Exploring the Night Sky: Summer

Program Purpose: The purpose of this program is to give students a better scientific and cultural understanding of the elements in the night sky.

Program Length: 1 hr

Program Age: 6th-12th

Maximum number of participants: 150 including adults (max. for lodge)

Objectives: After completing this activity students should be able to:

- Explain how moon phases occur
- Describe and explain at least two common misconceptions that people have about the moon
- Understand the importance and value of the moon
- Explain what a star is
- Explain 3 ways that the night sky has been used throughout history
- Recognize the stories and myths surrounding stars
- Be able to locate some of the constellations in the night sky

Preparation:
Before class arrives, set up computer and projector and gather materials.

Materials: Earth beach ball, moon on a stick, projector or strong flashlight to represent the sun, constellation myth cards, laser pointer, binoculars if desired, and telescope. Optional: paper and pencils for make-your-own-myth activity in bad weather.

Basic Outline:

I. Intro.
II. Moon Fact or Fancy show (15 min)
III. Lunar Cycle Activity (10 min)
IV. Sun and star facts (5 min.)
V. Constellation myths and slideshow (15 min.)
VI. Hand out star maps and go out to view stars / Create a myth if weather is bad (10 min.)
VII. Conclusion

Introduction
Pass out myth cards and instruct selected students to remember the name on the card, but not to read the backside yet. These students will read the myth when you get to their slide. You may want to have a flashlight handy to pass to those reading the cards if you have the lights very low in the lodge.

There are two slideshows for this presentation. Start with the Moon Power Point, then go to the Star Power Point.

***Moon**

The night sky has been sparking people's imaginations and curiosity for centuries. It still does the same thing to this day. Tonight, we will learn more about the objects that light up our night sky. We'll start with the largest, anyone have a guess what that could be?

Right--the moon. I'm going to give you a little quiz to see if you can sort the facts from the fancy. After I read each question, put your thumb up if you think its true, or point your thumb down if you think it's false.

"True or False: The moon has lots of holes in it and is therefore made of Swiss cheese. *(Slide 2-4)* I hope you guessed FALSE. Some cartoons may show the moon as cheese, but it is actually a solid ball of rock covered with many other rocks from the size of huge boulders to tiny pebbles. The surface is covered with a couple inches of dust that is very soft. The holes are actually millions of craters that were formed from meteors hitting the moon's surface a long time ago when the solar system was young. The moon also has huge mountains, valleys and hills, called highlands. There are also dark smooth areas called maria or seas. The first Apollo mission landed on the Mare Tranquilitatis (the Sea of Tranquility), they found out that these areas were not seas but ancient lava flows, but the name still stuck."

"True or False: The moon is about the same size as the Earth. *(Slide 5-6)* FALSE, the moon is much smaller. If we were to put the moon flat (2160 miles in diameter) on the Earth it would be about as wide as the United States.

"True or False: The moon is our closest planetary neighbor. *(Slide 7-8)* TRUE! It is about 230,000 miles away, which is very close when it comes to talking about distances in space. It took two days for the astronauts, traveling in the fastest rocket ever built, to reach the

moon. If we were to take a regular airplane (747) to the moon going 400 miles per hour it would take us 26 days to get there."

"True or False: The moon has 1/6th the gravity of earth. *(Slide 9-10)* TRUE. Have you ever seen footage of astronauts bouncing along the moon's surface? If you threw a baseball while you were on the moon it would travel 6 times farther than you would throw it on Earth. Imagine the size that the baseball field would have to be!" With this low gravitational force the moon doesn't have an atmosphere. There isn't any wind or precipitation to blow or wash away the marks left by the astronauts, footprints, and they will still be there ~10 million years from now.

"True or False: The moon is <u>always</u> very cold. *(Slide 11-12)* FALSE. Since the moon has no atmosphere like we do on Earth to protect it from the powerful rays of the sun, it gets very hot when the sun is shining on it (hotter than boiling, 260 degrees Fahrenheit) and in the shadows of the moon it gets very cold, -280 degrees Fahrenheit."

"True or False: The moon has a dark side. *(Slide 13-16)* FALSE, the moon rotates just like the Earth, which allows all the sides of the moon to get sunlight. It really should be called the "far side" of the moon, not the dark side!

"How did everyone do so far? Anyone get all of them correct? There is a lot more to learn about the moon than one might think!"

Lunar Cycles

Now if any of you were confused with the far side of the moon true and false, our next demonstration will help clear it up.

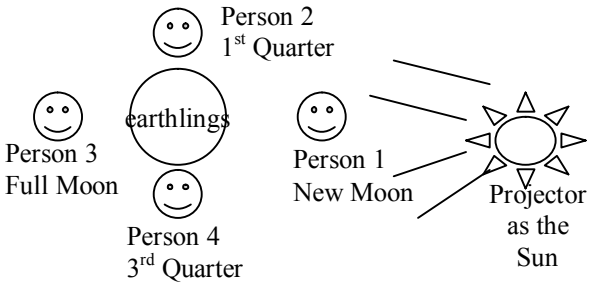
Ask the kids to raise their hand if they think the Earth revolves around the sun. "Yes it does! Does anyone know if the earth revolves around the moon or does the moon revolve around the earth? The moon revolves around the earth! Let's demonstrate this."

Have the projector set up on one side of the room. Ask, "What does this represent? The Sun!" Have a volunteer take the Earth beach ball. What direction does the Earth rotate? Counter-clockwise! And how long does it take for the Earth to rotate on its axis? 24 hours! We know the Earth orbits the sun, in what direction? Counter-clockwise! And how long does this take? 365 days.

Now, while this is happening we also have the moon. Have a volunteer come be the moon. Does the moon rotate on its axis? If so, in what direction? Yes, counter-clockwise. How long does this take? 28 days. We know the moon orbits the earth, in what direction? Counter-clockwise. Ask them how long this takes? About 28 days! If it takes the moon 28 days to orbit the earth and 28 days to rotate on its axis, this causes the same side of the moon to always face the earth. Demonstrate this a couple times. Have them notice that one side always faces the earth (face) and that all side of the moon receive sunlight at some point, so there is no "dark side" of the moon just a "far side".

What causes the different shapes of the moon that we see? We see the moon because sunlight is reflecting off of it. Add to this the moon orbiting the earth. Can someone describe the different shapes they have seen? So let's see what causes these different phases of the moon to happen."

Have the kids all scoot together sitting on the floor in tight blob. (Then turn off the lights and have the projector or someone holding a bright flashlight standing to one side of the crowd.) Ask if anyone can guess what this is representing. The SUN! "Now all of you together in the blob represent the earth and its earthlings." Next have four people stand around the earthlings (one directly in front the sun and place the other three like below).



Explain that as the moon revolves around the earth, the sun lights different parts of its surface. For example, give the "moon" to person #1. Have them hold it above their head and ask the "earthlings" how much of the surface that they can see is lit up? Their answer should be that they can see none of it. This is what we call a **new moon** when none of the surface is visible or it just looks black. This is because it is between the earth and the sun. As it revolves we see more of the moon. This is called a **waxing moon** because we see more and more of the moon.

Pass the moon to person #2 have them hold it above their head and ask the earthlings how much of the moon's surface they can see. They should only see half. Explain that this is called the **first quarter** (also called a half-moon) because the moon has completed one-quarter of its orbit around the earth. As it revolves we will see more and more of the moon until…..

Pass the moon to person # 3 and ask the earthlings what they see? They should see all of the surface, which is

called a **full moon**. There are 12 calendar months, but 13 lunar months. When there are two full moons in one month, the second one is called a "Blue moon".

Now as it continues to revolve we see a smaller part of the moon. This is called a **waning moon** because we see less and less of the moons surface.

Pass the moon to person #4 and ask the earthlings what they see? They should see half of the moon again. Explain that is called the **third quarter**, it has made it three quarters around the moon. Then you will see less and less of the moon until you see a new moon again.

"Now we know that we see other shapes of the moon besides just half of it, none of it, or all of it. Where could we place someone to make a **crescent moon**? (place someone between person #1 & #2 or between #1 & #4). Now the other term that is opposite of crescent is **gibbous** (a shape that is convex – bulges out). Where can we place them to make that shape?" (between person #2&#3 or #3&#4).

Review with them the different terms and go through the cycle again using the terms: new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, waning crescent. Use Slide 17 to help out with this!

Explain that one of the most common misconceptions about the moon is that we see the shadows of the Earth cast upon the moon. This is NOT True! What we are seeing is how the light hits the moon. For example, when there is a full moon, it is completely lit with light - with the myth we should be seeing a shadow on the moon. Can demonstrate this with the projector, moon ball, etc. if you want.

Lunar Eclipses

"Now sometimes in the sky, the moon can disappear completely right before your eyes. Does anyone know what special event I am talking about? A Lunar Eclipse! This is a special time when the moon, earth, and sun line up just exactly right so that this is the one time that the Earth DOES cast a shadow on the moon."

Optional: For older students you can explain the reason why this doesn't happen all the time, because the moon's orbit is tilted 5 degrees off the earth's orbit around the sun. This means that the moon spends most of the time either above or below the plane of the earth's orbit. During full moons the moon usually passes above or below the earth's shadows and misses them entirely and no eclipse takes place. But two to four times each year, the moon passes through some portion of the earth's shadows and a type of eclipse occurs.

"Using the materials here (projectors, earth ball, moon ball) does anyone think they can create this event right here in the room?" Assist them in getting volunteers or anything else they need. Somehow they should have the projector shining at the Earth beach ball so that it creates a shadow on the moon.

Moon Importance – *(Slide 17-19)*
"We are used to seeing the moon in the night sky very often and we don't give much thought at to it being there, but why should we care about it or appreciate it?

- Songs, art, stories, folklore, proverbs.
- Gives light
- Used as a measurement of time – The sun was used for short measurements and the moon for longer time periods. Moon and month come from the same root word.
- Research: NASA had 22 missions to the moon (1964-1972), 6 successful human landings
- Words – Moon oriented, Honeymoon, Lunatic, Moon madness, Moon flower, Mooning

If the moon didn't exist our world would be quite different!

- Earth would spin much faster because the interactive force between the moon and the earth slow us down. This fast spin would cause strong winds and storms.
- No solar or lunar eclipses.
- Might get hit by asteroids more often because the moon probably takes some that would otherwise hit us.
- Would have been no "moon race" in the 1960's, which is pretty important in modern day culture.

Optional Activity:
Show the picture of the moon and ask, "What do you see in the moon?"

***Stars**

"Now that we've explored the moon, the closest object in the night sky, let's move further out into the great big universe and investigate the stars."

Sun/stars *(Slide 1-2)*
First of all, what exactly are stars?

- Stars are burning balls of gas made mostly of hydrogen, helium, and dust.

What is our closest star? The sun.

- 93 billion miles away from earth and its light takes 8 minutes to reach us.
- For an idea of size: if the sun were the size of your head, the earth would be the size of your pupil!

- Our sun is about 4.5 billion yrs old-we think it will live another 5.5 billion yrs.
- The Sun's center is an incredible 15 million degrees Celsius. A pinhead that hot, 90 miles away, would kill you.
- The sun is a yellow star, which is about medium in heat. What color stars are hotter? Blue/white What are cooler? Orange/red

Optional:Did you know that stars have lives?

- *Stars are born when heavy clouds of dust and hydrogen gases are squished into a big ball by gravity and begin to spin.*
- *The ball is now a star and it uses its gases as fuel to give off heat and light. Eventually, the star runs out of gases and it will begin to shrink and die. Smaller stars just burn out, but larger ones can become black holes, which suck up everything near them, even light.*
- *The bigger the star, the shorter its life. The sun is a medium-sized star.*

How many stars are there? *(Slide 3-4)*
Imagine you are on a beach with a shovel and wheelbarrow. You shovel and shovel sand until the pile is taller than you. You reach up and pick one grain off of the top. That teensy weensy grain is all of the stars that we can see with our naked eye. The rest are all the stars in the sky and the universe that we can't see! Scientists think that just in our galaxy—the Milky Way—there are at least 200 billion stars. That's a lot of stars to keep track of.

Constellations
To help us make sense of the night sky, humans have divided the stars into 88 constellations, and cultures around the world have created myths and stories about them. What kinds of things could these constellations be used for?

- Navigation-especially sailors
- Telling time-the night sky changes from season to season, and ancient people used this to tell when it was time to plant crops or to store up food for the winter.
- For entertainment-creating myths and telling them is fun! In the past they didn't have video games and TV to amuse themselves with.

All right, let's take a look at some of these constellations.

At slide with Big Dipper *(Slide 5)*
This first pattern of stars is a fairly common one. Does anyone know it? Big Dipper. The Big Dipper is a circumpolar constellation (one that you can see all year long).

Star Distance *(Slide 6)*
Take a look at the three stars in the handle of the BD. Do they look far apart or close together? Actually, they are light years apart. A light year is the distance that light can travel in a year, about 6 billion miles! The left most star is 81 light years from Earth, the middle star is 78 light years away, and the right most star is 100 light years away. That's a big difference, but stars are so far away that they appear to line up and look closer to each other than they actually are. The stars in the Big Dipper's handle are actually closer to each other than the stars in most constellations.

Polaris the North Star *(Slide7-8)*
If you follow the pointer stars in the Big Dipper, they will lead you to Polaris, the North star. This star has been used for navigation for centuries. It is part of the handle of the little dipper, which has also been called the drinking gourd. There was a song telling slaves to follow the drinking gourd (North) to freedom.

Asterism *(Slide 9)*
The Big Dipper isn't actually a constellation: it's an asterism. An asterism is a pattern of stars within a constellation-in this case the Big Dipper is a part of Ursa major.

Cassiopia *(Slide 10-13)*
You can read the Perseus/Andromeda Love Story for these slides.

A good way to find this next constellation is to draw a straight line from the pointer stars in the BD, and keep going left past the North Star until you hit the middle of the W constellation.

Cygnus or Northern Cross *(Slide14-17)*
If you draw a vertical line through the W of Cassiopia and follow it South, you will hit Deneb- the tip of the constellation, and one of the brightest stars in the summer sky. This constellation lines up with the swath of Milky Way that stretches across the sky.

Pegasus *(Slide18-21)*
If you follow the left "wing" of the swan further left, you will hit the square of stars that makes up Pegasus's body.

What is a shooting star? *(Slide 22)*
Tiny bits of debris burning up in the upper atmosphere of earth. They are called meteors.

Why do stars twinkle? *(Slide 23)*
Earth's atmosphere isn't uniform. When light passes through a weird patch, it gets warped and twinkles. Imagine the atmosphere as a smudged window: things look different through the smudged bits. Stars twinkle and planets don't, because the light from stars are mere pinpoints and have to travel farther than the broad discs of light from nearby planets.

Lyra *(Slide 24-27)*
One of the brightest stars in the summer sky is in this constellation and is called Vega. The light that we are seeing from Vega, left the star 27 years ago!

Hercules *(Slide 28-31)*
If you go directly to the right of Lyra you will find the square that is part of this constellation.

Corona Borealis *(Slide30)*
Just to the right of Hercules you will find this half circle of stars.

Bootes *(Slide 32-35)*
If you follow the handle of the Big Dipper, it will arc towards a bright star called Arcturus, a star at the tip of this cone shaped constellation, 34 light years away.

Milky Way *(Slide 36-38)*
Where do we fit in with all of these stars? Show Milky Way picture. Our solar system is one star that is part of a galaxy of hundreds of billions. If you stretched our galaxy out on a ruler that measured light years instead of inches, the ruler would be 100,000 light years long, and the sun would be at 27,000 light years. On a very clear night, if you find a spot away from city lights, you might see a cloudy band across the sky: that is the Milky Way. The people of many cultures had ideas about what the Milky Way was-have student read card.

Before We Go Out *(Slide 39)*
Show the star map one more time and look at where constellations are relative to one another-especially well-known ones like the Big Dipper-Polaris-Cassiopia. Have students pick a constellation or two to look for when they go outside. Hand out star maps and encourage students to use them. Possibly organize students into teams and see which can identify the most constellations as you point to their general direction in the night sky, you could also ask questions about the myths that they learned. Use the telescope and possibly binoculars to see stars more closely.

If Weather is Bad *(Slide 40)*
Have students break into groups of 3-4, put up slide of starry night sky and ask them to pick out six stars, connect them into a pattern, and create a myth about it. Give them 5-10 min, and then share.

Conclusion:
Ask for final questions and collect materials. Encourage students to keep looking at the night sky.

Additional Options:
With a younger group, you may want to act out the Perseus/Andromeda/Cassiopia story in Appendix A.

References

Cornell University Astronomy:
http://curious.astro.cornell.edu/moon.pp

Inconstant Moon
www.inconstantmoon.org

NASA
http://lunar.arc.nasa.gov/project/faq.htm

Nova
http://www.pbs.org/wgbh/nova/tothemoon/origins.html

Northern Stars Planetarium Teachers Guide:
www.northern-stars.com

Ranger Rick's Naturescope: Astronomy Adventures

Scholastic Teacher Resources:
http://teacher.scholastic.com/researchtools/articlearchives/

Iconmaste Astronomy Curriculum
http://www.ioncmaste.ca/homepage/resources/web_resources/CSA_Astro9/files/multimedia/unit1/constellations_summer/constellations_summer.html-good