StellarLunar Curriculum

45 to 60 minutes for 3rd-5th grades

Notice

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Objectives

Students will learn:
- What the term 'phases of the moon' means;
- What causes the phases of the moon;
- The names and cycle of the phases of the moon;
- What a constellation is; and
- Information about two or three constellations.

Required Materials

- Flashlight
- Earth on a stick (globe with handles at north and south poles to represent axis)
- Spheres for scale model of the earth and moon *[Recommended sizes: Earth, 6 in/15 cm; moon 1.5 in/4cm]*
- Tape measure at least 15 ft/ 4.6 m long for use in Earth-moon scale demonstration
- Posters of the moon and sun
- Posters of several constellations
- 32 model moons (styrofoam balls 3 to 4 inches in diameter on dowels or pencils)
- Lamp with bright bulb (at least 60 watts) and no lamp shade
- Copy of directions for moon phase activity, to be left with classroom teacher
- Light and laser pointers
- Digitarium® system set for the current date, time, and location; atmospheric effects and landscape turned on; moon enlarged

I. Introduction *(10 minutes)*

A) Inform students that you'll be talking about the stars and the moon today. Let's start with stars. What are some things you know about stars? *[Show poster of the sun.]* Why is this star, the sun, so important to us? How do stars like our sun make light? What do we call a group of stars that makes a picture? *[Show posters of some constellations they'll see inside.]*

B) What do you know about the moon? *[Show poster of the moon.]* What keeps the moon in orbit around the earth? Have they heard the term 'phases of the moon?' What does that mean? What causes the phases of the moon? *[Watch out for the misconception that Earth's shadow causes the phases of the moon!]* Do we only see the moon at night? What does it mean that the moon has a cycle?

C) Do a distance and size demonstration of Earth and moon. Show students the earth sphere and ask them to show you with their hands how big they think the moon sphere would be using this same scale. Show students the actual moon sphere, which is about ¼ the size of the earth sphere. Pick a volunteer to estimate how far away the moon should be from the earth in this model (about 30 times the diameter of the earth sphere). Discuss the size and location of sun in this scale. *[If Earth is a 6 inch/15 cm sphere, the moon should be a 1.5 inch/4 cm sphere and the two objects should be 15 ft/4.6m apart. At this scale, the sun would be 50 ft/15.2 m in diameter and 1.1 miles/1.8km away from the earth sphere.]*

D) Model the earth, moon, and sun system with students. Choose three volunteers, one to be the sun, another to be the earth, and the last to be the moon.

- Position the sun volunteer in the middle of an open space. Ask the rest of the class what the sun needs to do. *[Rotate counterclockwise on its axis.]*
- Position the earth next. What does Earth do? *[Rotate counterclockwise on its axis and revolve around the sun, also counterclockwise.]* Have the earth volunteer practice this briefly. How long does it take for the earth to rotate once on its axis? About 24 hours, one day. How long does it take for Earth to revolve around the sun once? About 365 days, or one year.
- Add the moon. What does the moon volunteer need to do? *[Rotate on its axis, orbit Earth while Earth orbits the sun, all counterclockwise.]* Slowly put everything into motion, giving the volunteers hints on how to model the system accurately. *[Don't let the earth and moon rotate too long or they'll likely fall down!]* How long does it take for the moon to rotate on its axis? About 27.3 days. This slow rotation is why the same side of the moon always faces Earth. How long does it take for the moon to orbit Earth once? Also 27.3 days. That's right, the moon takes the same amount of time to rotate once on its axis as it does to revolve once around the earth.

- Have the volunteers return to their seats.

E) Prepare students to enter the planetarium ***[****what to expect, method of entry, rules for behavior, etc****.]*****.**

II. Exploring Tonight's Sky *(15 to 20 minutes)*

A) ***[****When all are in and seated, speed up time and turn off atmospheric effects and landscape to better show the night sky.****]*** Inform students that they are seeing the sky as it would look at about _____ p.m./a.m. tonight. What do they see as they look around?

Take some observations, then ask students to look for the Big Dipper. Have a student point out the Big Dipper using a LIGHT pointer. Demonstrate how to use the Big Dipper to find the north star, then review the cardinal points.

Use the earth on a stick to show how our north pole is aligned with the north star. Speed up time to show how from our perspective Polaris doesn't appear to move much.

B) Inform students that the Big Dipper all on its own is not a constellation; we have to add more stars to it to make it a true constellation. Does anyone know which constellation the Big Dipper is in? Right, Ursa Major, the Big Bear. Point out the stars of Ursa Major with your laser pointer, turn on the line drawing and then artwork for the big bear, and share your favorite Ursa Major story.

C) Choose two or three other constellations in different parts of the sky. Point out the stars in each or let a student do so, turn on the line drawing or constellation art, and share a story or cool fact about each group of stars.

III. Exploring the Phases of the Moon *(15 to 20 minutes)*

Notes:

- Experiment to find the best lighting solution for YOUR needs.
- If you are doing this activity in a portable dome, it can get crowded. To avoid overcrowding, do the phase modeling portion in a darkened classroom, or take just half of the class at a time into the dome.

A) Ask students if they see the moon in the planetarium's night sky *[if no one has mentioned it yet]*. If the moon is not visible, ask students where the moon could be. Move forward in time until the moon becomes visible, and tell the students the new time for your sky. What does this moon phase look like to them? *[You will need to have the moon enlarged in order for the phase to be obvious against the background of the stars.]* Do they know the name of the phase?

B) Inform students that they're going to have a chance to model what causes the phases of the moon and to learn the phase names.

- Turn off the Digitarium® system light or close the projector shutter. Set up your lamp as close to the middle of the dome as possible.
- Pass out a model moon to each person. The lamp will represent the sun, the thing they're holding will be the moon, and their heads will be the earth.
- Have students stand up and carefully make a circle as far back from the lamp as possible. ***[****Note: You may need to make two rows. Put shorter students in front to avoid unwanted eclipses, and set the lamp on a table/chair.****]***
- Stress that students should look at the shape of the light reflecting off the surface of the moon which is facing them, and that when they rotate, they'll rotate their entire bodies.
- Challenge students to figure out what arrangement the earth, moon, and sun must be in in order for us to see a new moon—no light reflecting off the surface of the moon facing them. ***[****All facing the sun with the moon directly between each person's head and the sun.****]***
- From the new moon, rotate counterclockwise to move through the rest of the phases: waxing crescent, first quarter, waxing gibbous, full moon *[Hold the moons up above head level, or you'll get a lunar eclipse],* waning gibbous, third quarter, waning crescent, and back to the new moon.

Explain what waxing and waning mean, and how you can tell whether the moon is waxing or waning. *[A helpful way for us in the northern hemisphere to remember: 'When the light is on the right, the moon is getting bright.' I.e., when light from the sun is reflecting off the right side of the moon, it's waxing.]*

D) After going through the phases in order two or three times, ask students how long it takes in the real night sky for the moon to go from new all the way through the other phases and back to new. About 29.5 days, or a 'moonth.' That's where the term 'month' comes from.

E) If time and space allow, 'quiz' the students by calling out a moon phase and having them position themselves to create that phase. **Remind them to be careful of the people around them!**

F) Collect the moons and have students sit. ***[****Open the projector shutter or turn the Digitarium® system lamp back on.****]*** Ask students how our model of the moon phases differs from what happens in the real sky. ***[****The earth wasn't revolving around the sun; Earth wasn't tilted on its axis; the moon wasn't rotating on its axis; etc.****]*** Inform students that they can add those factors in if their teacher has the time and materials to recreate the experiment in the classroom. You'll leave directions for

it with him/her just in case.

G) *[Set sky time to the current time, and move forward in time as needed to make the moon visible.]* Ask students what phase the moon is currently in, and which phase it will be in next. Zoom in on the moon, and travel forward in time day by day to allow students to watch the phases of the moon on the zenith.

H) Ask students why we can sometimes see the moon during the day. What phases can the moon be in when it is visible during the day? Zoom back out to full sky view, and, if necessary, speed up time to set the moon low in the west. With the moon enlarged and atmospheric effects off, slowly jump forward in time day by day to show students how the moon phases as it travels across the sky.

I) **OPTIONAL:** Show students images and videos from moon missions. These can be found in the “StellarLunar” directory on the Lesson Media DVD.

J) **OPTIONAL:** Run the Visit the Moon local script to change your viewing location to Earth's moon. Ask students for predictions of what they will see when you speed up time. Watch Earth phase from the surface of the moon, and discuss how the actual view was similar to or different from their predictions.

K) Prepare students for exiting and regroup outside the dome.

IV. Conclusion *(2 to 5 minutes)*

A) Ask students what they learned today. What does the term 'phases of the moon' mean? What causes the phases of the moon? What is a constellation? Encourage students to keep looking at the sky, and inform them of materials you'll be leaving with their teacher.