon
and so on, until fusion in the star's core has created every element up to iron




More massive elements (up to iron) are produced in the cores of stars by a chain of processes of nuclear fusion, which also releases energy.




Iron is the last element stars create in their cores,
and a kiss of death for any star with the the mass to make it to this point.

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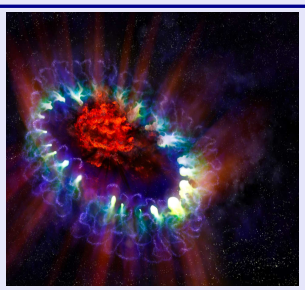
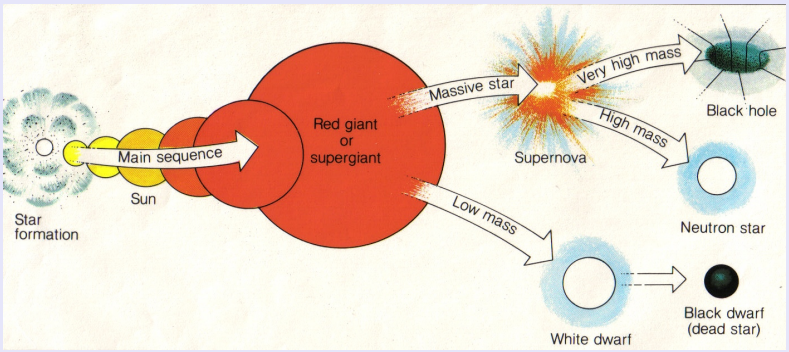
## THE DEATH OF STARS



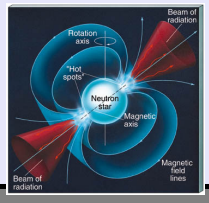



**Supernovae** are tremendous explosions of giant stars in which the outer layers are blown away. * produces elements more massive than iron

**Black holes** form from the super nova of a super massive star, with gravity so intense that not even light can escape. They can be identified using x-ray telescopes.

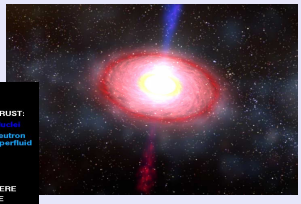

**Neutron stars** form *after the supernova of a high mass star, are very massive*

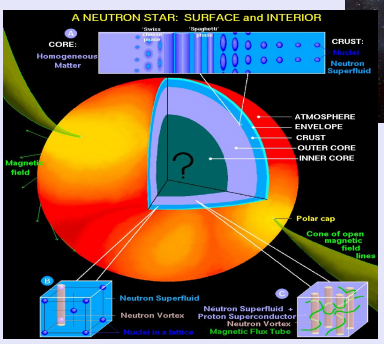
*twice the mass of our sun.




All the particles inside the star's core collapse under gravity and are forced together to form **neutrons.**

A spinning neutron star is called a **pulsar** and can be identified using radio telescopes.





*** Astronomical Unit (AU)- the distance from Earth to the sun.**

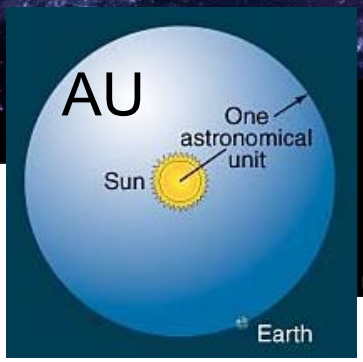
- equal to 93 million miles or 149,600,000 kilometers

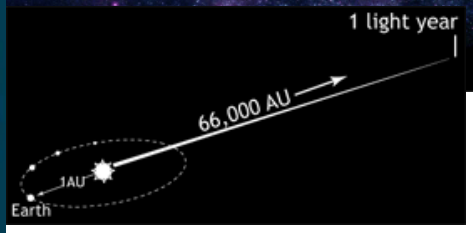
Measures distances **within** our solar system.

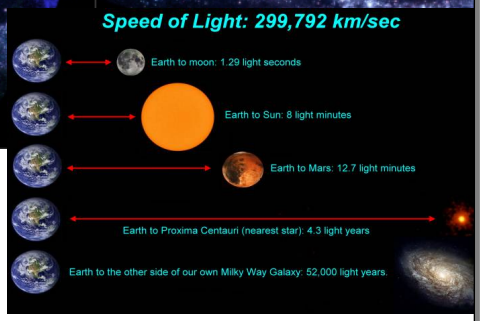
*** Light Year (lyr) - the distance light travels in one year,**

-equal to 6 trillion miles or 9.46 trillion kilometers.

Measures distances **outside** of our solar system




| Unit | Abbreviation | Conversion |
|---|---|---|
| Astronomical Unit | AU | 1 AU = $1.5 \times 10^{11}$ m |
| Light Year | lyr | 1 ly = $9.46 \times 10^{15}$ m |
| Parsec | pc | 1pc = $3.08 \times 10^{16}$ m |
| | | 1 pc = 3.26 ly<br>or<br>1 pc = 206265 AU |

## Attachments

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