

# How Far Is the Moon

## OVERVIEW —

Students gain a better perspective on the relationship between the size and distance of the Moon by creating a scale model.

**Ages:** 8 years and up

**Duration:** 15 minutes

## OBJECTIVE —

The students will:

- Predict and then measure the size of the Moon relative to Earth's diameter.
- Predict and then measure the distance of the Moon relative to a scale model of the Earth and Moon.

## MATERIALS —

- Tape measure
- Two balloons OR
- A basketball and a tennis ball
- *To increase student participation, provide a balloon and a ruler for each student*

## ACTIVITY —

1. Ask the students about **the size of the Moon**. *Is the Moon bigger or smaller than the Earth?*
2. Ask the students to **predict how many Moons will fit across the Earth**. Invite them to suggest ways to test their prediction.

As much as possible, enable the students to explore their suggestions and to respond to each other's ideas and experiences. Consider responding to the students' more elaborate ideas by asking others to politely share their opinions: *What do you think about \_\_\_\_'s idea—would that be a good way to see how many Moons fit across the Earth?*

3. **Make models of the Earth and Moon.**
  - If you have enough balloons, provide a balloon for each student, and ask them to work in pairs. One student in each pair should inflate a balloon to represent the Earth. Each pair should then decide how big to inflate the second balloon to make a Moon.
  - Alternatively, you can inflate a balloon to be the Earth and invite the class to share their thoughts on how big you should inflate the second balloon to be the Moon.
  - Or you can show a basketball to the class and invite them to share their thoughts on which type of ball would best represent the Moon.
4. After the students have shared their predictions or created their balloon models, **test their predictions.**
  - As a class, students can look up the diameters of the Earth and Moon online and divide the Earth's diameter by the Moon's.
  - Or you can share that the Moon is a quarter as wide as the Earth—that four Moons would fit across the Earth.
  - Students can then measure the diameter of their balloons to see how closely their models fit the scale.

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- Or you can measure the balloons or basketball for them. If you used a basketball to represent Earth, share that a tennis ball is about the right size for the Moon.
5. Ask the class how far apart the two balls should be to **represent the actual distance of the Earth and Moon**. Take a variety of estimates.
  6. **Calculate and model the distance:** multiply 30 times the diameter of the basketball or Earth-balloon to get the scale distance of the Moon. Use the tape measure to have one pair of students measure and demonstrate the scale distance between the Earth and Moon. Does the answer surprise the students?

### *EXTENSIONS —*

Have the students try to imagine how small the Moon actually appears in the sky. If they extended their arms and closed one eye, would they be able to cover the Moon up with one hand? One finger? (It would take less than the width of their smallest finger to cover up the Moon.) Have them go outside and try it!

### *BACKGROUND —*

Many illustrations and photos are misleading in the dimensions that they show for the Earth and Moon; often, the Moon is depicted as being much larger and much closer than it really is. The Moon is also shown in photos, movies, and books as larger than it really appears in the sky. Finally, our own minds often trick us into believing the Moon is larger than it truly appears, when it is near the horizon.

The Earth is 7921 miles wide, and the Moon is 2159 miles wide. The Moon's orbit is approximately 238,500 miles from Earth. In fact, the Moon's orbit is somewhat elliptical, so that it actually ranges from 225,600 miles to 251,800 miles. But even when it is at its furthest, and even when it is on the horizon, it can still be covered up with a little finger fully extended.

Understanding the scale of the Earth-Moon system accurately can help students to better understand the cause of lunar phases; students often mistakenly believe that lunar phases are caused by the Earth's shadow. This misconception is supported by mistaken assumptions that the Moon is very close to the Earth.

### *ADDITIONAL RESOURCES —*

#### **Space Place: The Moon's Phases in Oreos**

<http://spaceplace.nasa.gov/oreo-moon/en/>

This article explains the monthly variations in the Moon's appearance as seen from Earth. Directions for using Oreo cookies to illustrate the four major phases of the Moon are provided. The article is targeted to children ages 10-12.

#### **Explore: Marvel Moon**

Background: <http://www.lpi.usra.edu/education/explore/marvelMoon/background/>

Activities: <http://www.lpi.usra.edu/education/explore/marvelMoon/activities/>

This informal education program explores NASA's investigations into the ongoing saga that has shaped our Moon. Discover our scientific, cultural, and personal understanding of Earth's nearest natural neighbor.

#### **Sustainable Trainer Engagement Program: Lunar Phases**

[http://www.lpi.usra.edu/education/step2012/participant/lunar\\_phases/](http://www.lpi.usra.edu/education/step2012/participant/lunar_phases/)

This website has activities and resources for teaching lunar phases to middle school students.

### **Moon Posters**

[http://www.lpi.usra.edu/education/moon\\_poster.shtml](http://www.lpi.usra.edu/education/moon_poster.shtml)

Three posters, designed for students in 6<sup>th</sup> through 9<sup>th</sup> grades, explore how the Moon formed and changed through time, spacecraft missions measuring different wavelengths of light reflected off the Moon's surface, and how we can use the available materials to support future lunar outposts.

### ***TIES TO STANDARDS —***

#### **Next Generation Science Standards**

**Performance Expectation MS-ESS1-3.** Analyze and interpret data to determine scale properties of objects in the solar system.

##### **Disciplinary Core Idea: ESS1.B: Earth and the Solar System**

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

##### **Science and Engineering Practices: Developing and Using Models**

- Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).

##### **Science and Engineering Practices: Analyzing and Interpreting Data**

- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.

##### **Science and Engineering Practices: Using Mathematics and Computational Thinking**

- Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

##### **Crosscutting Concepts: Scale, Proportion, and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.