Earth, Earth's Moon, Mars Balloons

Grades: 5th Grade   Prep Time: ~10 Minutes   Lesson Time: 60 Mins

WHAT STUDENTS DO: Construct a Planetary Model

Curiosity about our place in space and whether we can travel to distant worlds beyond our own depends upon understanding the size, distance, and other characteristics of moons and planets in our solar system. For this activity, students will construct a balloon scale model to understand the relative sizes of the Earth, Earth's Moon and Mars in relation to each other and their relative distance to each other at this scale. They will use this model to predict distances and reflect on how scientists use models to construct explanations through the scientific process. In this collection, this activity introduces the concept of models, which will be built upon in subsequent lessons, as well as the first set of Earth/Mars comparisons.

NRC CORE & COMPONENT QUESTIONS	INSTRUCTIONAL OBJECTIVES
WHAT IS THE UNIVERSE & WHAT IS EARTH'S PLACE IN IT? *NRC Core Question: ESS1: Earth's Place in the Universe*	*Students will be able*
What are the predictable patterns caused by Earth's movement in the solar system? *NRC ESS1.B: Earth & the Solar System*	**IO1: to model** the Earth, Earth's Moon, and Mars system

1.0 Materials

Required Materials

Please supply:

- Each student will need a single balloon in one of three colors: blue (Earth), red (Mars) or white (Earth's Moon). For example, for a class of 30 students, you would need 30 balloons total: 10 blue, 10 red, 10 white.
- 10 Cloth Tape Measures (or meter sticks and pieces of string)
- 10 Calculators
- LCD projector and computer with access to internet
- Access to images on the following websites:
  - http://hirise.lpl.arizona.edu/earthmoon.php
  - http://marsrovers.jpl.nasa.gov/gallery/press/spirit/20040311a/11-ml-02-earth-A067R1_br.jpg

Please Print:

(A) Earth, Earth's Moon, Mars Comparison – 1 per student
(B) Relative Size & Distance Sheet – 1 per student
(C) Student Reflection – 1 per student

Optional Materials

(D) "Earth, Earth's Moon, Mars Balloons" Assessment Rubrics
(E) Alignment of Instructional Objective(s) and Learning Outcome(s) with Knowledge and Cognitive Process Types

3.0 Vocabulary

Models	a simulation that helps explain natural and human-made systems and shows possible flaws
Prediction	the use of knowledge to identify and explain observations or changes in advance (NSES, 1996)
Relative Distance	how far away objects are when compared to one another
Relative Size	how large objects are when compared to one another
Relationship	a connection among and between objects
Scale	a measurement that will represent a standard measurement for comparison among objects

5.0 Procedure

PREPARATION (~10 minutes)

A. Print handouts (A), (B), and (C) for each student.
B. Access pictures online

STEP 1: ENGAGE (~10 minutes)
Exploring Sizes of Planets

A. Using *(A) Earth, Earth's Moon, Mars Comparison* worksheet, ask students to make a prediction using a drawing of the Earth, Earth's Moon, and Mars, showing what they think the sizes are in relationship to each other.

B. Look at the image of Earth and Earth's Moon from the Mars perspective (http://hirise.lpl.arizona.edu/earthmoon.php) from an image taken from a spacecraft orbiting Mars. Discuss the size of the Earth and Earth's Moon in relationship to each other and from representations in books, charts, and other materials. Does it look like the Earth and Earth's Moon are the same size?

C. Look at the image of Earth from the surface of Mars. (http://marsrovers.jpl.nasa.gov/gallery/press/spirit/20040311a/11-ml-02-earth-A067R1_br.jpg).

STEP 2: EXPLORE (~15 minutes)

Representing planetary objects with a simple model.

A. Discuss how people use models to represent ideas or objects. Point out that scientists and engineers create models to understand an idea or object. Today, we will be making models of the Earth, Earth's Moon, and Mars to represent their sizes and distances to scale.

B. Distribute blue balloons to 1/3 of the class, red balloons to 1/3, and white balloons to the final 1/3. Explain that the three balloons represent the Earth (blue), Earth's Moon (white), and Mars (red).

C. Group students in groups of 3, each with a different color balloon.

D. Ask the students with the blue balloon to blow their balloons up until it is 63 centimeters in circumference. You may need to demonstrate for the students how to measure the circumference using a cloth tape measure or a piece of string and a meter stick.

E. Once the balloon is the appropriate circumference, ask the students to tie off the balloon. This balloon will represent Earth.

F. Ask the students to fill in *(B) Relative Size and Distance Sheet* with the circumference of Earth.

G. Students will now predict the relative circumferences of Earth's Moon and Mars based on the size of Earth and record that circumference prediction on the *(B) Relative Size and Distance Sheet* in the "Balloon Circumference Prediction" column.

H. Explain to students that the scale for this model is 63,800,000 times smaller than the real thing. Ask students to multiply the balloon circumference (63 cm) X 63,800,000 (scale factor) to find the actual diameter of Earth (4,019,400,000 cm or 40,194 km).

I. To find the "Actual Balloon Circumferences" for Earth's Moon and Mars, the circumferences have been provided for both. The students will need to divide these by 63,800,000. They should find the model of Earth's Moon is 17 cm and of Mars is 33 cm.

Differentiation Tip: Students may then convert centimeters to kilometers.

J. Students should now inflate Earth's Moon and Mars balloon to the appropriate sizes and tie them off.

STEP 3: EXPLAIN (~5 minutes)
Explaining scale in a model.

A. Discuss the idea of scale with students. Point out that it is obvious that the planets and moons are not as small as the balloons, but because we calculated them using a scale, the sizes represent the bodies in relationship to each other. Therefore, the Earth can be estimated as twice as big as Mars, and 4 times bigger than Earth's Moon.

STEP 4: ELABORATE (~15 minutes)
Using a model to make predictions.

A. Ask students to now make a prediction regarding the relative distances between Earth, Earth's Moon, and Mars.

B. They should stand as a group, arranging themselves based on their beliefs about the relative distances and measure these distances. These measurements will represent their prediction, to be completed on the *(B) Relative Size and Distance Sheet*.

C. Student will use their new understanding of scale to calculate the relative distances of the Earth, Earth's Moon, and Mars. They will continue to use the 63,800,000-scale model.

D. Once students have calculated the scaled differences, ask them to begin arranging themselves into the appropriate distances.

E. Eventually a student will say they need to step out of the room to get to Mars. This moment is a great time to mention that the distance to Mars is so great that, if we were to place it correctly according to this scale, it would actually be ¾ of a mile or 1.21km away. As a frame of reference for how far that is, provide a visual cue of a familiar neighborhood location recognizable by the students that is about ¾ of a mile from the school.

F. Discuss with the students the amount of time it would take us to travel to Earth's Moon and Mars. Typically, it takes 2 - 3 days to reach Earth's Moon using a rocket-powered vessel, while it would take approximately 6-11 months to reach Mars with robotic spacecraft, depending on where the Earth and Mars are in their orbits at the time of launch.

Differentiation Tip: Ask students to convert cm to km and/or use scientific notation for the planet distances.

STEP 5: EVALUATE (~20 minutes)

Reflecting metacognitively on the use of modeling in the scientific process

A. Ask students to complete the *(C) Student Reflection Sheet.*

6.0 Extensions

Explore the relative size and distance of the moons of Mars or other planets in our solar system.

7.0 Evaluation/Assessment

Use the student sheets as a formative and summative assessment, allowing students to improve their work and learn from mistakes during class. The checklist evaluates the activities using the National Science Education Standards.

(A) Student Handout. Earth, Earth's Moon, Mars Comparisons

NAME:______________________________

1. In the box below, draw the your thoughts (predictions) of how large the Earth, Earth's Moon, and Mars are.

3. Explain why you think your prediction to be true.

(B) Student Worksheet. Relative Size and Distance Sheet

NAME:______________________________

Planet/Moon	**Circumference (cm)**	**Balloon Circumference Prediction (cm)**	**Actual Balloon Circumference (cm)**
Earth		63	63
Earth's Moon	1,091,500,000		
Mars	2,133,300,000		

Planet/Moon	**Average Distance (cm)**	**Balloon Distance Prediction (cm)**	**Actual Balloon Distance (cm)**
Earth to Earth' Moon	38,400,000,000		
Earth to Mars	7,800,000,000,000		

Show your work:

(C) Student Worksheet. Student Reflection

NAME:________________________________

1. What did you find most surprising during this investigation?

2. Why did we have to use a scale to create our model of Earth, Earth's Moon, and Mars?

3. This is called a scale model. How do you think scientists use scale models? (Hint: how did you use it?

4. Revisit your original prediction. Was it correct? What do you now understand about the relative sizes and distances of Earth, Earth's Moon, and Mars?