The Planetarium at Raritan Valley Community College
118 Lamington Road, Branchburg, NJ 08876
Planetarium: 908-231-8805
www.raritanval.edu/planetarium

The Little Star That Could

Originally created and produced at the McDonnell Star Theater, St. Louis Science Center, ©1986.

Teacher Resource Guide

Thank you for scheduling a field trip to the Planetarium at Raritan Valley Community College, part of the New Jersey Astronomy Center for Education. The Planetarium is a 40-foot wide theater with 100 seats and room for 4 wheelchairs. Using multiple projection systems, the Planetarium can create virtually any environment. You can be seated in the interior of a spacecraft, witness the birth of a star, stargaze at the night sky over New Jersey (or anywhere else on Earth), or travel faster than light through the Milky Way Galaxy.

About the show

The Little Star That Could is a 40-minute planetarium show designed for primary grades. The show is written in a narrative format, presenting the following content:

- ★ Color as related to temperature of stars
- ★ Birth and death of stars
- ★ Structure of the Milky Way Galaxy
- ★ Double stars, multiple stars, and globular clusters
- ★ Differences between stars, planets, and moons
- ★ Characteristics of solar system planets

Grade Levels: 1 - 3

New Jersey Student Learning Standards

Supports NJSLS-Science: 2-PS1-1 Matter and Its Interactions, 5-ESS1-1 Earth's Place in the Universe

We welcome any suggestions, comments, or tips on these activities and resources, so we can improve these resources for you and your students. Thanks again for choosing the Planetarium at Raritan Valley Community College!

Contact us: Planet@raritanval.edu
Phone: 908-231-8805
www.raritanval.edu/planetarium

Amie Gallagher, Planetarium Director

Kevin Schindler, Planetarium Associate

“The Little Star that Could” Program Objectives:
Upon completion of this program, students will be able to:

1. Explain that stars are just like the Sun, but are located very far away, so they appear small;
2. Explain why stars have different colors;
3. Explain which star color is hottest, and which star color is coolest;
4. Identify the names and order of planets in our solar system;
5. Understand that only certain types of stars are just the right size and temperature to support life on any of their planets.

Pre-Visit Activities

Questions for you and your students to ponder before your visit…

Q: What are stars, & how far are they?
A: Stars are suns, many times farther away from Earth than our star the Sun – also known as Sol. The Sun is at the center of the Solar System, with its light and heat warming the planets. The Sun’s gravity keeps the planets orbiting around on a consistent basis. The Sun is approximately 93 million miles away, and a beam of light would take 8 and a third minutes to travel to the Earth. The next nearest star, Proxima Centauri, is 24.3 trillion miles, or a beam of light would take four years, two months, and two weeks to reach Proxima. Many of the stars you can see in the night sky range from six light years to over one thousand six hundred light years away from you.

Q: Where are the stars during the daytime?
A. The Sun, our star, is so close to the Earth that it shines much brighter than all of the other stars. This hides the stars, until the Sun sets in the west. Then we can see the other stars in the sky, if it is clear. When it is cloudy, the clouds block everything in the sky from our view.

Q: Why do we see different stars and star pictures during the year?
A. Earth orbits the Sun once a year, constantly moving during the 365 and one-quarter days it takes to go around the Sun. As we circle the Sun, our view of the stars also changes a little bit every day. So stars seen in night in the winter are not seen during the summer

Q: Why do stars have different colors?
A: Stars have different colors because they have different temperatures. The different temperatures tell astronomers a lot about each of those stars in the night sky.

Q. What are shooting stars, & where do they go when they disappear?
A. Shooting stars are actually among the smallest particles orbiting the sun, and most are no larger than grains of sand. Scientists call these tiny dust and rock objects meteoroids while they are in orbit around the Sun. Many of these meteoroids are castoffs from comets melting as they travel close to the Sun. As these meteoroids travel, they are sometimes pulled towards a planet by the force of the planet’s gravity. When a meteoroid gets very close to the Earth, the meteoroid is pulled towards us by the Earth’s gravity. They move fast, up to 128,000 miles per hour! They enter the Earth’s air and rub against the air. This friction produces a lot of heat, up to 5000 degrees F! Have your students rub their hands together to produce heat from friction. The meteoroid is now a meteor, or a shooting star. As the meteor

falls and heats up, it begins to glow and is sometimes visible from the surface of the earth. In many instances, the meteor melts on its way down towards the surface. The larger the meteor is, the brighter it appears in our nighttime sky. The intense heat melts almost all the meteors before they get close to the ground, and that is why a shooting star disappears from our view after a brief time. But if a meteor is heavier that one kilogram (about 2.2 pounds), there is a good chance that it will survive all the way to the ground. The meteor is now called a meteorite.

Q. What is in the Solar System?

A. The Solar System refers to our system of one star (the Sun), nine planets, over 100 moons, over 5,000 asteroids, millions of comets, and uncounted bits of dust and rock (meteoroids). Astronomers have found other stars with planets, but our system of one star and nine planets is known as the Solar System.

Q. Where do the stars move?

A. The Earth spins towards the east, so the Sun appears to rise in the east and set in the west. In fact, nearly everything that we can see also rises in the east and sets in the west. Only the stars near the North Star, Polaris, travel in a circle. These northern stars never rise or set.

Q. What are constellations and who made them?

A. Constellations are imaginary pictures made up of stars visible from the Earth. All peoples on Earth devised these star pictures, which were invented to honor heroes (Hercules, Perseus, Andromeda); royalty (King Cepheus, Queen Cassiopeia; animals (Ursa Major and Minor, Leo, Scorpius, Canis Major) among others. Go out on a clear night, and make up your own constellations and stories for each.

Q. Do the stars we see in the sky belong to the Milky Way galaxy?

A. Every star we see in the night sky belongs to the Milky Way, a collection of over 200 billion stars. While every star we see is a member of the Milky Way, there are many, many stars that we cannot see that also belong to the Milky Way galaxy.

Q. What are the planets?

A. Once thought to be gods, the planets (from the Ancient Greek word for “wanderer”) are worlds made of either solid matter (terrestrial or Earth-like) or Gas Giants (consisting of hydrogen, helium and other gases) Terrestrial planets include Mercury, Venus, Earth and Mars; while the gas giants include Jupiter, Saturn, Uranus and Neptune. Pluto has been reclassified, put into a new category of objects called “dwarf planets.” Dwarf planets are smaller, spherical objects that orbit the Sun.

Q. How do you tell planets from stars?

A. You can tell a planet from a star by watching the object and its location among the stars every clear night. Stars will remain in a relatively fixed place, rising in the east and setting in the west, while a planet will move among the stationary stars over the passing of days and weeks. The further the planet is from the Sun, the slower it will move in the sky.

Q: Where did the planets’ names come from?

A: Thousands of year ago, humans did not know what to think of the wandering lights that appeared among the stars. Superstition led our ancestors in places like Babylonia (ancient Iraq) to think the wandering lights were gods, and knowing where they appeared in the sky would help predict the future. This is how the practice of astrology began.

Q: Have humans traveled to another planet?

A. No one from our planet has traveled to another planet in our Solar System. The farthest anyone has traveled is to our closest neighbor, the Moon. Starting in 1969 through 1972, 27 American astronauts in have traveled to the Moon, with 12 astronauts landing on the surface. Plans announced by NASA have planned new manned missions to the Moon, and then on the Red Planet – Mars

Post-visit Activities

Activity 1

Colorful Stars

Stars are not just the white dots we see in the sky at night. Each star has a color, which tells us how hot the star is on its surface. Blue stars have a surface temperature about 40,000 degrees F, Yellow stars are about 10,000 degrees F, and red stars have a temperature around 3,000 degrees F. You can demonstrate temperature and color changes by lighting a candle. What is the flame's color by the wick? What is the color at the top of the flame?

Using the attached worksheet, color the stars in these two constellations following the chart.

Activity 2

Comparing the Sizes of Stars

From The New Detroit Science Center

From our view on the Earth, the stars we see in the night sky seem to be the same size, while at the same time we recognize the fact that some stars are brighter than others. In this activity, your students will compare some well-known bright stars in the sky for their size. This will be give your students a chance to compare stars up close, and to try to use reason to explain why some stars are brighter than others. The activity will conclude with you demonstrating the concept of near and far stars. The stars are not all the same distance from the earth. With a flashlight and your students at their desks, your students will experience the difference between near and far stars in our night sky.

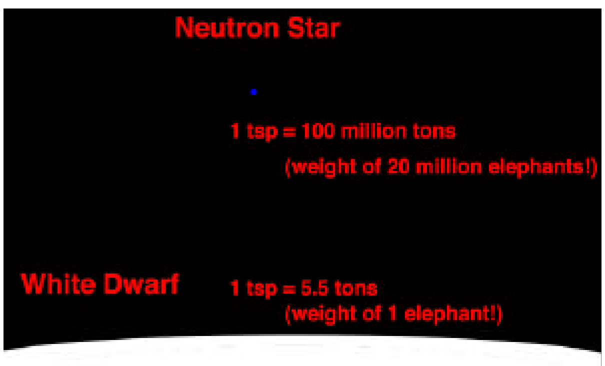
Most people do not realize that stars, just like humans, come in many different sizes. Study the following list to see just how large the difference can be. For the sake of this activity, assume that one solar diameter is 12 inches or 1 foot in size.

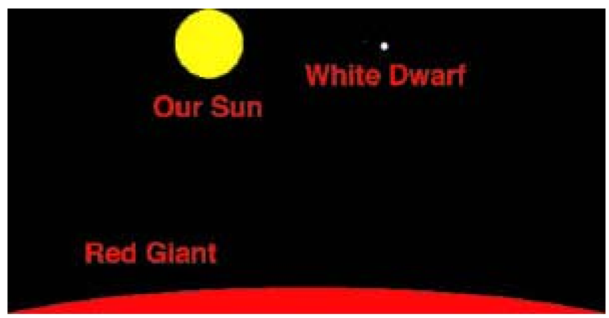
Star	Real Size	Model Size
Sun or Sol	1 Solar Diameter	1 foot
Rigel	50 Solar Diameters	50 feet
Betelgeuse	550 Solar Diameters	550 feet
Aldebaran	36 Solar Diameters	36 feet
Castor A	2 Solar Diameters	2 feet
Jupiter – Largest Planet	0.1 Solar Diameters	1.2 inches
White Dwarf	0.01 Solar Diameters	0.12 inches
Neutron Star	0.00001 Solar Diameters	0.00012 inches

Star size is measured by comparing it to our star, the Sun. The Sun has a size of 1 solar diameter. A star twice that big would have a size of 2 solar diameters. Because of the size of some stars, make your model flat instead of 3 dimensions. Paper is the best material to use.

Assemble a team of students to build each of the star models from the Sun to the white dwarf, but exclude the neutron star and Betelgeuse, since these two are too small and too large respectively, to build easily. Please be available to assist any of your teams if they have a question. For the largest stars, use butcher's paper, and use masking tape and apply it to the back of the paper to make a large enough piece for your model. A string cut to the length of the diameter of each star will help each of your teams build their star model. Using watercolors to paint and permit your students to give the proper color to their star.
For the largest star Betelgeuse, you will find it so large that you cannot make a model. You can describe how large it would be by comparing it to something familiar, such as a room or gym that is very large in your school. Use the length of the large room and divide it into the width of Betelgeuse. Your students will have an idea how many of the particular room you would need to equal the size of Betelgeuse.

To display your star models, request a location during the science fair next to a wall. Hang Rigel on the wall first, and then glue the other stars onto it. One idea is to place them all in the center, like the rings of a target. On a table in front of the other stars, have a second model of the Sun with another Jupiter on top of the Sun, also in the center.





<u>Activity 3</u>
How Big is the Sun?
Adapted from Project FIRST: Eye on the Sky (www.eyeonthesky.org)

Students may or may not know that the Sun is larger than the Earth, and the Earth is larger than the Moon. Let's see how big they are.

Materials:

- ½" inch circle stickers, from an office supply store. You'll need 109 stickers.
- Yellow bulletin board paper (to make the Sun). You'll need to make a circle 54.5" in diameter in step 3.
- String (at least 30" long) with a pencil tied to the end to make a large compass to draw a circle.
- 4 small pins with round heads to fit across one ½" label – will represent the Moon.

Procedure:

1. Ask students how big the Sun is if the Earth were the size of a marble, or a sticker only ½" wide.
2. 109 Earths can fit across the diameter of the Sun. On a large sheet of yellow bulletin board paper, have students place the round label stickers along a straight line. If you have multiple colors of stickers, place them in groups of ten, so you'll have ten yellow, then ten pink, then ten blue, etc. until you have 109. (Reinforces math skills and just makes it easier to count the stickers.)

3. Find the center of the line. Using a pencil attached to a length of string, hold the pencil at one end of the stickers and stretch the string to the center mark of your sticker line. Have one person hold the string firmly in place at the center point. Another person or teacher holds the pencil and draws a circle on the bulletin board paper showing the whole circle of the Sun.
4. Using ½" stickers, you'll have a Sun with a diameter of 54.5" or 4.5 feet across. Is this bigger or smaller than the students expected?
5. Explain that it takes nearly four Moons to cover the diameter of the Earth.
6. Tell students that one small pin represents the Moon. Ask how many pins are needed to span the diameter of Earth.
7. Place four small pins with round white heads across one blue label.
8. Students can make signs to post next to their new Sun to reinforce the comparative sizes. (Page 9 of this guide.)

Extension Activity:
This model of comparative sizes provides a good opportunity for discussing and practicing the mathematical concepts and symbols representing "greater than," "less than," and "equal to." The student work sheets for this lesson (page 10 of this guide) support classroom mathematics activities.

Assessment:
A whole-class discussion of the Sun and its size relative to the Earth and Moon can be started with the following discussion questions:

1. What is bigger, the Earth or the Sun?
2. How many "Earths" does it take to cover the diameter of the Sun?
3. What is bigger, the Earth or the Moon?
4. How many Moons does it take to cover the diameter of the Earth?
5. How many Moons do you think it will take to cover the Sun?

Teacher's Information Page on Star Colors

What do they mean to us?

From The New Detroit Science Center.

Have you noticed that some stars look red, while most look whitish or bluish? If you haven't, go out one clear winter night and look at the constellation Orion. Betelgeuse is the bright **red** star at the top left corner, and Rigel is the bright **blue** star at the bottom right corner. You may want to use binoculars to see the colors more clearly. The explanation for the colors of the stars is the same as why a stove burner turns red when you turn it on to the high position, or why the flame of a propane torch is **blue** in the center and red on the outside: the blue part of the flame is hotter than the **red** part. The stove burner turns **red** when you increase its temperature; if you could keep heating it, it would turn **blue**.

The temperature of the star determines its color. Blue stars are hotter than red stars.

In 1893, the German physicist Wilhelm Wien described the mathematical relationship between color and temperature. Color is associated with the wavelength of electromagnetic radiation, or light. Our eyes see the rainbow colors from blue to red. There are a lot more bands of light that our eyes can't see, like Xrays, ultraviolet, infrared, and radio waves. Wien discovered that the peak wavelength of radiation emitted by a body increases if the temperature decreases, and the peak wavelength decreases if the temperature increases. All bodies have a certain temperature associated with them. The temperature of the human body, about 97°F, emits light in the infrared. That's why policemen use infrared detectors to look for moving bodies in the dark. The stove burner looks like a dull black when it's not heated because it is emitting infrared light, which our eyes can't detect.

Astronomers take advantage of Wein's discovery to determine the temperature of stars. At their telescope they use an instrument called *photometer* to measure the colors of stars. A photometer consists of at least three filters, which allow only certain wavelengths of light to go through. Then they compare each neighboring wavelength band to determine which of the two is brighter and where the radiation peaks, and then they convert the color relationships to temperature.

Astronomers use another method to determine the temperature of the stars. Of course, different methods have to give the same result, so this is a way to check that the answers are correct. This second method uses the star's *spectrum*, which is the amount of light that the star gives off at every wavelength. Stars are mostly composed of hydrogen and helium, and traces of other chemical elements that absorb light. Different stars have different elements. The amount of light absorbed by the various elements, as seen in the spectrum, depends on the temperature of the star's outer layers. The coldest stars allow the formation of molecules, while the hottest stars strip the electrons off the atom to form ions.

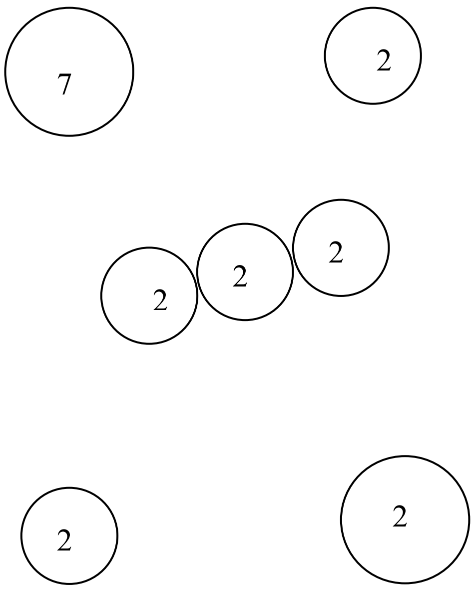
The temperature of a star is determined by the mass it had when it formed and by its "growth" stage. In general, the more massive a star is, the hottest its surface. Stars have temperatures between about 2600 degrees Kelvin and 50,000 K. Our Sun has a surface temperature of 5780 K, which corresponds to a peak wavelength of 500 nm, a green-blue color (we see it yellow because of the Earth's atmosphere). Some stars, called white dwarfs, are the end of their lives and can reach temperatures of 100,000 K.

Name: ____

Colorful Stars

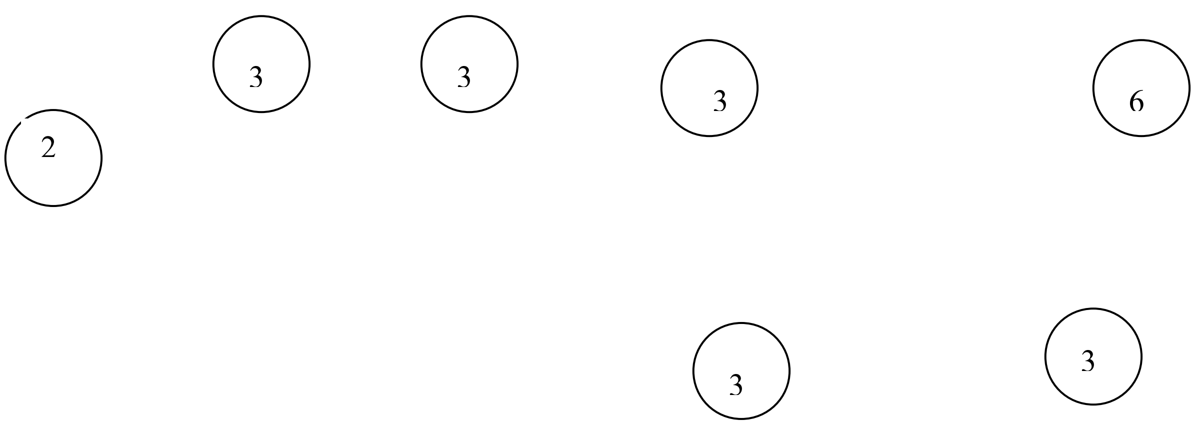
Stars are not just the white dots we see in the sky at night. Each star has a color, which tells us how hot the star is. Color the stars in these two constellations following the chart on the right.

Orion, the Hunter



<u>Hottest</u>
1 Blue
2 Blue-White
3 White
4 White-Yellow
5 Yellow
6 Orange
7 Red
<u>Coolest</u>

Ursa Major, the Big Bear (also called the Big Dipper)



Use these labels for Activity #3: How Big is the Sun?

The Sun > The Earth

The Earth > The Moon

The Sun > The Moon

The Moon < The Earth

The Earth < The Sun

The Moon < The Sun

109 Earths = The Sun

4 Moons = The Earth

Name ________________________________ Date ______________________

Read each sentence.
Put **>** **<** or **=** in the blank to make the sentence true.

1. The Sun’s size ______ the Earth's size.

2. 109 Earths ______ the Sun’s diameter.

3. The Moon’s size ______ the Earth’s size.

4. 4 Moons ______ the Earth’s diameter.

5. The Sun’s size ______ the Moon’s size.

6. The Earth’s size ______ the Sun's size.

7. The Moon’s size ______ the Sun’s size.

8. The Sun’s diameter ______ 109 Earths.

9. The Earth’s size ______ the Moon’s size.