Tour of the Universe: Teacher Packet

Compiled by:
Morehead State University Star Theatre
with help from Bethany DeMoss
Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of Contents</td>
<td>1</td>
</tr>
<tr>
<td>Corresponding Standards</td>
<td>2</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>3</td>
</tr>
<tr>
<td>Sizing up the Stars (Primary)</td>
<td>5</td>
</tr>
<tr>
<td>Oreo Moon Phases (Middle Grades)</td>
<td>11</td>
</tr>
<tr>
<td>The Universe: Big Bang Balloon (High School)</td>
<td>25</td>
</tr>
<tr>
<td>Reference</td>
<td>28</td>
</tr>
</tbody>
</table>
## Corresponding Standards

### Next Generation Science Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-ESS1-1</td>
<td>Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.</td>
</tr>
<tr>
<td></td>
<td>[Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]</td>
</tr>
<tr>
<td>6-ESS1-2</td>
<td>Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.</td>
</tr>
<tr>
<td></td>
<td>[Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).] [Assessment Boundary: Assessment does not include Kepler’s Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]</td>
</tr>
<tr>
<td>HS-ESS1-2</td>
<td>Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.</td>
</tr>
<tr>
<td></td>
<td>[Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]</td>
</tr>
<tr>
<td>Vocabulary Word</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Constellation</td>
<td>A configuration of stars in the same region of the sky. There are 88 official constellations, each taking up a portion of the celestial sphere.</td>
</tr>
<tr>
<td>Asterism</td>
<td>A group of stars that make out a pattern or shape that is easily identifiable but isn’t an official constellation.</td>
</tr>
<tr>
<td>Celestial Sphere</td>
<td>An imaginary sphere of very large radius, projected out into space with respect to Earth and the observer.</td>
</tr>
<tr>
<td>Celestial Equator</td>
<td>The equator of the Earth projected into space, separating the Celestial Sphere into Northern and Southern Hemispheres.</td>
</tr>
<tr>
<td>Ecliptic</td>
<td>The apparent annual path of the Sun on the celestial sphere.</td>
</tr>
<tr>
<td>Zodiac</td>
<td>The constellations that the ecliptic passes through.</td>
</tr>
<tr>
<td>Planet</td>
<td>A body in orbit around a star that has cleared its own path of other bodies.</td>
</tr>
<tr>
<td>Dwarf Planet</td>
<td>A solar system body that is large enough to be spherical in shape and have a circular orbit around the Sun, but not large enough to clear its own path of other bodies. Examples include Ceres, Pluto and Eris.</td>
</tr>
<tr>
<td>Star</td>
<td>A massive gaseous body held together by gravity and generally emitting light. Stars generate energy by nuclear reactions in their interiors.</td>
</tr>
<tr>
<td>Comet</td>
<td>A small body of ice and dust in orbit about the Sun. While passing near the Sun, a comet’s vaporized ices give rise to a coma and tail.</td>
</tr>
<tr>
<td>Asteroid</td>
<td>One of tens of thousands of small, rocky, planet like objects in orbit about the Sun.</td>
</tr>
<tr>
<td>Astronomical Unit(AU)</td>
<td>The semi major axis of the Earth’s orbit; the average distance between the Earth and Sun (approximately 93,000,000 miles)</td>
</tr>
<tr>
<td>Light year</td>
<td>The distance light travels in one vacuum year (approximately 6 trillion miles)</td>
</tr>
<tr>
<td>Orbit/Revolution</td>
<td>To move about a central object in a circular/elliptical path. The Earth completes an Orbit/revolution every 365 days.</td>
</tr>
<tr>
<td>Rotation</td>
<td>To spin on an axis. The Earth completes a</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Moon</td>
<td>A celestial body in orbit around a planet.</td>
</tr>
<tr>
<td>Galaxy</td>
<td>A large assemblage of stars, nebulae, interstellar gas and dust</td>
</tr>
<tr>
<td>Milky Way</td>
<td>The galaxy to which the Sun belongs. Seen from Earth, the galaxy is a pale, milky band in the night sky. The Milky Way is a barred spiral type galaxy.</td>
</tr>
<tr>
<td>Galactic Halo</td>
<td>The approximate spherical region surrounding spiral galaxies. The halo contains mainly old stars, as are found, for example, in globular clusters. The halo also appears to contain large amounts of dark matter.</td>
</tr>
</tbody>
</table>
Sizing up the Stars

From: Stanford Solar Center
Teacher Overview

Materials List

Science Exploration

- Sizing Up the Stars

Per small group, partner, or small team
- Long, flat surface (table, counter top, sidewalk)
- Two identically sized round objects (tennis ball, rubber racquetball, golf ball, ping pong ball, balled up sheets of paper, marble, bubblegum ball, etc. (These round objects are listed according to size.)
- 1 round object of a slightly smaller size than the other two round objects (For example, if a group has two tennis balls, then the smaller round object should be a rubber racquetball or golf ball.)
- Measuring tape or meter stick (The students will need to be able to mark and measure distances.)
- ruler
- Student Guidesheet: Sizing Up the Stars
Science Explorations

• Sizing Up the Stars

Purpose: This activity is designed to get students to observe that two objects of equal size can appear to be of different sizes when placed at a greater or lesser distance from the observer. This is intended to assist students in visualizing that the sun is actually quite a small star compared to other stars, but because our planet is so much closer to the sun than to any other star, the sun appears much larger.

Distribute the student guidesheet Sizing Up the Distance and review the directions for the activity. Instruct the students to place and hold the round object on the table while measuring from the front edge of the round object emphasizing the importance of consistency in measurement for accuracy. Remind the students that when they are observing they should place their "eyes" in the same place each time, perhaps placing their chin directly on the flat surface.

The questions on the guidesheet will lead the students to develop a procedure similar to what is given below:
• Place the two equal size round objects 30 cm apart and 90 cm from the observer’s eyes (the edge of the flat surface).

• Observe and compare the apparent size of the round objects.

• Leave the round object on the right in its position. Maintaining the 30 cm separation between the two equal size round objects, place the left one at a closer distance to the observer from the one on the right.

• Observe and compare the apparent size of the round objects.

• Leave the round object on the right in its position. Maintaining the 30 cm separation between the two equal size round objects, place the left one at a greater distance to the observer than the right round object is.

• Observe and compare the apparent size of the round objects.

• Repeat the procedure except leave the left round object in place while moving the right round object closer and farther away from the observer.
Science Explorations (continued)

- Sizing Up the Stars (continued)

  - Using one small round object and one larger round object, the students will be asked to place the round objects in such a way as to make them appear the same size. Note: Based upon their previous observations, the students should be able to ascertain that to make the smaller round object appear equal in size to the larger object, it must be placed closer to the observer than the larger round object.

  - Using one small round object and one larger round object, the students will be asked to place the round objects in such a way as to make the smaller round object appear larger than the larger sized round object. Note: Based upon their previous observations, the students should be able to ascertain that to make the small round object appear larger it must be placed even closer to the observer than where it was placed previously OR the larger round object will need to be moved farther back than where it had been previously placed.
**Science Exploration GUIDESHEET**

**Sizing Up the Stars**

**Directions:** Follow each step below and answer the questions.

1. Take both round objects your teacher gives you and place them on a flat surface 30 cm apart and 1 meter from the observation point. See diagram below. Please, note that the observer must be able to place his/her eyes at eye level with the round objects for this activity.

2. Placing your eyes at eye level to the two round objects, observe the apparent size of each object to the other. Do they appear to be the same size?

3. Leaving the round object on the left in the same position, move the round object on the right so that it appears smaller than the round object on the left. Measure the placement of both round objects and record it below on the diagram.

4. Leaving the round object on the left in the same position, move the round object on the right so that it appears larger than the round object on the left. Measure the placement of both round objects and record it below on the diagram.

5. Using what you have learned from steps 3 and 4, replace one of the round objects with a smaller round object. In order for the smaller round object to appear the same size as the larger round object, predict what the placement of both round objects would be by drawing a picture of it below.
Sizing Up the Stars (continued)

6. Place both round objects in such a way that the smaller round object appears the same size as the larger round object. Measure the placement of both round objects and record it below on the diagram. Was your prediction correct?

7. Use what you have learned from steps 3 and 4 and the same two different sized round objects for this next step. In order for the smaller round object to appear larger than the larger round object, predict what the placement of both round objects would be by drawing a picture of it below.

8. Place both round objects in such a way that the smaller round object appears larger than the larger round object. Measure the placement of both round objects and record it below on the diagram. Was your prediction correct?

9. Explain how it is possible that the sun in our solar system can actually be smaller than some of the stars visible in the night sky.
Oreo Moon Phases
From: Bethany DeMoss
Oreo Moon Phases

Created by: Bethany DeMoss
Activity Overview

Activity Goal: Students to understand the phases of the moon’s lunar cycle while creating a physical display.

Standards: This activity meets the Next Generation Science Standards; the standard for 6th grade students is 6-ESS1-1.

Students: This activity is targeted for middle school students; however it can be used several grades lower and grades above. This activity is one that children off all ages will enjoy if adapted to fit their specific needs.
**Teacher Instruction**

Your role in this activity is to guide and assist your students. This activity is to be completed individually but can also be completed in groups as long as students have their own physical model and answers on to the questions in their packet. As the teacher decide what will be best suited for your students. Also take note that, a student with an intellectual and developmental disability might need special accommodations with this activity. Students with disabilities might not enjoy the sticky feeling the Oreos might leave on their fingers. One solution would for you to make the phase on the Oreo after they draw the phases on their paper. The student and teacher packet include the same step by step activity directions, teacher packet includes answers for teacher to go by.

---

**Materials**

- Oreos (each student will need 8 each)
- Paper Plate or napkin, to keep Oreos off the desks
- Spoons
- Copies of Student Packet
- Markers, Colored Pencils, Crayons, etc.
Oreo Moon Phases

You are going to be creating the phases of the moons lunar cycle by using Oreos, but first let’s discuss how we see the moon’s phases. The moon’s phases are created because of not only the moon, but the sun and the Earth as well. Without the sun and the Earth we wouldn’t be able to see the different phases, because there wouldn’t be any!

The moon orbits the Earth. As the moon orbits the Earth it has the same amount of light from the sun at all times but it changes position in the sky which is why we see different phases.

The sun in the middle of the picture is giving off light to the Earth and the Moon constantly as they orbit. As the moon orbits around the Earth we see the moon in a different position than the night before. In the picture the moon is a Full Moon. The Moon orbits out of the Earth’s shadow, so it is getting direct light from the Sun.
The Moon has a lunar cycle of 28 days. Every day the moon has a new position around the Earth because it is constantly orbiting. Picture A shows the lunar cycle of the Moon. Picture B shows the main phases of the Moon. If we drew a picture of the moon, every night for a month we would see a pattern like Picture A. If we looked at the moon every two days we would begin to see a pattern like Picture B.
1. The following circles represent the Moon in different phases, but what is missing? The phases themselves! Draw the position of the Earth and the Sun. The position of your Sun effects the position of where your phases are placed. Your Full Moon should be farthest from the sun. Using your Oreos create the phases. Use your spoon to remove icing when needed. Label with PENCIL the name of each phase. Draw arrows between each phase in GREEN. Color your Moon Phases with BLACK.
2. How many more phases are shown on Picture A than Picture B? ______________________

3. In which phase does the Moon have no light shown on its surface? _____________________


5. What is the difference between the Waning Crescent and the Waning Gibbous?
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

6. The New Moon is fully shaded in Picture B; the Full Moon is not shaded at all. Explain why.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
7. Describe what effect the Sun has on the Moon’s phases. ______________________________

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

8. Why does the Earth get placed in the center of your drawing of the Moon’s phases?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Oreo Moon Phases

Have your students read the information on the first two pages first, while they read work on getting materials ready for #1 of their activity!

You are going to be creating the phases of the moon's lunar cycle by using Oreos, but first let’s discuss how we see the moon’s phases. The moon’s phases are created because of not only the moon, but the sun and the Earth as well. Without the sun and the Earth we wouldn’t be able to see the different phases, because there wouldn’t be any!

The moon orbits the Earth. As the moon orbits the Earth it has the same amount of light from the sun at all times but it changes position in the sky which is why we see different phases.

The sun in the middle of the picture is giving off light to the Earth and the Moon constantly as they orbit. As the moon orbits around the Earth we see the moon in a different position than the night before. In the picture the moon is a Full Moon. The Moon orbits out of the Earth’s shadow, so it is getting direct light from the Sun.
The Moon has a lunar cycle of 28 days. Every day the moon has a new position around the Earth because it is constantly orbiting. Picture A shows the lunar cycle of the Moon. Picture B shows the main phases of the Moon. If we drew a picture of the moon, every night for a month we would see a pattern like Picture A. If we looked at the moon every two days we would begin to see a pattern like Picture B.
1. The following circles represent the Moon in different phases, but what is missing? The phases themselves! Draw the position of the Earth and the Sun. The position of your Sun effects the position of where your phases are placed. Your Full Moon should be farthest from the sun. Using your Oreos create the phases. Use your spoon to remove icing when needed. Label with PENCIL the name of each phase. Draw arrows between each phase in GREEN. Color your Moon Phases with BLACK.

All student answers will vary in where they put their Sun. However, the Earth has to be in the center of all of the Moons. Check that they have their Earth drawn in the middle of their moons before allowing them to proceed. Arrows must be pointing in the correct direction. (New Moon to Waxing Crescent) What is important is their alignment they must be in order.

Phases: New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, Waning Crescent
2. How many phases does the Moon have? ____________________ 8 ____________________

3. In which phase does the Moon have no light shown on its surface? New Moon


Waning Gibbous    Waning Crescent

5. What is the difference between the Waning Crescent and the Waning Gibbous?

Answers will vary. Main idea is that the waning gibbous is not full crescent shape (you see the white) and the waning crescent is a tiny crescent. Waning Gibbous is larger than the Waning Crescent.

6. The New Moon is fully shaded in Picture B; the Full Moon is not shaded at all. Explain why.

The new moon is fully shaded because none of the Moon’s surface is being seen from Earth.

7. Describe what effect the Sun has on the Moon’s phases. The Sun gives light to the Earth and the Moon allowing us to see the moon and for us to see around us. The Moon is always fully lit by the Sun, we see the phases depending where around the Earth the Moon is during its orbit.
8. Why does the Earth get placed in the center of your drawing of the Moon’s phases?

The Earth is in the center because the Moon is orbiting the Earth.
The Universe: Big Bang Balloon
From: Discovery Channel School’s Curriculum Center
The Universe

Big Bang Balloon

Background Information
In the 1920s astronomer Edwin Hubble used the red shift of the spectra of stars to determine that the universe was expanding. By carefully observing the light from galaxies at different distances from Earth, he determined that the farther something was from Earth, the faster it seemed to be moving away. This relationship has become known as Hubbleís Law, and itís just one piece of a bigger puzzle known as the Big Bang theory.

Developed over many years and by many people, the theory states that about 15 billion years ago the universe was compressed into an infinitely small space, known as the primordial atom. It exploded in a sudden burst of energy and created a small, superdense, extremely hot universe that began to expand in all directions. Over time things cooled, and tiny bits of matter clumped together to form stars and galaxies. As a result of this explosion, all of these objects are still moving away from each other. In this experiment, you'll create a simple model to learn how the universe expands over time.

What You Need
- 12-inch (30-cm) round latex balloon
- a permanent felt-tip marking pen
- 24-inch (60-cm) piece of string
- metric ruler

What to Do
1. Inflate your balloon until it is about 4 inches (10 cm) in diameter, but do not tie the end.
2. Using the felt-tip marker, make six dots on the balloon in widely scattered locations. Label one dot "home" and the others A-E. The home dot represents the Milky Way galaxy, and the others represent galaxies formed in the early universe.
3. Without letting air out of the balloon, use the string and ruler to measure the distance from home to each dot. Record the distances in the worksheet table under the heading "Time 1."
4. Inflate the balloon so that its diameter is about 2 inches (5 cm) bigger. Again measure the distances to each of the dots, and record the distances under "Time 2" on the worksheet.
5. Inflate the balloon in 2-inch (5-cm) increments three more times. After each inflation, measure and record the distances on the worksheet.
6. Answer the follow-up questions on the worksheet.

http://www.discoveryschool.com/curriculumcenter/universe
The Universe
Big Bang Balloon Worksheet

Name: ________________________________

Record your measurements below.

<table>
<thead>
<tr>
<th>Distance from home</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Time 3</th>
<th>Time 4</th>
<th>Time 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dot A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dot B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dot C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dot D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dot E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How did the distance from the home dot to each of the other galaxies change each time you inflated the balloon?

Did the galaxies near home or those farther away appear to move the greatest distance?

How could you use this model to simulate the "Big Crunch," a time when all the galaxies might collapse in on themselves?

http://www.discoveryschool.com/curriculumcenter/universe
References for Activities

*Sizing up the Stars*


*Oreo Moon Phases*


*The Universe: Big Bang Balloon*