

**I. Objectives**

1. Create a scale model of the solar system.
2. Classify the various types of solar system bodies based on size and location.
3. Practice calculations and unit conversions.

**II. Introduction**

A model of the solar system can provide us with a visual representation that helps us to see the relationships among the planets' sizes and distances from the Sun. We will create a linear model, just a little over 100 m in length, with the Sun at one end and Eris at the other.

**III. Theory and Calculations**

To keep our model simple, we will round our numbers a little, and use 150,000,000 km for one AU, instead of 149,600,000 km. We will then use the following conversion factors to calculate the distances and sizes in our scale model:

$$\frac{1.5 \text{ m, scale model}}{1 \text{ AU}} = \frac{1.5 \text{ m, scale model}}{150,000,000 \text{ km}} = \frac{1.0 \text{ m, scale model}}{100,000,000 \text{ km}} = \frac{1.0 \times 10^{-8} \text{ m, scale model}}{1 \text{ km}}$$

**IV. Prelab Definitions**

1. terrestrial planet
2. dwarf planet
3. jovian planet

**V. Prelab Questions**

1. List the names of the 8 planets in our scale model.
2. List the names of the 5 dwarf planets in our scale model.
3. What are the characteristics of planets and dwarf planets that distinguish them from each other?
4. Summarize the formation process of our solar system.
5. Describe the runaway greenhouse effect.
6. Why do jovian planets have rings and so many moons?



**VI. Lab Procedure**

1. In the *Distances from the Sun and Radii of Solar System Objects* table below, convert column B, distance from the Sun in AU to column C, distance from the Sun in m in our scale model:  $C = B \times 1.5$ .
2. Calculate column E, diameter in km, from column D, radius in km:  $E = D \times 2$ .
4. In column F calculate the scale model diameter in m from the actual diameter in km in column E:  $F = E \times 1.0 \times 10^{-8}$ .
5. In column G calculate the scale model diameter in mm from the scale model diameter in m in column F:  $G = F \times 1,000$ .
6. Follow the instructions given in class for creating our scale model of the solar system.

*Distances from the Sun and Radii of Solar System Objects*

| A                   | B                              | C                                  | D                   | E                     | F                         | G                          |
|---------------------|--------------------------------|------------------------------------|---------------------|-----------------------|---------------------------|----------------------------|
| Solar system object | Actual distance from Sun in AU | Scale model distance from Sun in m | Actual radius in km | Actual diameter in km | Scale model diameter in m | Scale model diameter in mm |
| Sun                 | 0.0                            |                                    | 695,990             |                       |                           |                            |
| Mercury             | 0.4                            |                                    | 2,439               |                       |                           |                            |
| Venus               | 0.7                            |                                    | 6,052               |                       |                           |                            |
| Earth               | 1.0                            |                                    | 6,378               |                       |                           |                            |
| Mars                | 1.5                            |                                    | 3,398               |                       |                           |                            |
| Ceres               | 2.8                            |                                    | 450                 |                       |                           |                            |
| Jupiter             | 5.2                            |                                    | 71,494              |                       |                           |                            |
| Saturn              | 9.5                            |                                    | 60,330              |                       |                           |                            |
| Uranus              | 19.2                           |                                    | 25,559              |                       |                           |                            |
| Neptune             | 30.1                           |                                    | 24,750              |                       |                           |                            |
| Pluto               | 39.4                           |                                    | 1,151               |                       |                           |                            |
| Haumea              | 43.4                           |                                    | 1,518               |                       |                           |                            |
| Makemake            | 45.8                           |                                    | 750                 |                       |                           |                            |
| Eris                | 67.7                           |                                    | 1,300               |                       |                           |                            |

**VII. Lab Discussion**

1. Using the scale in this lab, what items could we use to represent the Sun, the planets, and the dwarf planets?
2. Given the layout of your model, where are the solar system objects located? Why?
3. How does the creation of this model help us to understand the actual scale of our solar system?

**VIII. Answers***Distances from the Sun and Radii of Solar System Objects*

| A                   | B                              | C                                  | D                   | E                     | F                         | G                          |
|---------------------|--------------------------------|------------------------------------|---------------------|-----------------------|---------------------------|----------------------------|
| Solar system object | Actual distance from Sun in AU | Scale model distance from Sun in m | Actual radius in km | Actual diameter in km | Scale model diameter in m | Scale model diameter in mm |
| Sun                 | 0.0                            | 0.00                               | 695,990             | 1,391,980             | 1.39e-02                  | 1.39e+01                   |
| Mercury             | 0.4                            | 0.60                               | 2,439               | 4,878                 | 4.88e-05                  | 4.88e-02                   |
| Venus               | 0.7                            | 1.05                               | 6,052               | 12,104                | 1.21e-04                  | 1.21e-01                   |
| Earth               | 1.0                            | 1.50                               | 6,378               | 12,756                | 1.28e-04                  | 1.28e-01                   |
| Mars                | 1.5                            | 2.25                               | 3,398               | 6,796                 | 6.80e-05                  | 6.80e-02                   |
| Ceres               | 2.8                            | 4.20                               | 450                 | 900                   | 9.00e-06                  | 9.00e-03                   |
| Jupiter             | 5.2                            | 7.80                               | 71,494              | 142,988               | 1.43e-03                  | 1.43e+00                   |
| Saturn              | 9.5                            | 14.25                              | 60,330              | 120,660               | 1.21e-03                  | 1.21e+00                   |
| Uranus              | 19.2                           | 28.80                              | 25,559              | 51,118                | 5.11e-04                  | 5.11e-01                   |
| Neptune             | 30.1                           | 45.15                              | 24,750              | 49,500                | 4.95e-04                  | 4.95e-01                   |
| Pluto               | 39.4                           | 59.10                              | 1,151               | 2,302                 | 2.30e-05                  | 2.30e-02                   |
| Haumea              | 43.4                           | 65.10                              | 1,518               | 3,036                 | 3.04e-05                  | 3.04e-02                   |
| Makemake            | 45.8                           | 68.70                              | 750                 | 1,500                 | 1.50e-05                  | 1.50e-02                   |
| Eris                | 67.7                           | 101.55                             | 1,300               | 2,600                 | 2.60e-05                  | 2.60e-02                   |