Solar System Scale

After Activity D-5 in Solar Project Astro Resource Notebook

Grades: 6-12

Subject: Space Science

Purpose: Students create a scale model of planetary distances in the solar system. It is a good way to demonstrate the vast distances among the outer planets and to apply math skills in proportion. Sizes and distances in the Solar System are difficult to visualize and scale models are usually distorted in textbooks so that they will fit on the page.

Materials: meter sticks, 400 cm heavy string for each group, masking tape

Procedures: Ask students to draw a picture of what they think the solar system looks like. This will help them get focused on the activity. Next, hand students the following chart to complete, or work out the calculations on an overhead with the students, depending on students' readiness level.

Planet	Distance from Sun (AU)	Distance to planet (kilometers)	Scale distance from Sun (centimeters)	Actual diameter (kilometers)
Sun (a star)	0			1,391,980
Mercury	0.39	58,000,000		4,880
Venus	0.72	108,000,000		12,100
Earth	1.00	150,000,000		12,800
Mars	1.52	228,000,000		6,800
Jupiter	5.20	778,000,000		142,000
Saturn	9.54	1,430,000,000		120,000
Uranus	19.2	2,870,000,000		51,800
Neptune	30.1	4,500,000,000		49,500
Pluto	39.4	5,900,000,000		2,300

AU – astronomical unit, which is the distance from the Earth to the Sun.

To calculate the distance from the model sun to each model planet, you need to calculate a scaling factor. For simplicity, use a scale distance from the Sun to Pluto of 394 cm. Determine the scaling factor by dividing the distance 394 cm by the distance from the Sun to Pluto in AU. 394 cm divided by 39.4 AU is 10 cm/AU. Multiply the scaling factor 10 cm/AU by the actual distance from the Sun to each of the planets in AU.

Planet	Distance from Sun (AU)	Distance to planet (kilometers)	Scale distance from Sun (centimeters)	Actual diameter (kilometers)
Sun (a star)	0			1,391,980
Mercury	0.39	58,000,000	3.9	4,880
Venus	0.72	108,000,000	7.9	12,100
Earth	1.00	150,000,000	10	12,800
Mars	1.52	228,000,000	15.2	6,800
Jupiter	5.20	778,000,000	52.0	142,000
Saturn	9.54	1,430,000,000	95.4	120,000
Uranus	19.2	2,870,000,000	192	51,800
Neptune	30.1	4,500,000,000	301	49,500
Pluto	39.4	5,900,000,000	394	2,300

After calculations are complete, have each group use 400 cm string and measure distance of planet from sun using meter sticks. Use pieces of tape to mark planets.

When everyone is complete, ask students to draw another picture of the solar system using the completed scale as a model.

Questions:

1. How did the solar system scale we worked out and your original drawing match? How did they differ?
2. Why do you think the outer planets are so much farther apart than the inner planets?
3. Is there a correlation between planet size and how far it is from other planets?

Extensions: Students can use this exercise to start studying gravity and its role in the solar system.

Assessments: Have students write a reflection paper on what they learned in this activity. They can focus on the differences between their before and after pictures.

National Science Standards addressed:

Content Standards 5-8, Content Standard D, Earth in the solar system: The Earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, and average star, is the central and largest body in the solar system.

Content Standards 9-12, Content Standard B, Motions and forces: Gravitation is a universal force that each mass exerts on any other mass. The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

New Mexico Science Education Standards addressed:

Grades 5-8, Earth and Space Science, Strand II, Standard III, Benchmark I: Describe how the concepts of energy, matter, and force can be used to explain the observed behavior of the solar system, the universe, and their structures. Grade 5, #1: Know that many objects in the universe are huge and are separated from one another by vast distances (e.g., many stars are larger than the sun but so distant that they look like points of light).

Grades 9-12, Earth and Space Science, Strand II, Standard III, Benchmark I: Examine the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe, and their interconnections. Grade 9-12, #1: Understand the scale and contents of the universe, including objects in the universe such as planets, stars, galaxies, and nebulae.