Star Life Cycle

Let’s begin your journey
Your Mission

In order to complete your mission you must answer questions about a star’s life cycle. You will answer questions that will ultimately decide the fate of your star.

Let’s get started...
Step One

Stars ultimately begin with a nebula. A nebula is a giant cloud of gas and dust.

The hydrogen in the nebula gets pulled together by gravity and it starts to spin.

As the gas spins, it becomes a protostar.

Click on the circle to continue your mission.
Step Two

Now that you have your protostar, it is time to start making decisions about the fate of your star.

Choose an option below regarding the mass of the star. This will determine the path of your star’s life.

- Low Mass Star
- High Mass Star
- Very High Mass Star
Low Mass Star

You have chosen the Low Mass option for your star. You will now begin the following steps in developing your protostar.

Click on the circle below to continue your mission.
High Mass Star

You have chosen the High Mass option for your star. You will now begin the following steps in developing your protostar.

Click on the circle below to continue your mission.
You have chosen the Very High Mass Star option for your star. You will now begin the following steps in developing your protostar.

Click on the circle below to continue your mission.
You have journeyed through the protostar phase and are reaching a higher and higher temperature. Protostars need to reach an extremely high temperature to reach a phase called nuclear fusion.

How hot do you think a star needs to be to reach the point where nuclear fusion occurs?

- 10,000 degrees Fahrenheit
- 15,000,000 degrees Fahrenheit
- 13,000,000 degrees Fahrenheit
Try Again...

That temperature is too low for nuclear fusion to occur.

Click on the circle to return to Step Three.
Correct! 15,000,000 degrees Fahrenheit!

Stars need to reach a temperature of 15,000,000 degrees Fahrenheit in order to reach the **nuclear fusion** phase.

Now that we’ve reached **nuclear fusion**, what exactly is **nuclear fusion**?

Click on the circle below to continue.
Step Four

Nuclear fusion occurs in the cloud’s core.

Nuclear fusion is a process where several small nuclei combine to make a larger one.

Do you think the mass of the new nucleus will be larger, smaller, or stay the same?

Larger

Smaller

Stay the Same
Try Again...

Hint: Remember, some of the mass is converted to energy.

Click the circle to return to Step Four.
Correct! The mass will be smaller!

The mass of the nucleus will actually be smaller than the sum of the smaller ones. Some of the mass is converted to energy.

This is the source of the Sun’s energy now!

Now, you have a main sequence star. Main sequence stars remain in this stage for millions to billions of years.

Click the circle to continue your mission.
Step Five

In this step, the main sequence star continues to glow and hydrogen is converted into helium.

Eventually, the hydrogen will run out and the core will become unstable and contract.

The outer shell of the star will expand and cool and glow a certain color. What color do you think it will start to glow?

- Red
- Blue
- Yellow
Try Again...

Blue is the color of the hottest stars, remember the outer shell is cooling.

Click the circle to return to Step Five.
Try Again...

This color star is too hot for this phase, what is the coolest color of star?

Click the circle to return to Step Five.
The star has now entered the **Red Giant** phase. It is red because it is cooler than a main sequence star and it is called a **Red Giant** because the outer shell has expanded.

Now, helium fuses into carbon in the core.

Click on the mass of the star you have chosen to continue your mission.
You are now passing through the **Red Giant** phase.

After the helium fuses into carbon, the core of your star will collapse again. The outer layers of your star are expelled.

What do you think will be formed when this happens?

- A Supernova
- A Black Hole
- A Planetary Nebula
Try Again...

Your star does not have enough mass to form a supernova.

Click on the circle to return to the previous screen.
Try Again...

Your star does not have enough mass to form a black hole.

Click on the circle to return to the previous screen.
Correct! A planetary nebula is formed!

When the outer layers of the star are expelled, a planetary nebula is formed! A planetary nebula has a ring shape and is composed of the gas from the star.
Low Mass Star

You know that the outer layers form a planetary nebula, but what happens to the core?

- Returns to the protostar phase
- Remains as a white dwarf
- Remains as a red dwarf
Try Again...

The core does not return to its **protostar** phase. Remember, it is cooling.

Click on the circle to return to the previous screen.
Although it does become a type of dwarf star, it is not a red dwarf.

Click on the circle to return to the previous screen.
Correct! It remains as a white dwarf!

Click on the circle to continue to learn about the white dwarf star.
The core of your star remains as a **white dwarf** and eventually cools to become a **black dwarf**.

A **white dwarf** is a star that has exhausted most or all of its nuclear fuel and has collapsed to a very small size.

A **white dwarf** has the radius equal to about .01 times that of the Sun, but about the same mass!

A **white dwarf** has the density about 1 million times that of water!

Click on the circle to move on to the **black dwarf** stage.
Low Mass Star

A black dwarf is a non-radiating ball of gas that results from the cooling of a white dwarf.

A black dwarf has all of its energy radiated away.

Click on the circle to complete your mission.
High Mass Star

You are now passing through the **Red Giant** phase.

The core temperature of your star is increasing and carbon atoms are formed.

Fusion continues and forms new elements.

What do you think the order of the elements are?

- Oxygen, Nitrogen, Iron
- Iron, Nitrogen, Oxygen
- Nitrogen, Oxygen, Iron
Try Again...

Iron is not the next element formed.

Click on the circle to try again.
Try Again...

Nitrogen is not the next element formed.

Click on the circle to try again.
Correct! The order is oxygen, nitrogen, iron!

Once the core is iron, fusion stops because iron is so compact and stable.

Energy is no longer being radiated from the core and in less than a second, the star begins gravitational collapse.

The core temperature reaches over 100 billion degrees and the iron atoms are crushed together.

What do you think will happen next?

- White dwarf is formed
- Planetary nebula is formed
- Supernova explosion will occur
A white dwarf is formed when you have a much less massive star.

Click on the circle to try again.
Try Again...

A planetary nebula is formed by a much less massive star.

Click on the circle to try again.
Correct! A supernova explosion will occur!

Click on the circle to learn more about supernovas.
High Mass Star

A **supernova explosion** has a sharp increase in brightness and eventually fades.

**Supernovas** can even outshine galaxies!

The expanding cloud they produce forms a **supernova remnant** which is visible long after the initial explosion fades.

What do you think happens to the **supernova**?

- Nuclear fusion occurs
- Neutron star forms
- Red Giant forms
A supernova does not form a Red Giant.

Click on the circle to try again.
Try Again…

The star has already gone through nuclear fusion.

Click on the circle to try again.
Correct! A neutron star forms!

Click on the circle to learn more about neutron stars.
A neutron star is the imploded core that is the remnant of a supernova explosion.

A neutron star has the mass about 1.4 times the sun.

Neutron stars have magnetic fields 1 million times stronger than those produced on Earth.

Click on the circle to complete your mission.
If you have the high very high mass star, click the circle in the bottom right corner and follow the high mass star path. The paths are the same up until a certain point. Once you get to that point, you will see a special very high mass star circle that will direct you in your mission. Click on that icon when you see it.

This is the Very High Mass Star Icon. Be sure to click on this when you see it!!!
Very High Mass Star

A **supernova explosion** has a sharp increase in brightness and eventually fades.

**Supernovas** can even outshine galaxies!

The expanding cloud they produce forms a **supernova remnant** which is visible long after the initial explosion fades.

What do you think happens to the **supernova**?

- Black hole forms
- Neutron star forms
- White dwarf forms
A neutron star does form from a high mass star, but something special forms from a star with even more mass.
A white dwarf forms after the death of a low mass star.
Correct! A black hole will form!

Click on the circle to learn more about black holes.
A **black hole** is an object whose gravity is so strong light cannot even escape from it.

The force of gravity overcomes nuclear forces and the core of the star is swallowed by its own gravity.

**Black holes** attract any matter and energy that come near it.

Click on the circle to complete your mission.
Congratulations!

- You have completed your star’s life cycle and therefore completed your Star Mission.
- You may return to the home slide to start a mission as a new star or finish your lesson.

Return home  Finish lesson
You have completed your mission. Thank you for participating!