Starry Faces in Faraway Places
Grade level: 2-3

NJCCCS: 5.1, 5.2, 5.3

Field Trip Overview

Upon arrival students are introduced to their topic of study through music, the familiar lullaby *Twinkle, Twinkle, Little Star*, and reminded that before the advent of modern astronomy, people had very little understanding of the vast universe surrounding our tiny planet. Through several demonstrations employing student manipulatives, a review of the unique qualities of stars and what differentiates them from planets follows. The morning ends with a consideration of the changing position of the sun in the sky and how this observable change creates the basis for our system of timekeeping.

The afternoon begins with a Native American creation story, *How Grizzly Bear Climbed the Mountain.* Describing the origin of the Big Dipper and the Milky Way, the story serves as an introduction to constellations. Beyond simply enabling students to recognize familiar constellations, the afternoon session, by way of a kinesthetic recreation of the Earth's revolution around the sun, makes it clear why most constellations are only visible during certain times of the year. The program culminates with the students making their own simple "constellation finder", a device similar to a Planisphere that assists them in locating common constellations throughout the year.

Background Information

It is sensible when discussing stars to compare and contrast them with planets since the differences and similarities between these objects help us to better define them both. First to the similarities. Stars and planets both have gravity and the end result of this gravity is that both objects are spherical. In addition, both contain matter which rotates around a central axis. While many videos of the Sun rotating have been captured (see *References* for a link to some) evidence of this phenomena with stars is cannot be observed directly. On the other hand, evidence of Earth's rotation is all around us, the most obvious of course being the Sun's daily apparent trek across the sky.

Having brought up the subject of matter, it is time to address some differences between planets and stars. While it's true that the same basic elements found in stars exist in planets, the *state* this matter is in is quite different. Stars are sometimes referred to as *dynamic balls of hot gas* and this is a fitting description since they're composed of superheated gas known as plasma. The energy necessary for the elements within a star to be

converted to the plasma state is generated in the star's core where nuclear fusion occurs. Since similar conditions are rare on planets, plasma is seldom seen on them. Natural occurrences of plasma on Earth are largely restricted to lightning and the Aurora Borealis or Northern Lights. The inner, terrestrial planets like Earth, are dominated by solid matter while the outer planets, the so-called gas giants like Jupiter, are made mostly of gasses.

Aside from their composition stars and planets differ in how they appear from Earth. One can often distinguish them in the night sky, for example, by their brightness. An object's brightness as it appears to us is known as *apparent magnitude* and is a factor of that object's intrinsic brightness, its so-called *absolute magnitude*, as well as its distance from us. The brightest planets, Venus and Jupiter, both have apparent magnitudes greater than any star (other than the Sun of course) and as a result appear noticeably more brilliant than most stars.

Another difference between these objects that most stargazers notice quite readily is that many stars twinkle, that is, their brightness seems to be constantly fluctuating. On the other hand, planets remain consistently bright; they don't twinkle. Because stars are so much farther away (the closest after the Sun, Proxima Centauri, is 8 million times farther than Neptune, the most distant planet in our solar system) they appear to us as mere points of light. Some of this light inevitably gets "disturbed" by Earth's atmosphere, creating the illusion of twinkling. Planets, on the other hand, are not single points of light but essentially small discs reflecting multiple points of light. If a few of these points of light are affected by Earth's atmosphere, enough light still reaches our eyes to make any change in brightness undetectable.

Vocabulary:

Rotation – the movement of an object around an internal axis or axis within the object; the Earth's rotation results in what we experience as day and night

Revolution – the movement of one object around another; the Earth's revolution around the Sun is partly responsible for our seasons as well as the fact that most constellations are only visible at certain times of the year

Constellation – a group of stars in apparent proximity to one another imagined by one or more ancient cultures to represent mythical characters

Star – a spherical object made of superheated gas held in place by the opposing forces of gravity and outward pressure generated by these gasses emanating from the star's core

References/Resources:

Background information on stars:
"Stars." *NASA's Imagine the Universe*. NASA Goddard Space Flight Center, n.d. Web. 10 Dec. 2012. <http://imagine.gsfc.nasa.gov/docs/science/know_l2/stars.html>.

What is plasma?
http://science.nasa.gov/science-news/science-at-nasa/1999/ast07sep99_1/
http://www3.gettysburg.edu/~marschal/physics/plasma/index.htm

Why do stars twinkle?
http://curious.astro.cornell.edu/question.php?number=114

Videos of Sun's rotation:
http://sohowww.nascom.nasa.gov/bestofsoho/Movies/movies2.html

Starry Faces in Faraway Places

Pre-Trip Activities

Where do we *Star*t?

Students discover what a star is and isn't

Duration: 30-40 minutes

Objectives

Students will be able to…

Name several objects that are visible at certain times in the night sky
Define a star
Describe what makes stars different from other celestial objects

Materials

Our Stars by Anne Rockwell
Close-up images of celestial objects listed in the Introduction below, printed or digital
Celestial objects composite image
Crayons, colored pencils, or marker
My Celestial Objects Factsheet

Vocabulary

Celestial, comet. constellation, crater, horizon, ice, meteor, moon, orbit, planet, satellite, solar system, star, telescope, twinkle, Venus

Procedure:

1. **Introduction**
   Show the class the composite picture provided illustrating the following celestial objects: comet, constellation, meteor, moon, planet, star. Ask the students "*How many different objects do you see in this picture of the night sky*?" Discuss the following factors which make some of the objects easier to see than others:
   - Size: larger objects are easier to find than smaller ones
   - Brightness: brighter objects are easier to find than dimmer ones
   - Viewing duration: the longer an object is visible in the night sky the better chance we have of seeing it

2. Activity

a. Introduce the *Our Stars* book to the class.
b. Write the following vocabulary words on the board and review them with the class: astronaut, comet, constellation, ice, orbit, planet, meteor, moon, pictures, star, tail, twinkle. *"Some of these words are new to you but by the end of the story we will all be able to define all of them."*

   Note: The text on page 1 reads "When night comes, I can see billions of stars twinkling in the dark sky." You may choose to clarify for the students that although there are billions of stars in the Milky Way galaxy, they are not all visible. At any given time at a particular location on Earth hundreds to several thousand stars are visible to the naked eye.

c. After reading *Our Stars,* distribute the *My Celestial Objects Factsheet* to each student. Instruct the students to select the correct vocabulary words from the board to complete the factsheet. Provide students with appropriate images and craft supplies needed to complete drawings of each celestial object.
d. Review the factsheet. Have students share their drawings and read from their factsheets.
e. Display the numbered composite image provided and have the students identify each object.
f. Review the characteristics which differentiate celestial objects discussed during the introduction of the lesson.

Celestial Object	Characteristics		
	Size	Brightness	Viewing information
Comet	The closest ones appear larger and brighter than all planets and stars		Visible for several hours at a time; movement only noticeable through close observation over the course of many nights; have predictable orbits like planets
Constellation	Largest objects in the night sky made of dozens of stars	see stars	Most are seasonal; others, the circumpolar constellations like the Big and Little Dipper, are visible all year
Meteor	Equivalent to stars; the streak they create may be many times longer than the diameter of the object itself	Equivalent to stars of medium to high brightness	Appear as a brief streak of light across the sky; can be sporadic or part of seasonal showers
Moon	Appears as the largest and brightest object in the night sky		As the moon moves from its full phase toward new it rises with the sun and becomes visible during the day; as it moves from new to full it appears at night
Planet	Jupiter and Venus appear larger and brighter than all stars; others planets appear smaller and dimmer than bright stars; Neptune is invisible to the naked eye		Visible for weeks at a time seasonally, at night or at dusk or dawn
Star	Appear smaller and dimmer than Venus and Jupiter, some brighter than other planets		As with constellations, most appear seasonally, those part of circumpolar constellations, all year

References and Resources

Images:

Celestial object composite: Starry Night Pro Plus 6 program

Comet (Hale-Bopp)
http://apod.nasa.gov/apod/ap970416.html

Meteor (Leonid meteor shower)
http://static5.businessinsider.com/image/50a17c82ecad04cc73000001-960/leonid-meteor-shower.jpg

Planet (Jupiter)
http://www.warren-wilson.edu/~physics/PhysPhotOfWeek/2012PPOW/20121116JuptrInTaurus/index.html

For a free interactive sky chart showing when various celestial objects are visible register with Sky and Telescope:
http://www.skyandtelescope.com/observing/skychart/

Factsheet answers:
Star – sun, gas, twinkle
Comet – ice, tail
Constellation - pictures
Planet – twinkle, orbit
Meteor – shooting stars
Moon - astronauts

Celestial objects composite picture answers
1. Meteor (from leonid meteor shower)
2. Moon (waning crescent)
3. Star (Zubeneschamali of Libra)
4. Constellation (Libra, the scales)
5. Planet (Jupiter)
6. Comet (Hale-Bopp)

Starry Faces in Faraway Places

Pre-Trip Activities

Star Myth Story Time

Students hear a Native American story about how stars were created.

Duration
Introduction: 20 minutes
Activity: 30 minutes

Objectives
Students will be able to…
Define a myth as a fictional story that may contain an element of truth or describe the origin of a natural phenomena

Materials
Copy of the story *How the Stars Came to Be* (see link in Reference and Resources section below)

Vocabulary
fiction, non-fiction, myth

Preparation
Print the attached *Fact or Fiction* cards on cardstock and cut them out.

Procedure:

1. **Introduction**
    a. Distribute the *Fact or Fiction* cards to students, one for each pair.
    b. Have the students discuss their statements and decide with their partners whether they are true or false.
    c. Come up with a definition for the words fact and fiction.
    d. Introduce the term myth and discuss its relation to the word fiction
    e. Discuss how myths ("false facts") come to be and how they are disproven.

2. **Activity**
    a. Read the story *How the Stars Came to Be.*
    b. Distinguish elements of the story that are factual from those that are fictional. Draw a "T" chart on the board and make a list of these different elements.

c. Confirm that the students recognize that this story describes the origin of the day/night pattern we experience as well as stars.
d. Discuss the message of the story. Explain that some myths have a message while others don't

References and Resources:

How the Stars Came to Be story

http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/las_vegas_field_office/red_rock/environmental_ed_apps/teacher_resources.Par.26988.File.dat/How%20it%20Came%20to%20Be.pdf

Fact or Fiction

Cats have nine lives.	Owls can turn their heads in a full circle.
Touching a toad can give you warts.	Camels store water in their humps.
Ostriches bury their heads in the sand when they're frightened.	If the groundhog sees its shadow, expect six more weeks of winter. If he doesn't, expect an early spring.
Elephants are afraid of mice.	Beavers pack mud between the sticks in their lodges using their tails.
Bats are blind.	If you swallow gum it will stay in your stomach forever.
Talking to plants helps them grow.	Cutting hair makes it grow faster.
Some snakes can see heat similar to a person wearing night vision goggles.	The Earth spins on its axis at a speed of 1,000 miles per hour.
Porcupines can shoot their quills.	A turtle can crawl out of its shell.

False Cats may be able to survive falls and mishaps better than other animals but they can't be reincarnated!	**False** They can turn their heads nearly in a full circle, ¾ of the way around, but not quite all the way.
False A toad's "warts" are actually glands that contain poison and can protect the animal from getting eaten, not contagious skin infections like real warts.	**False** A camel's hump stores fat, not water. This allows the animal to go several days without eating but it still needs regular drinking water.
False Watching from a distance an ostrich's head may disappear in its nest when it tends to the eggs but the bird is not plunging its head into the ground.	**False** Winter *always* comes around March 21, about 6 weeks after February 2, Groundhog Day, no matter if the Groundhog sees his shadow or not!
True Though not likely to cause a stampede, mice have been known to cause elephants to stop walking and move backwards.	**False** They use their front feet for this though they do use their tails to swim and for slapping the surface of the water body they occupy to signal danger.
False Though bats often rely on echolocation to find their way around in darkness they do have functional eyes and many types can see quite well.	**False** If gum is swallowed it will simply pass through your digestive system undigested.
True There is some evidence that since plant growth is affected by movement and other changes in their surroundings, their growth can also be affected by vibrations in the air caused by talking!	**False** Hair grows at the same rate regardless of whether or not it has been recently cut.
True Pit vipers, like rattlesnakes, have special organs that are able to detect the heat of their prey, warm-blooded animals.	**True** The Earth, which is approximately 24,000 miles around (in circumference), takes 24 hours to rotate once. Therefore, simple division allows us to calculate its rotational speed to be approximately 1000 per hour!
False The quills can be easily dislodged from the porcupine's skin but they cannot be forcibly ejected.	**False** The shell is part of the turtle when it hatches from the egg and grows with the rest of the turtle. Their skin is permanently attached to their shells and cannot be detached.

Starry Faces in Faraway Places

Post-trip Activities

Create a Constellation

Students draw a constellation and compose a story to describe its origin.

Duration: 40 minutes

Objectives
Students will be able to…
Name several ancient cultures that created constellation myths
Explain why different cultures created unique characters from similar groups of stars

Materials
Copy of Philippine story *The Big Dipper in the Sky*
Images of a variety of constellations showing the diversity of objects they represent

Vocabulary
culture, myth

Preparation

Procedure:

1. **Introduction**
   Review key content from the *Starry Faces in Faraway Places* program:
   - Constellations are imaginary pictures made by people from ancient cultures.
   - The figures we are most familiar with are usually composed of the brightest stars but some constellations contain many more dim stars that are difficult to see.
   - Stories called myths were created by many cultures to explain how the constellations ended up in the sky.

2. **Activity**
   a. Show the students a picture of the Big Dipper and remind them of the story they heard during the *Starry Faces in Faraway* Places program, *How Grizzly Bear Climbed the Mountain*. Review the main events of the story.
   b. Read a second story that describes the origin of the Big Dipper from a culture other than a Native American one.

c. Lead a discussion on the similarities and differences between the stories. Organize the elements of the stories using a Venn Diagram like the one provided.
d. Have the students create their own constellation using their own original drawings or pictures of animals, instruments, mythical creatures, favorite foods, or just about anything. Provide images of a variety of constellations as inspiration!
e. After drawing or tracing a picture of their constellation, instruct the students to draw a dozen or so stars in key places of their constellations. If available use glow-in-the-dark paint to highlight the stars.
f. Have the students compose a creation story describing how their constellation came into existence and entered the night sky.

Assessment Opportunity:

- Traditional methods can be used to assess the students' overall effort and writing proficiency through composition of their constellation myths.

References and Resources:

Websites

StarrySkies.com:
Provides information on the Big Dipper and its constituent stars as well as myths from several cultures describing its origin. It also describes several other celestial objects found within the Ursa Major constellation.
http://starryskies.com/The_sky/constellations/ursa_major.html

Spacetelescope.org:
Good ground-based image of Big Dipper in addition to countless links to other images of various celestial objects and much, much more!
http://www.spacetelescope.org/images/opo0706b/

Seasite.niu.edu:
The website is part of Northern Illinois University's SEAsite Project providing information on the language and culture of the Philippines. The webpage below provides a link to a Philippine folktale describing the origin of the Big Dipper.
http://www.seasite.niu.edu/Tagalog/folktales/mythsintroduction.htm

Books

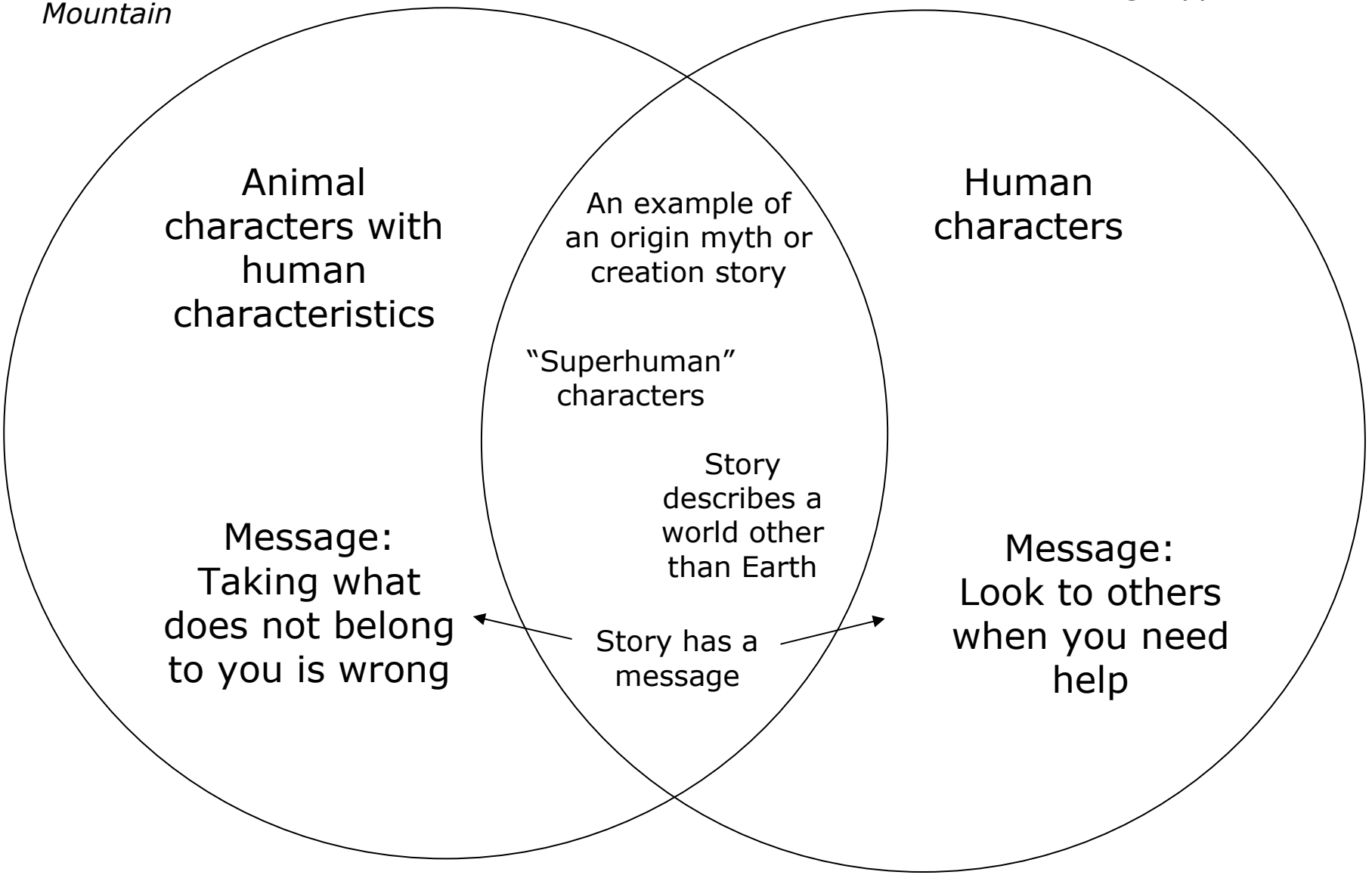
The Big Dipper:
Thorough treatment of the Big Dipper, its stars, myths, how to find it in the night sky, and some general information on making observations of the night sky.

Peters, Stephanie True. *The Big Dipper*. New York: PowerKids, 2003. Print.

Big Dipper Origin Myth Venn Diagram

Origin of the Big Dipper:
Native American Story
How Big Bear Climbed the Mountain

Origin of the Big Dipper:
Philippine folktale
The Big Dipper in the Sky



Starry Faces in Faraway Places

Post-Trip Activities

Bake Star Cookies

Use a solar oven to bake star-shaped cookies

Duration:
Preparation – 1 hour
Activity – 90 minutes

Objectives
Students will be able to…
Recall that stars are spherical objects
Recall that stars are different colors and that these colors correspond to a star's temperature

Materials
Pizza box solar oven
Picture of the sun (see link at end of lesson plan)
Collection of pictures of star-shaped objects
Cups 2-3" diameters at top, 1/pair of students
*2-3" Star-shaped cookie cutters, 1/pair of students
Bamboo skewers cut into 2-3" pieces, 1/group of 4-6 students
Small paper drinking cups, 1/student
4" x 4" squares cut from black construction paper
Small craft sticks, 1/student
Ribbon or string, 12" piece/student
Ingredients for gingerbread cookies:
3x5 index cards, 1/student

- 1 cup of white sugar
- 1 cup of molasses
- 3/4 cup of butter flavor shortening (or regular)
- 1/2 cup hot water
- 2 eggs
- 6 cups all purpose flour
- 1 tsp baking soda
- 1/2 tsp salt
- 1 1/4 tsp ground cinnamon
- 1 1/2 tsp ground ginger
- 1/4 tsp ground cloves
- 1/4 tsp ground allspice
- 1/2 tsp vanilla

Ingredients for royal icing

- 2 large egg whites
- 2 teaspoons fresh lemon juice
- 3 cups confectioners' sugar, sifted
- Food coloring

* can be substituted with cardboard star templates or plastic stencils that can be used to cut shapes in dough with plastic knives

- Pre-heat solar cooker
- Roll out dough to a 1/4 inch thickness on a floured surface.
- Cut into desired shapes
- Place cookies onto very, very lightly cooking sprayed dark sheet.
- Bake for about 15 minutes or until cookies are firm (no indentation should remain when cookie is pressed on lightly)
- Take finished cookies off tray within a minute to avoid sticking
- Ice with favorite icing

Vocabulary

Preparation

- Mix gingerbread dough and roll it in advance into ¼" pieces, 1/group of 2-4 students; separate pieces with lightly floured wax paper and place in refrigerator
- Mix icing (see steps at end of lesson plan)
- Build pizza box solar oven (follow link in References/Resources section below)

Procedure:

1. **Introduction**
   Display an image of sun and ask the students to compare this to the pictures we usually see of stars. *"How does this look different from stars we see in pictures?"* Show a collection of pictures of star-shaped objects and discuss the similarities between them and how they are different from the photograph of a real star.

2. **Activity**
   a. Review the key concepts introduced in the *Starry Faces in Faraway Places* program.

- Stars are objects in space made of gases which are hotter than any substance on Earth
- Stars are much larger than planets; as a comparison, the sun is over 100 times the diameter of Earth
- Stars are different sizes and different colors
- A star's color indicates its temperature. White stars and yellow stars like the sun are medium hot. Red stars are the least hot and blue stars are the hottest.
- Stars are spherical and do not have well-defined spikes, rays, or "arms" as is often depicted in cartoons, emblems, and other illustrations

b. Introduce today's activity. Explain that in addition to all this amazing information, it's important to know that the Sun is useful. *"How is the Sun useful to us? It gives us light and heat that allow us to survive. One way we use the heat is simply keeping warm but there's another way we can use the sun's heat. We can cook with it!"*
c. Display the pizza box solar cooker and explain how it works.
d. Distribute rolled gingerbread dough on wax paper to student pairs or small table groups
e. Demonstrate the procedure for cutting a star shape from the dough using your chosen method.
f. After shapes have been cut have the students place a 1/8" hole one 1/2" from the edge of the star using a skewer.
g. Have each student write his initials on a small square piece of black construction paper and place his cookie on it.
h. Collect the cookies and place them into the solar oven.
i. Place the oven outside in a sunny spot.
j. While students are waiting for their cookies to bake have them decide what color icing they will make. This will be the color of their star. Next, have them create a star card that will be displayed with their stars. This can provide basic information about the star as well as a short poem about it. (see samples at the end of the lesson plan)
k. When cookies are done bring them into the classroom and let them cool.
l. While students are waiting for cookies to cool they can decorate their star cards with crayons and star stickers.
m. During this time, make the royal icing. Distribute about 1 tablespoon of icing to each student and a drop of yellow, red, or blue food coloring (or none if making a white star) in the paper cups.
n. Instruct students to mix their food coloring and icing with a craft stick.

o. Distribute cookies and have students ice them.
p. Finished stars can be eaten or hung around the classroom.

Assessment Opportunity:

Consider the following questions:
How well were the students able to recall content from the *Starry Faces in Faraway Places* program during the review period?
Did they effectively incorporate some of this content into their poems?

References / Resources:

http://txu-solaracademy.need.org/Pizza%20Box%20Solar%20Oven.pdf
http://photojournal.jpl.nasa.gov/jpegMod/PIA03149_modest.jpg
http://www.wunderground.com/data/wximagenew/s/seflagamma/1295.jpg

To make gingerbread dough:

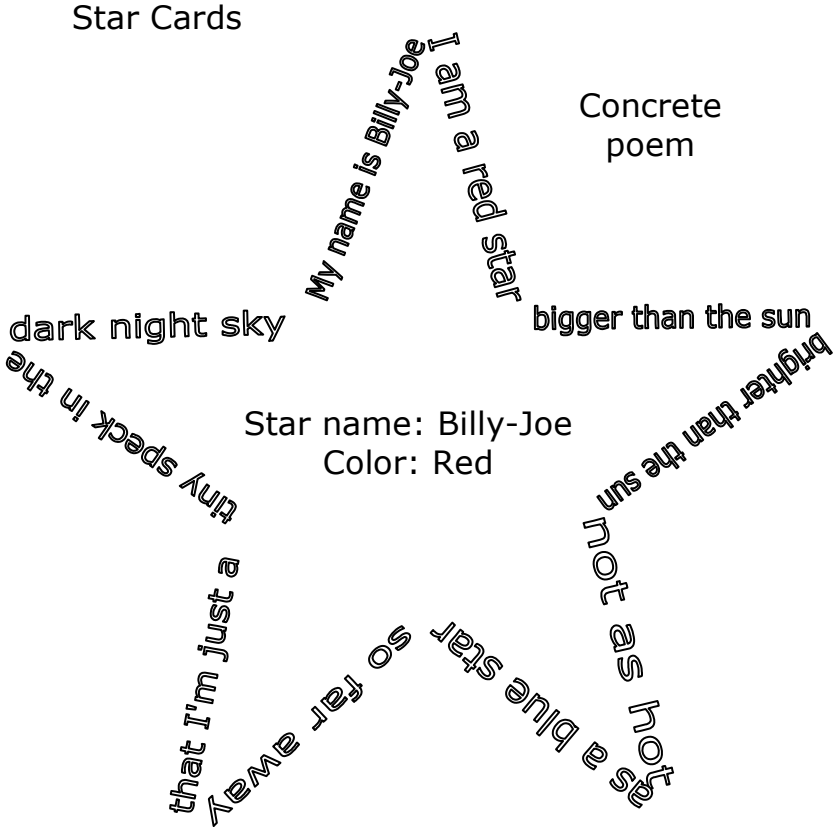
- In large bowl, mix together sugar, molasses, and shortening until smooth.
- Rinse molasses out of the measuring cup with hot water.
- Stir in eggs
- Combine flour and rest of dry ingredients
- Stir batter to form a soft dough.
- If too sticky add more flour if needed.
- Cover dough in bowl and refrigerate at least an hour.

To make royal icing:

- Sift 3 cups of powdered sugar into a bowl. Sifting is not absolutely necessary but will help keep your icing from getting lumpy.
- Separate 2 egg whites into a separate bowl.
- Combine the sugar, lemon juice, and egg whites and stir until shiny and opaque. This is most easily done in an electric mixer for around 5 minutes, but old-fashioned elbow grease will do in a pinch.

Star Cards

Concrete poem



Free verse poem

Star name: Billy-Joe
Color: Red

Billy Joe is my name
A red star, big and bright.
But not so hot as my blue friend, Russ.

Holiday decoration

Symbol of someone's celebrity status

Jewelry

Stickers

Emblem on efficient appliances

Symbol of a sporting event