 **Stars: From Beginning to End**

 60 Minute Space Science Lesson

 Planetarium and Observatory Program Grades: 8-12

**TEACHER GUIDE**

**Ohio’s Learning Standards**

**Grade 8:** Earth and SpaceScience – Forces and Motion

* Forces between objects act when the objects are in direct contact or when they are not touching.
* There are different types of potential energy.
* Forces have magnitude and direction.

**Grade 9 and 10:** PhysicalScience – Energy and Waves

* Radiant energy and the electromagnetic spectrum
* Waves

**Grade 9 and 10:** Earth and SpaceScience – The Universe

* Stars
* Fusion in stars
* Formation; stages of evolution.

**Objectives**

* Identify planets visible to the unaided eye in the evening/morning sky.
* Name at least three constellations visible in the evening/morning sky.
* Differentiate the significance of a star's color relative to its temperature.
* Compare the fundamental importance of a star’s mass to its life history and be able to state that massive stars live much shorter lives than stars like our Sun.
* Describe the evolutionary track of two stars of differing masses.

**Description**

Follow the cycle of a star’s life from its birth in a nebula to its final end. Discover red giants, white dwarfs, supernovae and black holes in the immersive Shafran Planetarium.

**Stars: From Beginning to End**

# If this will be your first trip to the Museum for your students you may want to review the following:

**Before Your Museum Visit**

# What is a Museum?

# What is our purpose for visiting The Cleveland Museum of Natural History?

# How should we handle objects at the Museum?

# Introduce the vocabulary and additional resources provided below

**Vocabulary**

**Black Hole** - The end result of an extremely massive star supernova explosion. A black hole is the region surrounding the core of a dead star with so much gravitational force that even light is not allowed to escape the tremendous pull.

**Milky Way ‑** The Sun and Solar System belong to the Milky Way galaxy, a vast spiral of hundreds of billions of stars. All of the individual stars seen on a clear night are nearby neighbors of the Sun in the Milky Way galaxy. A hazy band of light across a dark sky made up of countless faint stars is also called the Milky Way. This band is the view of our disk-shaped galaxy as seen from the solar system's location within the vast flattened spiral of hundreds of billions of stars.

**Nebula** - a cloud of gas and dust from which stars and planets form. Our solar system formed from a nebula 4 1/2 billion years ago.

**Neutron Star** - The end result of a massive star supernova explosion. A neutron star is only a few miles in diameter, yet many times more massive than the Sun. A spoonful of neutron star material weighs hundreds of billions of tons.

**Observatory ‑** a building equipped with a telescope for viewing the real sky.

**Planetarium ‑** a machine which projects images of stars, the Sun, Moon and planets onto a domed ceiling. The machine rotates to illustrate celestial movements. Also a building or room housing such a device.

**Red Dwarf** - the most common type of star in the galaxy, smaller and cooler than our Sun. The Sun is a yellow dwarf star.

**Red Giant** - One of the last stages of a star's evolution, where a star runs low of hydrogen fuel in its core and swells to thousands of times the size of the Sun. Our Sun will become a red giant in several billion years, and then gently throw off its outer atmosphere to become a slowly cooling white dwarf star. Massive stars become red supergiants.

**Star Cluster** - a group of stars formed in the same nebula.

**Supernova** - A cataclysmic explosion marking the end of a massive star's evolution. A star that has run out of fuel collapses under its own weight and then explodes outward. Only a small fraction of stars (the massive ones) become supernovae.

**White Dwarf** - The end result of an average star's evolution (the Sun is an average star). A white dwarf is extremely hot, dense, and only a few times larger than the Earth.

**Black Hole** - The end result of an extremely massive star supernova explosion. A black hole is the region surrounding the core of a dead star with so much gravitational force that even light is not allowed to escape the tremendous pull.

1. Have students create a list of the objects that they see in the sky.

**Extension Activities**

1. Have students estimate the number of stars they can see on a clear night. Brightly lit urban skies typically show a few dozen, suburban skies a few hundred, and country skies several thousand.
2. Ask if any students have visited a planetarium before; have them relate their experience to the class.
3. Constellations are often shown as pictures in the sky formed by the outlines of sets of stars. Let students make pictures using the dot-to-dot method. A sheet of tissue could be placed over a drawing or picture of an everyday object, and students could draw in and number the dots. Classmates could connect each other's dot pictures, then compare the finished pictures to the originals.
4. Have students observe a candle flame and note what colors are visible. What is the hottest part of the flame? (blue - blue stars are the hottest, then yellow, red stars are coolest).
5. Ask students to compile a list of objects of different colors. Are the objects emitting their own light or reflecting light from some other source? Only extremely hot objects emit their own visible light. Which is hotter - a red-hot or a white-hot poker? (white-hot) Higher temperature, blue- sources include gas burners, welder's torches and blue stars.
6. The air we breathe is considerably denser than the gas in a typical nebula. Blow out a candle flame and observe the smoke - the microscopic particles of smoke that you see are about the same size as the dust grains in a nebula. Think of the number of dust particles required to make a planet the size of Earth!
7. Ask students to consider examples in their experience where denser objects condense or collect out of clouds of thinner, or less dense, material (e.g. raindrops, dewdrops, snow, lumpy oatmeal, mud settling in the bottom of a jar of muddy water.)

**Online Resources for Teachers and Students**

Click the link below to find additional online resources. These websites are recommended by our Museum Educators and provide additional content information.

CMNH Educators regularly review these links for quality. Web addresses often change so please notify us if any links have issues. Please note that aside from our own Museum website, the Museum is not affiliated with and does not endorse these online resources.

Cleveland Museum of Natural History https://[www.cmnh.org](http://www.cmnh.org/)/edlinks

The Educator Resource Center offers educator workshops, thematic teaching kits, animal dioramas, and more for loan to area teachers.

Contact the ERC at 216-231-2075 for information on individual or school membership.

Visit the Museum’s ERC website for more information on workshops https://[www.cmnh.org/ERC](http://www.cmnh.org/ERC)

**Hours**

* Monday through Friday, 1 to 5 PM
* Wednesday, 1 to 6 PM
* Saturday, 9 AM to 2 PM

**Materials for Loan**

If you’re interested in additional resources be sure to check out the following ERC materials or browse ERC materials online at

 <http://cmnh.hosting.l4u.com>

Related ERC kits for this topic include:

**Portable Planetarium:** Launch into space from your own classroom! The STARLAB Portable Planetarium allows you and your students to step into the universe and explore interactive, cross-curricular lessons about astronomy, history and more. This inflatable planetarium can hold 30 students and requires teacher training and reservations through the ERC.

**Educator Resource Center (ERC)**