The Life Cycle of a Massive Star
All Ages

Objective

• NASA’s James Webb Space Telescope (JWST) is planning to launch December 18, 2021. We at the Maria Mitchell Association are sharing activities from NASA to get excited about this next great space observatory!

This activity will model the life cycle of a massive star using beads to represent a star’s creation, formation, and change over time.

Big Idea:

• The James Webb Space Telescope (JWST) will launch and set up orbit about four times the Earth-Moon distance. It has the ability to study star formation, first galaxies, galaxy assembly, planets and life, and more.
• According to NASA, the “JWST spans the size of a tennis court and stands three stories tall. It will be the largest observatory ever sent into space.” This telescope will see in infrared light, which is a wavelength humans cannot see, but can feel as heat. Using infrared light, the JWST will be able to detect signals from distant objects such as massive stars.

Activity Description:

• In this activity, you will make a visual representation of the life cycle of a massive star by associating different colored beads to different stages of stellar life.

Materials Provided for The Life Cycle of a Massive Star

• Pony beads: green, blue, white, yellow, orange, red, black, and green
• Pipe cleaner
• Webb Life Cycle Bookmark
• Webb Telescope Sticker

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Info Sheet for The Life Cycle of a Massive Star:

First, let’s talk about life cycles! Can you think of the life cycle of a butterfly or other creature?

Similar to butterflies, stars have life cycles, too!

The life cycle of a star depends on its mass, which is a measure of the amount of “stuff” that makes up an object. The larger the star’s mass, the shorter its life span. Stars live for a very long time, and this time can range from millions to billions of years.

In this activity, you will follow the steps on your Webb Life Cycle Bookmark to create your own Life Cycle of a Massive Star bracelet. To begin this activity, take out your pipe cleaner and container of beads.

Now, we are on a journey. Reference your bookmark and use the steps on the next page to order your beads to match the lifecycle of the star. Check out the diagram below for a depiction of a star’s lifecycle.

Image Credit: NASA and the Night Sky Network
Directions for The Life Cycle of a Massive Star:

Step 1: Add a green bead to your pipe cleaner. A cloud of gas and dust collapses due to gravity, creating a protostar. This is the beginning stage of a massive star formation.

This is an image of a protostar from NASA’s Spitzer space telescope. According to NASA, protostars like this behave like a police strobe light. (Image credit: NASA/ESA/JPL-Caltech/STScI/NOAO/University of Arizona/Max Planck Institute for Astronomy/University of Massachusetts, Amherst)

Step 2: Add a blue bead. Gravitational energy powers the young star until...

Step 3: ...nuclear fusion occurs! Add a yellow bead to represent this. Nuclear fusion is a process in which the nuclei of atoms are joined and release energy. See a diagram of this below.

The main sequence star may live millions, or even billions, of years.

Step 4: EXPANSION! Add a red bead. The star expands into a red giant when the star’s hydrogen level drops. Below is an image of a red giant.
**Directions for The Life Cycle of a Massive Star (continued):**

**Step 5:** Add an orange bead. Different fusion processes occur. The star expands, cools, and loses mass each time.

**Step 6:** Add a white bead. Fusion stops and a **supernova** explosion occurs. Most of the star is blown away.

![Image of supernova remnant](image)

This picture was captured by NASA’s Spitzer Space telescope. The red veins mark the location of the remnants of a supernova. (Image credit: NASA/JPL-Caltech/IPAC)

**Step 7:** Add a black bead. Depending on the original star’s mass, either a black hole or neutron star remains.

![Image of black hole](image)

This photo is an artist’s rendition of a supermassive black hole which can distort light and space around it. (Image credit: NASA/JPL-Caltech)

**Step 8:** Lastly, add another green bead. The material shed during the star’s life joins new gas clouds, and new stars are formed.

**Take It Further!**

1. Explore NASA’s website: [www.jwst.nasa.gov](http://www.jwst.nasa.gov)
2. Count down until the launch! The JWST is set to launch on December 18, 2021. How will you count down the days until this observatory goes into space?
Vocabulary:

Mass: a measure of the amount of “stuff” that makes up an object.

Protostar: beginning stage of a massive star.

Nuclear Fusion: a process in which the nuclei of atoms are joined and release energy.

Red Giant: a giant star that has low surface temperature and is much larger than the sun in our solar system.

Hydrogen: an element on the periodic table of elements.

Supernova: the explosion of a star in which the star increases greatly in brightness and ejects most of its mass.

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Resources: Original activity from https://jwst.nasa.gov/education/JWSTLifeCyclesActivity.pdf