Planets' Relative Positions

This is a hands-on, interactive, cooperative learning activity where students have to use problem solving skills and apply math concepts such as estimation, ratios and converting units of measurement, to determine the relative position of the planets to the sun and each other. It is to follow the "Scaled Model of the Solar System" lesson.

Supplies:

- large open space
- index cards
- masking tape
- metre stick
- string or yarn
- "Planets' Distances From the Sun" table
- planet cards from "Scale Model of the Solar System" lesson

*This lesson could be integrated into your math curriculum when you are covering ratios. It would work well when students are learning about scales with reference to maps.

Procedure:

1. Students are put into groups.

2. Each group writes the name of the Sun and the planets on a set of index cards.

3. Each group places their SUN card at one end of the space you are using for this activity.

Objectives

- identify the planets' positions relative to the Sun and each other

Key Concepts:

- solar system is mainly empty space

- inner planets (Mercury, Venus, Earth and Mars) are much closer to the sun and each other, than the outer planets

- to infer the effect a planet's distance from the sun has on the planet's temperature, orbit, etc.

1. Recalling the relative sizes of the planets in the "Scaled Model" lesson, groups discuss how far from the Sun (and each other) to place each of the planet cards. They place their cards according to their predictions.

2. Students are given a copy of the distance table (see below) which shows how far each of the planets is from the Sun. Have students convert the distance from kilometers to meters, determine the scaled distance and the number of steps required to travel the scaled distance.

- Like the Scaled Model lesson, the scale factor is 1:10 billion. This means that every meter the students take is equal to 10 billion meters in the real solar system.

- A "step" is considered $\frac{1}{2}$ a meter. Students need to take approximately two steps to equal one meter.

Example:
Mercury is roughly 58 million km from the Sun. 58 million kilometers is 58 000 000 000 meters (58 billion). Round 58 billion to the nearest ten billion (60 billion). Our scale is one meter for every 10 billion meters. Our scaled distance for Mercury would then be 6 meters. If a step is $\frac{1}{2}$ meter, then the students would have to walk 12 steps to total 6 meters.

3. Given the results on their distance table, students determine how many meters of space they will need to get to Neptune.

4. Students tape their string to the SUN card and pace out the distance each planet is from the Sun, taping their planet cards from the "Scaled Model" lesson to the string at the predetermined distances.

5. Have students compare where they predicted the planets would be and the actual scaled positions. Discuss their findings.

6. Have students record in their Astronomy Journal what they have discovered and what might have surprised them as a result of this exercise.

- Draw the students' attention to the fact that the planets travel in an ellipse, not a circle around the sun, and therefore, there are times when the planets are a little closer together or farther apart. This activity shows the minimum distances between the planets.

- After the exercise is complete, tell the students that at this scale, the nearest star would be another grapefruit that would need to be placed at a distance of 1,500 km from the one representing the Sun. This is roughly the distance between Winnipeg and Ottawa.

ADAPTATION

Your class can adapt the above lesson plan to create a solar system using toilet paper. Instead of using string and index cards, toilet paper will be used. The scale used would be:

1 sheet of toilet paper = 10 billion meters

Assuming the Sun is at the edge of the beginning of the toilet paper, students will unwind the toilet paper, marking each planet's location on the paper.

PLANET DISTANCES FROM THE SUN

Planet	Distance from Sun (km) (average)	Distance from Sun (m)	Distance from Sun (rounded to the nearest 10 billion meters)	Scaled Distance from Sun	Steps from Sun (step = ½ m)
Mercury	(58 million km) 58 000 000	(58 billion meters) 58 000 000 000	(60 billion meters) 60 000 000 000	6	12
Venus	108 000 000				
Earth	150 000 000				
Mars	228 000 000				
Jupiter	778 000 000				
Saturn	1 427 000 000				
Uranus	2 870 000 000				
Neptune	4 497 000 000				

- The scale factor is 1 to 10 billion. Every meter in the scale model represents 10 billion meters in the real solar system.

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Venus	108 000 000	108 000 000 000	110 000 000 000	11	10
Earth	150 000 000	150 000 000 000	150 000 000 000	15	8
Mars	228 000 000	228 000 000 000	230 000 000 000	23	16
Jupiter	778 000 000	778 000 000 000	780 000 000 000	78	110
Saturn	1 427 000 000	1 427 000 000 000	1 430 000 000 000	143	130
Uranus	2 871 000 000	2 871 000 000 000	2 870 000 000 000	287	288
Neptune	4 497 000 000	4 497 000 000 000	4 500 000 000 000	450	326

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