

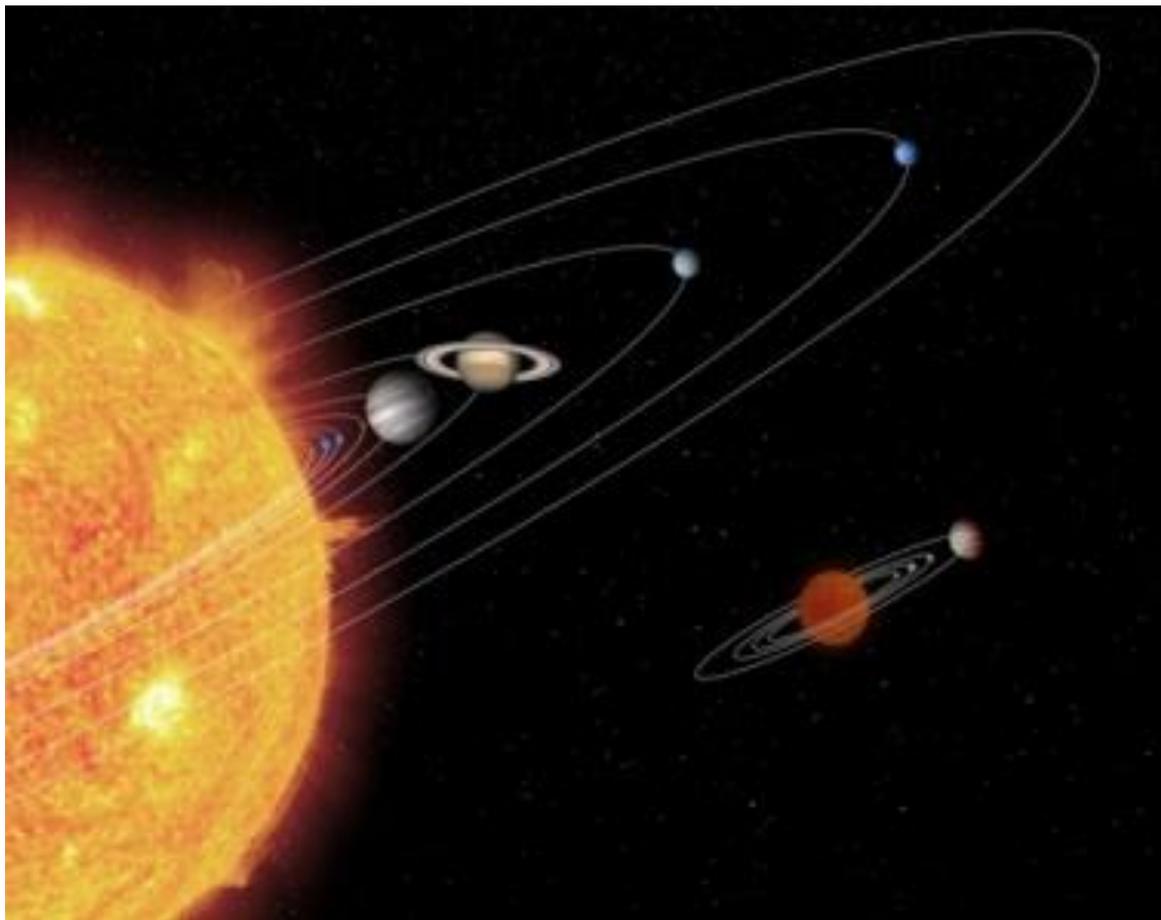


Mars Rover Celebration

Curriculum Module

Week 1: Learning Research Skills

Lesson 1: Overview of the Solar System



Educational Product	
Educators & Students	Grades 6-8

Week 1: Learning Research Skills

LESSON 1: OVERVIEW OF THE SOLAR SYSTEM

GRADE LEVEL: 6-8

LENGTH: 2 DAYS

VOCABULARY: apply
astronomical
scale

MATERIALS:

- Computer with projector and screen
- Access to at least one of the web sites listed in the Resources section
- Science Notebooks
- Assorted spheres (diameter):
 - Cake sprinkles (2 mm)
 - Cinnamon imperials candy (2.8 mm)
 - Dried peas (5.2 mm)
 - 6mm ball bearings (5.4 mm)
 - Gumballs (20 mm)
 - Styrofoam balls (50 mm)
 - Ping pong balls (60 mm)
- For each team:
 - 1- bolt of kite string (~200 m)
 - 1- beach ball (approximately 2ft [60 cm] diameter)
 - Transparent tape
 - Calipers
 - Graph paper

ESSENTIAL QUESTION:

How might you describe the solar system to a friend who knows nothing about the relative sizes of the sun and planets or the distances among them?

LESSON OBJECTIVE(S):

Students will be able to:

- Review and elaborate on the structure, content and size of the Solar System.
- Identify the central body of the Solar System (*Sun*) and the 8 major planets.
- Describe the motion of the planets in the sky, including retrograde motion.
- Complete an investigative study of the scale of the solar system.
- Demonstrate a grade appropriate understanding of orbital motion (revolution) and planetary spin (rotation).

ENGAGEMENT

Note: Prior to conducting the Engagement with students, teachers will want to practice using at least one of the recommended web sites to ensure that the lesson progresses smoothly when presenting it to students.

1. At the beginning of this lesson, and using the attached documents, present the Essential Question and Key Vocabulary for students to consider during the lesson.
2. Using one of the recommended web sites below (Supplemental Resources > For Teachers), prepare a pre-set solar system tour.
3. Start with a viewpoint looking “down” in a direction perpendicular to the plane of the Earth’s orbit (*the ecliptic plane*). Begin by asking students to identify the four planets shown and ask what observations students can make in regards to the planets’ orbits. (*Mercury, Venus, Earth, Mars; Orbits appear to be nearly circular.*)
4. Shrink the planets to actual scale and using the Planetary Data worksheet as a guide, ask students to share observations about the size of the planets in relation to each other. Discuss the concept of distance and how far away the planets are from each other. Introduce the Astronomical Unit- a unit of length (149,597,870.700 km) approximately equal to distance between Earth and the Sun.
5. Begin a discussion on the difference between rotation and revolution. Ask students to discuss examples they are seeing. To further solidify this concept, ask students to stand up and physically demonstrate orbital motion (*Revolution- moving around the room in a circular path*), planetary spin (*Rotation- spinning in place*), and both orbital motion and planetary spin at the same time.
6. Expand the view to show the orbits of Neptune and Pluto. Ask students to identify the four major planets of the outer system, (*Jupiter, Saturn, Uranus, and Neptune*). In the expanded view, ask students to make observations about how the planets move in relation to each other. Ask students:
 - a. Which two planets are not acting in the same fashion as the others (*Venus and Uranus*)?
 - b. How are those planets behaving differently than the others (*They are spinning in a retrograde motion*)?

EXPLORATION

1. With students divided into teams of 4-5, students should research the diameter of the Sun and the 8 major planets and calculate the size of the scale model planets using a 2 foot (60 cm) diameter beach ball to represent the sun.
2. According to a planetary table, students will find that the diameter of the Sun is 1,319,000 km. By using the beach ball diameter, 60 cm, and dividing by the actual diameter of the Sun (converted to cm) the scale factor is determined.

$$\text{Scale Factor} = \frac{\text{diameter of the beach ball}}{\text{actual diameter of the Sun}} = \frac{60 \text{ cm}}{139,100,000,000 \text{ cm}} = 4.31344 \times 10^{-10}$$

3. After students calculate the correct scale (4.31344×10^{-10}) calculations can be made to determine the diameters of the scaled planets by multiplying the actual diameter of each planet by the scale factor found above.
4. Example: Determining the scaled diameter of Mercury

$$\begin{aligned} \text{Scale}_{\text{Mercury}} &= (\text{Scale Factor}) (\text{Diameter of Mercury in km}) \\ \text{Scale}_{\text{Mercury}} &= (4.31344 \times 10^{-10}) (4879.4 \text{ km}) \\ \text{Scale}_{\text{Mercury}} &= 2.1047 \times 10^{-6} \text{ km} \\ \text{Scale}_{\text{Mercury}} &= .00000210427 \text{ km} \\ \text{Scale}_{\text{Mercury}} &= 0.210427 \text{ cm} \sim 2.1 \text{ mm} \end{aligned}$$

5. Concluding that the scaled diameter of Mercury is 2.1 mm, students should determine that the cake sprinkle should be selected to represent Mercury. (*Starting with Mercury, students should arrive at diameters of 2.1 mm, 5.2 mm, 5.4 mm, 2.8 mm, 60.2 mm, 50.1 mm, 21.8 mm, and 21.2 mm.*)
6. To assemble the scaled system, have teams tape one end of a bolt of kite string to the equator of the beach ball and wrap the string around 34 times. Cut off the extra. Take the Earth sphere (*ball bearing*) and tape it to the end of the string. This will use approximately 64 m of string.
7. Take students into an open space and unwrap the string showing the scale distance between Earth and the Sun. Ask students to make observations and answer the key questions in their Science Notebooks. Specifically, students should answer:
 - In what ways are our real Earth-Sun scale model different from our real Earth, Moon, and Sun?
 - How were we able to correctly scale down our real Earth-Sun into a scaled model?
 - What are some advantages and disadvantages of using a scale model?
8. As teams finish, they should use their data to determine which assorted spheres will correctly represent the other 7 planets and record their answers in the chart in their Science Notebooks.

EXPLANATION

1. After completing the Exploration, students should be brought together to discuss results and information recorded in their Science Notebooks. The teacher should ask specific questions such as those listed below to identify and correct any misconceptions:
 - a. How did we explore and understand the term scale?
 - b. What observations did you make about the astronomical size of our solar system?
 - c. How did you determine which of the assorted spheres would represent each of our planets?
 - d. Explain the difference between orbital motion and planetary spin.
2. Then, students should individually answer the Essential Question in their Science Notebooks.

ELABORATION

1. If time allows, students may repeat this exercise using a total of 52 wraps of string and a scale model of Mars (*cinnamon imperial candy or other 2.8 mm diameter sphere*) to demonstrate the distance and scale of Mars in relation to Earth and the Sun.
2. Students may also work with a partner to design and build a model that describes the role of gravity within our solar system.

EVALUATION

1. After Day 1 of this lesson, students should complete the Mars Rover Celebration pre-assessment as a homework assignment. If your class will be participating in our ongoing evaluation of these materials, please keep the papers. If you are not yet working with us to improve our materials and would like to help, please contact us at <mailto:MarsRover@uh.edu>.
2. During this two day lesson, the teacher is encouraged to use formative assessments to determine and deepen student understanding. Teachers may wish to use one or both of the included Exit Tickets after the conclusion of the first day or review and/or grade students' Science Notebooks to establish student understanding.
3. Teachers are encouraged to create their own grade-level and ability-level assessments so as to best meet the needs of their students.

Supplemental Resources

For Students

Planet Size Comparison

http://www.messenger-education.org/Interactives/ANIMATIONS/Planet_Size_Comparison/planet_size_comparison_full.htm

Explore the Solar System

<http://spaceplace.nasa.gov/solar-system-explorer/en/>

<http://eyes.nasa.gov/>

For Teachers

Solar System Scope

<http://www.solarsystemscope.com/>

Eyes on the Solar System

<http://eyes.nasa.gov/>

World Wide Telescope

<http://www.worldwidetelescope.org/Home.aspx>

Discover the Red Planet with the World Wide Telescope

<http://www.worldwidetelescope.org/whatis/whatIsWWT.aspx?Page=Mars>

Solar System Lithograph Set

http://solarsystem.nasa.gov/multimedia/download-detail.cfm?DL_ID=262

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