*Scale of the Solar System Experiment A06*

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| Name |  | Lab Section |

*Objective*

* To create a scale model of our solar system

*Materials*

Calculator Printer Tape

Ruler Two different color pens/pencils

*Theory*

Our solar system is so enormously big that it’s difficult to consider the distances between planets. For example, the distance from the Earth to the Sun is about 93 million miles (1.49 x108 km). If you could travel at the speed of light (the fastest speed possible according to physics), it would take about 8 ½ minutes to travel from the Sun to the Earth.

This lab is designed to take the vast emptiness of our solar system and create a scale model that is easier to visualize.

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| ***Part A: First Estimate*** |

First, take a roll of receipt paper to get a long piece of paper. (Another option is to use several pieces of notebook paper and tape them together.) Unroll your paper until you have a length that is about equal to your “wingspan” (the length from fingertips to fingertips when you spread your arms apart).

On one end of the strip, draw and label the Sun. On the other end, draw and label Pluto. Remember that Pluto is no longer considered a major planet, but it is at the inner edge of the Kuiper Belt.

In between the Sun and Pluto, draw and label ***where you think*** the rest of the planet orbits are. Also place the asteroid belt. Don’t go look up the order of the planets or their relative positions. There’s no right or wrong here. This is just about getting your thoughts on where the planets are scattered throughout the solar system so that we can compare it to the actual placements later.

Once you are finished with your estimated positions, take a selfie with your “Solar System”. Include your picture below. If you are uncomfortable taking a selfie, you can take just a photo of your solar system. (If the required selfies are not submitted, a **zero** will be recorded for the lab.)

Delete this box and insert your photo here.

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| ***Part B: Scale Model*** |

Next, we’ll use the known distances between planets to create a scale model to compare to your model. Provided on the next page is a table with the semi-major axis (average distance from the Sun) for each planet (in kilometers). As you can see in the table, the distance between Pluto and the Sun is 5.91 X 109 kilometers (over 3.6 billion miles).

Measure the length of your paper strip in centimeters.

Length of Paper: cm

To scale everything down, we must convert the real-world distances to our scale model distances. For your conversions, you will use the scale factor:

$$Scale Factor=\frac{(your paper strip length in centimeters)}{5.91 × 10^{9 }kilometers}$$

What is your Scale Factor?

Scale Factor:

As you calculate the scaled distances for the planets on your paper, enter that value in the table below.

 **Here is an example of the calculations you will need to do:**

If your measured distance between the Sun and Pluto on your strip is 30 cm (it won’t be! It will be much longer than this!), and wanted to see what the scaled distance between the Sun and Mercury is, then you would calculate

$\left(\frac{30 cm}{5.91 × 10^{9} km}\right)$ $× \left(5.83 × 10^{7} km\right) =0.29 cm$

In this example, the distance from the Sun to Mercury on our paper would be 0.29 cm (about 0.1 inches).

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| **Object** | **Semi-major Axis (km)** | **Scaled Distance Calculated (cm)** |
| **Sun** | ----------- | ----------- |
| **Mercury** | 5.83 x107 |  |
| **Venus** | 1.08 x108 |  |
| **Earth** | 1.50 x108 |  |
| **Mars** | 2.27 x108 |  |
| **Asteroid Belt** | 3.28 x108 to 4.77 x108 |  |
| **Jupiter** | 7.78 x108 |  |
| **Saturn** | 1.43 x109 |  |
| **Uranus** | 2.87 x109 |  |
| **Neptune** | 4.50 x109 |  |
| **Pluto** | 5.91 x109 |  |

***(Be careful to note the value of the exponent in each case.)***

Once your table is complete, use a different color to mark the actual positions of the planets and asteroid belt on your paper strip. Include a key to indicate which color are your predictions and which are the actual locations. The distances you calculated are how far the planet is from the Sun in centimeters.

***Take a selfie with your finished Solar System and include it below.***

Delete this box and insert your photo here.

1. Compare your estimated positions to the actual positions. Are there differences? What surprises you most about the differences you see?

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| Enter Answer Here |

1. We often refer to the “inner planets” and “outer planets”. Describe the actual positions of the planets on your strip which illustrate this distinction. Where is the “split” between inner and outer planets?

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| Enter Answer Here |

1. Some of the planets much further out than Earth are brighter in Earth’s night sky than planets that are closer to Earth. What could that tell us about those brighter, outer planets?

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| Enter Answer Here |

*This lab manual was written by Justin Mason, Old Dominion University, and copied to be made available on this website by Corey Sargent, Old Dominion University, Fall 2021*