NATIONAL GEOGRAPHIC

**GIANT MAPS**

**SOLAR SYSTEM**

# SPACE IN SPACE

**RECOMMENDED GRADES: 4-12**

**TIME NEEDED: 40 MINUTES**

### Description

Students use astronomical units to measure distances in the solar system and create a model solar system map along a 12.5-meter (41-foot) rope.

### Learning Objectives

Students will:

- measure and communicate the relative distances between each planet in the solar system using astronomical units

### Materials

- 15.24-meter (50-foot) rope, marked at 12.5 meters
- Calculators (20)
- Clothespins (10)
- Measuring tapes (8)
- Planet Cards (32 total, 4 per group)

### Preparation

*5 minutes*

- Place a tape measure and a clothespin at each planet along the edges of the map.
- Place a 12.5-meter (41-foot) rope along the edge of the Giant Solar System map where the sun is partially displayed.
- Establish a place away from the map where students may record their measurements; i.e., whiteboard, paper on easel.

### Rules

Have students remove shoes before walking on the map.

## DIRECTIONS

1. Gather students around the map to observe the scale size of the planets printed on the map edges. Call the students' attention to planet features such as color, shape, and size. Ask: *What do you notice about the sizes of the inner planets and the outer planets? How many Earths do you think would fit in Jupiter?*

2. Divide the class into eight planet teams and have each team sit on the edge of the Giant Solar System map near their assigned planet.

3. Provide each team with their respective Planet card (four copies of each Planet card) which lists information on physical characteristics of their team's planet (diameter, distance in miles, kilometers, and astronomical units from the sun).

4. Have students gather along the sun edge of the map. Encourage students to observe characteristics of the sun. Ask: *What can you tell me about the sun? Does the sun have features that are not found on planets?* (Sample answers: sunspots, solar wind, solar flares). Explain that the entire sun could not fit on this map; the sun's diameter is 1.392 million km (864,938 mi). Using Earth's diameter 12,756 km (7,926 mi) scaled to 11.5 cm (4.5 in) on this map, the sun would be 1,254.9 cm or 12.5 m (494.1 in or 41.2 feet).

5. Lay out the 15.24-meter (50-foot) rope, marked at 12.5 meters (41 feet), to demonstrate the relative size of the sun. Have students stand along the rope and gaze back to their planet along the edges of the Solar System map. Ask: *How does the relative size of the sun compare to the size of the planets?*

6. Use the enclosed 11.5-cm (4.5-in) ball to further demonstrate the relative size of Earth to the size of the sun. Ask students to consider why the sun does not look so large in the sky. Encourage students to think about the distances that exist in space as they prepare for the next activity.

7. Have students return to their planet team and sit near their respective planets.

8. Explain to students that previous astronomers and mathematicians studying the solar system used astronomical units to describe distances in the solar system. Astronomers such as Tycho Brahe, Johannes Kepler, and Giovanni Cassini all tried to perfect the measurement of an astronomical unit. In 2012, the International Astronomical Union defined the astronomical unit to be 149,597,870.7 km (rounded to 150 million km). Ask students if they know of other units used to measure distances in space, e.g., light years or parsecs.

9. Have students locate the measurements of 20 AU, 30 AU, and 40 AU on the Solar System map. Let students walk around the orbits at those distances. Have students describe what they observed on their "travels" in the solar system.

10. Lay the 15.24-meter (50-foot) rope, marked at 12.5 meters (41 feet), from the sun end on the Solar System map to the opposite end.

11. Working in their planet teams, have students read the AU data on the their Planet cards to see the number of AU each planet is from the sun. Using the scale of 1 AU = 30.5 cm (1 foot), have students calculate how many feet/meters their planet is from the sun. Check

student work using the Relative Planet Distances Answer Key, found at the end of this activity.

12. Have students measure their calculated distance from the sun end of the rope and place a clothespin on the rope at the location of each planet:

    - Mercury 5 cm (4.6 inches)
    - Venus 11 cm (8.76 inches)
    - Earth 30.5 cm (12 inches = 1 foot)
    - Mars 46. 3 cm (1.52 feet = 18.24 inches)
    - Jupiter 158.2 cm = 1.58 m (62.3 inches = 5.19 feet)
    - Saturn 291.39 cm = 2.91 m (114.72 inches = 9.56 feet)
    - Uranus 583.7 cm = 5.84 m (229.8 inches = 19.15 feet)
    - Neptune 913.4 cm = 9.13 m (359.6 inches = 29.97 feet)
    - *Just to note: Pluto would be at 1215.16 cm = 12.2 m (478.4 inches = 39.9 feet)*

13. Observing the clothespins on the rope, discuss with students the location of the inner planets (Mercury, Venus, Earth, and Mars) and the outer planets (Jupiter, Saturn, Uranus, and Neptune). Have students describe what separates the inner planets from the outer planets (the asteroid belt).

## EXTENDING THE LEARNING

- Incorporate more math by having students calculate each planet's distance from the sun in astronomical units and compare their answers to the values provided on the Planet Cards. To calculate the distance for each planet, divide the planet's distance from the sun in kilometers by the Earth's distance from the sun in kilometers (1.50 x 108 kilometers).

- Additionally, have older students calculate the light minutes to each planet from the sun using the scale of 1 AU = 30.5 cm (1 foot). The speed of light is 300,000 km/s or about 186,000 mi/s. Older students can also calculate the number of Earths that can fit into each planet by volume, not just by diameter. (Remember, the volume of a sphere equals (4/3)πr3.)