Department of Geology
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Geology 103, Lab 01
Solar System and Nebular Hypothesis

In this lab you will collect planetary data from the internet and evaluate those data in light of the Nebular Hypothesis. For this lab you will need to recall our lectures on the Nebular Hypothesis, and be familiar with Excel. At the beginning of next lab meeting, turn in your answers to the questions at the end of this lab, hard copies of the graphs, and an electronic copy of the Excel worksheet including the graphs.

A) First thing to do is go to the link *Information on the planets* provided on the lab webpage (accessed through compass) or type the url http://www.nineplanets.org/ into your browser. There you will find pretty images of the planets and some basic data such as Mass, Diameter and Distance from the Sun. Record these data for each of the nine planets and enter them into an Excel spreadsheet like so…

Planet	**Distance**	**Mass**	**Diameter**
	km	kg	km
Mercury	5.79E+07		
Venus			
Earth			
Mars			
Jupiter			
Saturn			
Uranus			
Neptune			
Pluto			

Notice that distance and mass values are exceedingly large. Enter these numbers as scientific notation. For example a number like 15 million (15,000,000) is written as $1.5x10^7$ in scientific notation. Where the ^{7} is simply the number of decimal spaces to the right of the first digit. To enter 15 million as scientific notation in Excel, simply enter 1.5e7 and hit return. Alternatively, simply type in 15000000 and hit return. Then highlight the cells you want displayed in scientific notation, click on the Format menu, choose 'cell' and then click the 'number' tab and select 'scientific' from the list of options.

B) Now that you have the basic data (distance, mass and diameter) in a table, you can perform some tasks. First, calculate the density of the planets. This is a simple matter, just think about what is required: Density is the mass/volume of an object expressed in grams per cubic centimeter. So, you need to calculate the volume of the planets (assume they are spheres). Then simply calculate the density (include the conversion to g/cm^3 within your density calculation).

For grading purposes, add a fake planet called 'Check' after Pluto. Input a mass of $9x10^{27}$ kg and a diameter of $2x10^5$km, and calculate it's density.

C) Create an X-Y graph of Distance from the Sun vs. Mass of the Planets (excluding the fake planet 'Check"). You will have to adjust the axes to plot on logarithmic scales. Notice how the first four planets (Mercury, Venus, Earth and Mars) are near the origin on this graph and except for Jupiter and Saturn, the other planets all lie nearly along the Xaxis. Thus, this is a terrible graph because it masks all information regarding trends in mass relative to distance.

Change the axes to logarithmic scale by clicking on each axis, choose the ‘scale’ tab and check the ‘log scale’ box. Do this for both axes and also change the ‘minimum’ axis values (also in the Scale dialog box) as such: Distance minimum = $1x10^7$km, and Mass minimum = $1x10^{22}$kg.

D) Create an X-Y graph of Distance from the Sun vs. Density of the Planets. Here, only the distance need be expressed on a logarithmic scale.

E) Answer the following questions in light of the nebular hypothesis. Ignore Pluto in all your answers.

1. Compare the diameter of the smallest Jovian planet to the largest Terrestrial Planet. Express this quantitatively (e.g. as a percentage, or ratio).

2. How does mass of the planets vary with distance from the Sun?

3. How does density of the planets vary with distance from the Sun?

4. Explain why mass and density vary with distance from the Sun. Recall our discussion of the Nebular Hypothesis and the formation of the planets.