Solar System—Lesson Three

Finding where the planets are in the Solar System using a scale

STANDARD III: Students will understand the relationship and attributes of objects in the solar system.

Objective 1:
Describe and compare the components of the solar system.

Indicator c:
Use models and graphs that accurately depict scale to compare the size and distance between objects in the solar system.

Lesson Performance Expectation:
The students will be able to use math to find out the planets' relative position rom the Sun out to Pluto.

The Planets' Scale and Position Background information:
(Part of the background information is taken from the State of Utah Science Teacher Resource Book, 6th Grade, 2005, pages 10.2.8 and 10.2.9)

"Students often have misconceptions about the relative sizes of objects in the solar system and the distances between them. Inaccurate commercial models, posters, drawings in books, and science fiction movies perpetuate these errors."

"One of the best ways to dispel these misconceptions is to give students opportunities to record accurate representations. It is difficult to accurately measure to scale both the size of objects in the solar system and their corresponding distances because of the vastness of the solar system."

"The diameter of the sun is approximately 109 times larger than the diameter of
Earth. By coincidence the distance from the sun to Earth is a little more than 107 times the distance of the sun's diameter, or 107 sun diameters. Earth's diameter is approximately 1.5 times the diameter

of the moon. The distance from Earth to the moon is approximately 30 Earth diameters. These ratios are useful in calculating relative size and distance. The distances of the planets from the sun are arranged in a somewhat orderly geometric progression."

Science Practices:

- Developing and using models
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations
- Communicating information

Crosscutting Concepts

- Patterns
- Scale
- System Models

Disciplinary Core Ideas

- Mathematics

The Investigation

Materials:

1. Calculator for each student
2. Desk-sized map of the United States
3. Wall map of the United States
4. Strip of paper 300 cm long x 10 cm wide per team
5. Meter Ruler for each group
6. Words for each of the planets for each group
7. Worksheet: Scale of the Planets for each student
8. Tape for each group

Preparation

1. For each group cut a strip of bulletin board paper 10 cm wide and 300 cm long.
2. Run off the worksheet for each student.
3. Have calculators ready to hand out to each student.

Pre-activity Work

1. Put the students in groups of 2, 3 or 4.
2. Give each group the pre-cut strip of paper, a meter ruler, the words of the planets, and tape.
3. Give each student in each group a calculator and the worksheet.
4. Tell the students that by using a scale, we can place the planets in their proper order and proper distance to scale on the 300 cm strip of paper.
5. Tell the students that to find a scale for what we are doing, we have to do some calculations on a calculator.
6. The sun will be our first object and Pluto will be our last object.
7. Have the students put the word "Sun" at one end of the 300 cm strip of paper and the word "Pluto" at the other end of the trip of paper. These will be our reference points for figuring out our scale.
8. We have two numbers we can work with to find the scale:

a. 300 cm (the length of the strip of paper)
b. 3,666,200,000 miles (the actual miles from the sun to Pluto)

9. Ask the students what can we do to find how many miles will equal 1 cm. Have them work it out for a couple of minutes to see if they can do the math.
10. Ask what they did to find how many miles is 1 cm. (If we divide 3,666,200,000 miles by 300 cm we find that one centimeter is equal to 12,220,666 miles.)
11. We can round this off to 12,221,000 miles per centimeter.

Activity Directions

1. Pass out the worksheet to each student.
2. Tell the students that by using division on their calculators, they are able to find where to put each planet to scale on the 300 cm strip of paper.
3. They are to divide the distance of each planet by the number of mile per cm (12,221,000).
4. When they see the number on the calculator, they are to round the centimeter answer off to the nearer centimeter.
5. Have them do all the calculations for each planet and write the answers on there worksheets as they go. They should all do it

separately so they can cross-verity each answer. (You probably should do the first one with them.)

6. At this time, they are not to do anything with the percentage distance.
7. When they are done with all the calculations and have written them down on their worksheets, have them measure, with the meter ruler, the number of centimeters that each planet is away from the sun and write that number on the strip of paper.
8. Put the names of the planets on the strip of paper on the number they represent.
9. Have a discussion of what they discovered about the spacing of the planets.