Our Corner of the Universe
AST 101, FALL 2007
SCALE MODEL OF SOLAR SYSTEM
Week of October 16

PRE-LAB

Sizes and distances in the Solar System are difficult to visualize. The distance from the Sun to Earth is 150 million km. The diameter of Jupiter is 140 thousand km. Both of these measurements are much larger than anything you ever see, so they are difficult to imagine. But, there is another way of thinking about the Solar System that is much simpler. It involves reducing all the sizes by the same amount: for example, dividing all the sizes and distances by two. These new values can be used to make what is known as a scale model. We have used scale models often in class. In this lab you will make a scale model of the solar system.

Examples of scale models are all around. Model railroads are scale models of trains. A globe is a scale model of Earth. See Cosmic Perspective, pp. 9-11. The advantage of scale models is that they allow us to determine the distance and size of the true object. All that is needed is the *scaling factor* that was used in making the model. For example, if the wheels of a model care are 10 cm in diameter, and the wheels of a real car are 70 cm, then the scaling factor is 70 ÷ 10 or 7. Now, any size in the real care can be determined by looking at the model car. If the door of the model is 20 cm long, then the door of the real care is 20 × 7 or 140 cm long.

Johannes Kepler built a scale model of the Solar System almost 300 years ago using the best estimates for size and distance available at his time. As his base scale, he used what would later become known as the Astronomical Unit, the distance between the center of mass of the Sun and the center of mass of the Earth-Moon system. Once the true length of an AU was found (150 million km), the scaling factor could be determined and the rest of the distances calculated.

OBJECTIVE

The objective of this activity is to build a scale model of the planetary distances in the Solar System.

PROCEDURE

1) Each group will be assigned a different region into which they will "scale" the Solar System. For this region, measure the longest distance you can. [Try to make your measurement to 3 significant figures.] Record this data in Table 1. This distance will represent the distance between the Sun and the planet Pluto (that is 39.4 AU or 5.9 billion km).

2) To calculate the distance from the model sun to each model planet, you need to calculate a scaling factor. Determine the scaling factor by dividing the distance from step 1 above by the distance from the Sun to Pluto in Data Table 2. Record the scaling factor in Data Table 1. For example, if the longest distance usable is 78 m, then the scaling factor is 78 m ÷ 39.3 AU = 1.98 m/AU.

3) Multiply the scaling factor from step 2 by the actual distance from the Sun to each of the planets in AU. Use the distances in Data Table 2. Record the answer in the column labeled "scale distance from Sun."

DATA TABLE 1

Largest usable distance	Distance to Pluto (AU)	Scaling factor (m/AU)
	39.4	

DATA TABLE 2

Planet	Distance from Sun (AU)	Distance to planet (kilometers)	Scale distance from Sun (meters or cm)	Actual diameter (kilometers)
Sun (a star)	NA	NA	NA	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

4. Measure out a scale distance to Mercury from the Sun. Mark out this distance (use paper clips, paper, hats or people, depending on how big your region is. From that point, continue measuring out to Venus, and mark that spot. Continue doing this for all the planets out to Pluto.

QUESTIONS AND CONCLUSIONS

1. Describe what your model looks like.

2. The nearest star to Earth is Alpha Centauri, 274,332 AU away. Where would this star be placed in your scale model of Solar System distances?

3. What are some of the advantages and disadvantages that you see in using a scale model? Be specific and use examples from this activity.

4. How large is the sun in your scale model? What actual object could represent this?