HPS – Video Observations 2021 Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“[Life and Death of a Star](https://live.myvrspot.com/iframe?v=fMjEwOGYyYzc2ZmJlOGYwZjdkMmEyMzNkZDI5OTUwNGE)”

Objective 5: Star Properties → Magnitude, Temperature, Brightness, Luminosity, Mass, Composition, HR Diagram

Objective 6: Star Life Cycle → Sequence & summarize the processes in the life cycle of the stars.

Key Terms: Nebula, Protostar, Main Sequence Star, Red Giant, Super Red Giants, White Dwarf, Black Dwarf, Red Dwarf, Neutron Star, Black Hole, Element formation

Directions: Pay close attention to the objectives and these terms, and write down at least 15 key facts while watching the video.

Galaxies made of billions of stars, 400 billion in Milky Way galaxy alone

Nebula – cloud of dust and hydrogen gas (key component of stars), birthplace of stars. Gravity pulls things together to give us planets, stars, galaxies in universe.

Protostar – starts cold, but gravity pulls material in to sphere and heat rises 🡪 protostar.

Main Sequence – thermonuclear fusion occurs past 18 million degrees. Produces E to power star throughout its life. Constant battle: forces from nuclear fusion vs. gravity. Equilibrium – inward force of gravity = outward force from fusion. Our Sun is in this phase (life span is 10 billion years)

*Color and temp are related. Blue stars are hotter, red stars are cooler.*

Red Dwarfs – most common star in our universe. Blue Main Sequence – large and hot!

*Mass drives the life history of a star! More massive – shorter life because they burn through their fuel more quickly than lower mass stars. Gambling metaphor, semi truck vs. economy car*

*Massive star life span – millions of years, low mass star – billions maybe trillions of years*

When a star runs out of fuel fusion stops and gravity wins. Massive stars explode, while smaller ones dim and fade away.

Red Giant/Supergiant – LIFELINE: In 5 billion years, our Sun will run out of H fuel. Gravity will crush the star. Needs a new source of fuel, but the core needs to be hotter to fuse He (overcome strong nuclear force). LIFELINE: core is superheated by gravity that is trying to crush it. He will fuse in core! Delaying the inevitable 🡪 death. Heat of He burning causes outer atmosphere of star to expand and cool.

Planetary Nebula -. Core condenses until it is supported only by electron degeneracy. Outer envelope of gases are ejected 🡪 planetary nebula.

White Dwarf - Star then falls in on itself due to gravity. Electrons don’t like each other, though, so they repel each other. Electron degeneracy pressure holds star up. Very dense! Retired stars as the light that shines is from E it created over its lifetime. Spending its life savings. (0-8 SM)

*Binary or multiple star systems – if a white dwarf is gravitationally bound to another star, it can steal material from a companion star and grow in mass. Then, it can undergo an explosion – Type IA Supernova. Our Sun won’t do that, because it’s a loner*.

Massive Main Sequence - Massive stars run out of fuel, but they have enough mass and heat to fuse other elements. It looks like an onion with layers, and the mass determines how many reaction phases a star can go through, and therefore the composition of the star. Then the star collapses! 90% of a star’s life is in this phase.

Supernova – collapse of iron core of a high mass star blows apart the rest of the star in a colossal explosion. Source of heavy elements that make up the life around us.

Neutron Star – Core is left in tact after a supernova. Gravity defeats the electron degeneracy, but electrons plus proton to make neutrons. Neutrons don’t like each other – neutron degeneracy. Cosmic pebbles, EXTREMELY dense! 1 tsp weighs a billion tons! Spin very fast, hundred of times per second, and have a high magnetic field. This forces electrons to go along the axis of the magnetic field. The accelerated electrons give off beam of light. Pulses! (8-20 SM)

**OR**

Black Hole – 20-40x Sun’s mass. Gravity’s victory over mass. Complete collapse of a very massive star. Matter compresses into such a high density that nothing can escape its gravity – even light. (20+ SM)

OR??

Normal supernova are 10x our Sun, but this one was 150-200x our Sun. Mega explosion! Largest iron factories in the universe. 2006gy

Star Collisions – modeled by scientists. 2 neutron stars orbit one another, get close together, move nearly the speed of light, unleashing more E than the Sun in its entire lifetime.
If White dwarf collided with the Sun. White dwarf’s gravity would distort the shape of the Sun, sending a shockwave throughout the Sun that it would explode. Chances of this happening are slim as the Sun is in a less densely populated part of the Milky Way.

Globular Cluster – more densely population of stars. No organized motion. Crowded and chaotic conditions. Every star is born about the same time, but there are some large Blue stars that are younger than they should be. 2 dimmer, main sequence stars come together to form Blue Stragglers.

Brown Dwarf – failed stars, dim, low mass and cannot fuse. Act like planets. Some have discs of dust and gas around them. Could they become planets?

ENDS ABOUT 43 minutes.

Closing Questions:

What determines the life cycle of a star?

How is color related to the temperature of a star?

What two forces are at war in a star?

Which force wins? Why?

How does mass affect the lifespan of a star? Why?

What determines the composition of a star?

What holds a white dwarf up?

What holds a neutron star up?