Solar System Size and Scale Lab

Part 1: Group Introduction

Your prediction for how far in paces Mercury should be from the Sun:

The class' consensus prediction for how far in paces Mercury should be from the Sun:

The true distance in paces from the Sun to Mercury in this scale model:

1. What was your first reaction to the scale model of the Sun and Mercury that we just created in the classroom? Is it anything like what you first pictured in your mind when you were asked to space the planets out in the classroom yourselves?

2. What is the ratio of the number of paces to Mercury in your original model to the number of paces in the scale model? How far off were you as a percentage?

3. How much space do you now think we will need to construct a complete scale model of the solar system?

Part 2: Classroom Investigation

You must visit each of the following three stations, which are set up around the classroom, one at a time. At stations 1 and 2, ONE MEMBER of your group should pick up the face down instruction sheet and read it aloud step by step to the other members **without showing it to them**. Rotate the group member reading the instructions from station to station. Once you have completed the activity at stations 1 and 2, answer the questions for that station. Do NOT attempt to answer the questions before completing the activity. At station 3, DO NOT flip the sheet of paper over until the activity tells you to do so. **Show your work and answer in complete sentences.**

Station 1: Play Dough Planets

1. Note: At (almost) every step of this activity, you were asked to divide the play dough into ten equal pieces. If the entire lump of play dough represents the total size of all of the material in the solar system if you were to lump it all together. At the first step, you divided this total into ten equal pieces, so each lump represents 1/10, or 10% of the total material in planets in the solar system. At the next step, 1/100 or 1% and then 1/1000 or 0.1%. Use this trend to complete the chart below.

Planet	Fractions	Percentage of Total
EXAMPLE: Planet "X"	$\frac{5}{10}+\frac{3}{100}+\frac{1}{1000}=\frac{531}{1000}$	53.1%
Mercury		
Venus		
Earth		
Mars		
Jupiter		
Saturn		
Uranus		
Neptune		
Pluto		

2. Now, using your number from the chart for the Earth as a **unit conversion** (1 Earth = ___% of solar system), determine how many times larger or smaller each planet is relative to the Earth. Round your answers to the nearest tenth. (Example: Planet X is 3.1 times larger than the Earth, while Planet Y is 5.2 times smaller).

Mercury is __________ times _________ er than the Earth

Venus is __________ times _________ er than the Earth

Mars is __________ times _________ er than the Earth

Jupiter is __________ times _________ er than the Earth

Saturn is __________ times _________ er than the Earth

Uranus is __________ times _________ er than the Earth

Neptune is __________ times _________ er than the Earth

Pluto is __________ times _________ er than the Earth

BEFORE YOU MOVE ON, check that all of your answers in the first blank above are bigger than one. If not, your bigger/smaller conclusion is incorrect. If you are not sure how to revise your answer, raise your hand and I'll come help.

3.

a. Do these numbers (both the percentages that you computed in (1) and the ratios the you computed in (2)) represent the relative **volume, area, or radii** of the planets and how do you know?

b. How would the number be different (bigger or smaller and by what factor) for the other two?

Station 2: Register Tape Solar System

1.
   a. What object lies at the “halfway point” of our solar system?

   b. Does this answer surprise you? Why or why not?

2.
   a. What percentage of the solar system’s length (from Sun to Kupier Belt/Pluto) is taken up by the inner “terrestrial” or rocky planets (Mercury, Venus Earth and Mars)?

   b. What percentage of the solar system’s AREA is taken up by the inner “terrestrial” or rocky planets?

   c. Did the answers to (a) and (b) surprise you? Why or why not?

3. Measure the distance from the Sun to Uranus in your model using the ruler or tape measure provided and record it below (include units!)

   Distance from Sun to Uranus:

4. The true distance to Uranus is _________ AU. Use your Units Cheat Sheet and your measurement of the distance from the Sun to Uranus in your model to determine the scale factor for this model and fill it in in the blank below.

   This solar system has a scale factor of 1: ______. This means that we would have to

   scale it up by _________ times to make it equivalent to the true solar system.

5. Is this scale factor larger or smaller than the scale on a typical world map? Why or why not?

Station 3: The "Mystery Bag" Solar System

Record the masses of the bags in the table below. **When you are done**, fill in the second column with your guess as to which planet is which. Only when both columns are complete should you open the key and record the correct answers in column 3.

Bag Label	Mass (you measure this – include a unit!)	YOUR GUESS as to which planet this is	Correct Planet (DO NOT FILL IN THIS COLUMN UNTIL YOU'VE COMPLETED ALL THE OTHERS)
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			

1. There are two sets of planets in our solar system that are in many ways twins of one another. Which TWO sets of planets (ex: Planets B and G and Planets A and D) were most similar in mass? Which planets are these in our real solar system?

2. Although these "twin" planets are very similar in many ways, the properties of their surfaces and atmospheres are very different. Come up with an explanation for why this might be.

3. Now, using your number for the Earth as a **unit conversion** (1 Earth = ___ mg or ot whatever unit you used to measure mass), determine how many times more or less massive each planet is relative to the Earth. Round your answers to the nearest tenth. (Example: Planet X is 3.1 times more massive than the Earth, while Planet Y is 5.2 times less massive).

Mercury is __________ times _________ massive than the Earth

Venus is __________ times _________ massive than the Earth

Mars is __________ times _________ massive than the Earth

Jupiter is __________ times _________ massive than the Earth

Saturn is __________ times _________ massive than the Earth

Uranus is __________ times _________ massive than the Earth

Neptune is __________ times _________ massive than the Earth

Pluto is __________ times _________ massive than the Earth

4. Add together all of your masses and record the value below in kilograms (this may require a unit conversion).

Total mass of all of the mystery bags: ____________ kg

5. The true mass of all of the planets in the solar system is _________ kg. Use these two numbers to determine the scale factor for this model and fill it in in the blank below.

This solar system has a scale factor of 1: ______. This means that we would have to scale it up by _________ times to make it equivalent to the true solar system.

6. Why are the numbers you recorded in #3 different from those you recorded for Station #1?

What property relates the mass and the size of an object and what is the formula for determining it? Hint: look up units

How is this property different for the terrestrial vs. the outer gas giant (or Jovian) planets?