Solar System Size and Scale Lab Continued

Part 3: Solar System Planet Presentations

Each group will present their research on a solar system planet/group of moons/belt to the class in an informal 3-5 minute presentation.

On a separate sheet of paper, write the most interesting thing that you learned about the planet/group of moons/belt from each presentation (except your own). Staple this to the back of the lab.

A portion of your grade for this part of the lab will be based on my examination of your posters according to the rubric below, and a portion will be based on the scores that your peers give you in the following three categories: effectiveness of presentation, quality of research and visual appeal of poster.

Instructor Assessment (1-10 for each category)

______ 5 "interesting facts" were well chosen and explained in the text

______ Data table was completed accurately and with thought, effort and careful attention to instructions

______ Highlighted mission was relevant and well explained

Comments:

Average of your Peer Assessments (1-10 for each category)

______ Effectiveness of Presentation

______ Quality of research

______ Visual appeal of poster

Comments:

Part 4: Pima Campus

We will now create a model of the solar system that is accurate in relative sizes of the planets **and** the distances between them as we started to do in the class introduction.

Your job is to record:

(1) The object representing each planet in our scale model (marble, peppercorn, mustard seed, etc.) in column 2

(2) The distance between the planets in our model *in paces* in column 4

Planet	Object in Our Model	Diameter of that Object	Real Diameter of that Planet (in km)	Distance to that object in our model (in paces)		Real Distance to that Planet (in 10^6km)
Sun	Yellow ball	8 in	1,391,000	0 paces (center!)		0
Mercury			4879			57.9
Venus			12,104			108.2
Earth			12,756			149.6
Mars			6792			227.9
Jupiter			142,984			778.6
Saturn			120,536			1433.5
Uranus			51,118			2872.5
Neptune			49,528			4495.1
Pluto			2930			

Part 3: Investigate Your Model

Before you begin, make sure that if you recorded paces **between** planets as we were going through the lab, you go back and add them up so that each number is the **total** number of paces from the sun to each planet. (a blank column is provided for this if you didn't do it to begin with).

1. You recorded the type of object that was used to mark each planet. These objects are at the front of the classroom now together with a set of rulers. **Measure the diameter of each in *centimeters* and record it in the second column of the table**. In order to be truly systematic about this, you should measure the diameter of several of the more irregular objects (peppercorns, mustard seeds) and average them, then record that number in your table in column 3.

2. Centimeters are a much nicer unit for our purposes than inches because we can be more precise in measuring the objects with a smaller unit. The diameter of the "Sun" that we used to establish our model, however, is still listed in *inches.* You will need to convert this to centimeters using the fact that there are 2.54cm in 1 inch. Show your work below, then record the diameter of the sun in cm in the table underneath the "8in".

3. Now, assuming that we used our "sun" to establish the <u>**scale factor**</u> for our model. A scale factor is the conversion from real physical distance units in the solar system to distance units in our scaled down model. (Hint: 8in (rather, 8in converted to cm) is our model's equivalent to the real physical diameter of the sun, 1,391,000km). Show your work below and then fill in the scale factor.

Model Scale factor: ____________ cm = ____________ km (use scientific notation!)

4. You will often find it convenient to know what one unit in your scale model is equivalent to in real physical units. To find out how many real kilometers one centimeter in our model represents, simply divide both sides of the scale factor you wrote above by the number of centimeters you filled in on the lefthand side. Fill in this equivalent scale factor below.

Model Scale factor: 1 cm = ____________ km

5. One nice thing about having converted into cm for our model is that we now have both set of measurements in metric system units. One thing we could do now is find out what fraction (or percentage) of the true size of the solar system our model represents. To do this, you will first need to make the units in your scale equal (by either converting cm to km or vice versa). Show your work below.

6. Now, you should have two numbers in either cm or km (one of them will be very small or very large, depending on which way you went). In ether case, divide the smaller number by the larger below and write your answer in *scientific notation* and *rounded to one significant figure* below.

7. We now want to represent this as a fraction, which is a little easier for us to wrap our minds around conceptually when considering scales. For example, if you had ended up with the answer 8×10^{-3}, or 0.008, that is equivalent to 8/1000. This would mean that our model was eight one-thousandths the size of the true solar system! What is the real scale between our model and the true solar system represented as a fraction? If it is still unclear to you how to convert a number in scientific notation into a fraction, ask your instructor for help.

8. Venus and Earth were the same size in our model (both peppercorns). Is this strictly accurate? Use your scale factor (either version will do!) to convert the true diameter of both the Earth and Venus to a diameter in our scale model (in cm).

   Earth:

   Venus:

9. In order to compute our error in using a peppercorn for each one, use the "percent error" formula. In this case, do the following for both the Earth and Venus:

$$\text{Percent Error} = \frac{\text{Calculated scaled diameter - true size of peppercorn}}{\text{Calculated scaled diameter}} \times 100$$

   Earth:

   Venus:

10. Finally, lets evaluate the accuracy of our pacing measurement. Develop a method for establishing the “average” pace size of the members of our class. Describe your method and then do it, putting your final answer in the blank at the bottom of the page

    Description of Method:

    Data:

    ______________ cm = 1 pace

11. When we made our scale model, we were using a precalculated model for the number of paces between each of the planets. In fact, every distance in our model (sizes of planets AND distances between them) was established when we chose an 8in diameter ball to represent the sun. Because of this, there was actually a "correct" answer for the number of centimeters represented by 1 pace. To find it, follow the same methodology you used with the last scale factor. Use the planet Mercury, for example. You know how many paces we used to represent the real physical distance to Mercury in km (careful, because the table in your lab actually lists the distances in units of 10^6 km). Write this scale below and then convert it to a 1pace = _______km scale, just as you did earlier.

    Scale factor: _____________ paces = ____________ km

    Scale factor: 1 pace= ____________ km

12. Now, compute the percent error in the pace scale that we calculated in class. After computing this, reflect on how we could have been more accurate in our measurement. Can you think of a better way to have computed the average human pace length than the one that you developed and carried out?