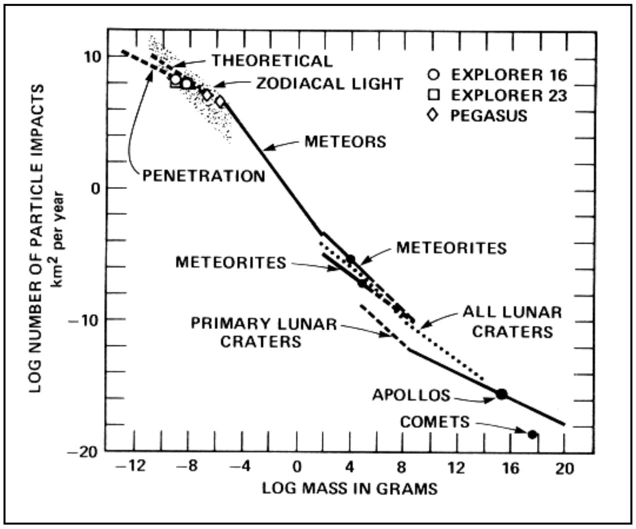

The space between the planets is filled with fragments of asteroids, comets and material left over from the formation of the planets. These rocks and debris rain down upon exposed surfaces at speeds up to 30 km/sec.

The figure on the left summarizes the impact frequency of various sizes of particles in space. Note the graph is plotted in the Log-Log format due to the enormous range of masses and rates being described.

Understanding the data graph:

Problem 1 - A meteorite with a density of 3 grams/cm^3 has a diameter of 4 centimeters (about 1 1/2 inches).

A) What is the mass of this meteorite assuming it is a sphere?

B) From the graph, where on the horizontal axis are objects of this mass located?

C) What is the number of impacts per year you would expect over an area of 10,000 square kilometers?

Replacing a data graph with an empirical model:

Problem 2 - What linear function of the form y = mx + b best describes the data in the LogLog graph?

Problem 3 - What function N(m) is obtained from your answer to Problem 2?

Problem 1 - A meteorite with a density of 3 grams/cm^3 has a diameter of 4 centimeters (about 1 1/2 inches). A) What is the mass of this meteorite assuming it is a sphere? Answer: Mass = Density x Volume. Radius of sphere = 2 cm, so M = 3.0 x (4/3) (3.14) $(2)^3$ = **100 grams**.

B) From the graph, where on the horizontal axis are objects of this mass located? Answer: The horizontal axis is un units of Log(grams) so Log(100) = 2, and this is the location **half-way between 0' and '4' on the axis**.

C) What is the number of impacts per year you would expect over an area of 1000 square kilometers? Answer: From 'x=2' ,a vertical line intercepts the data at about 'y=--3.5' on the vertical axis. This represents Log(n) = -3.5 so that N = 0.00032 impacts/km^2/year. Over an area of 10000 km^2, there would be an estimated 0.00032 impacts/km^2/year x (10000 km^2) = **3.2 impacts per year.**

Problem 2 - What linear function of the form y = mx + b best describes the data in the LogLog graph? Answer: Use the two-point formula:

$$(y - y1) = \frac{y2 - y1}{x2 - x1}(x - x1)$$ with p1 = (x1,y1) and p2 = (x2,y2)

Select: p1 = (-4, +2) p2 = (16, -16) and get **y = -0.9x - 1.6**

Problem 3 - What function N(m) is obtained from your answer to Problem 2?

Answer: Since y = Log(N(m)) and x = Log(m) we have

Log(N(m)) = -0.9 Log(m) - 1.6 then

$10^{Log(N(m))} = 10^{Log(m)}$

And N(m) = $10^{-1.6}$ $m^{-0.9}$ so N(m) = 0.025 $m^{-0.9}$