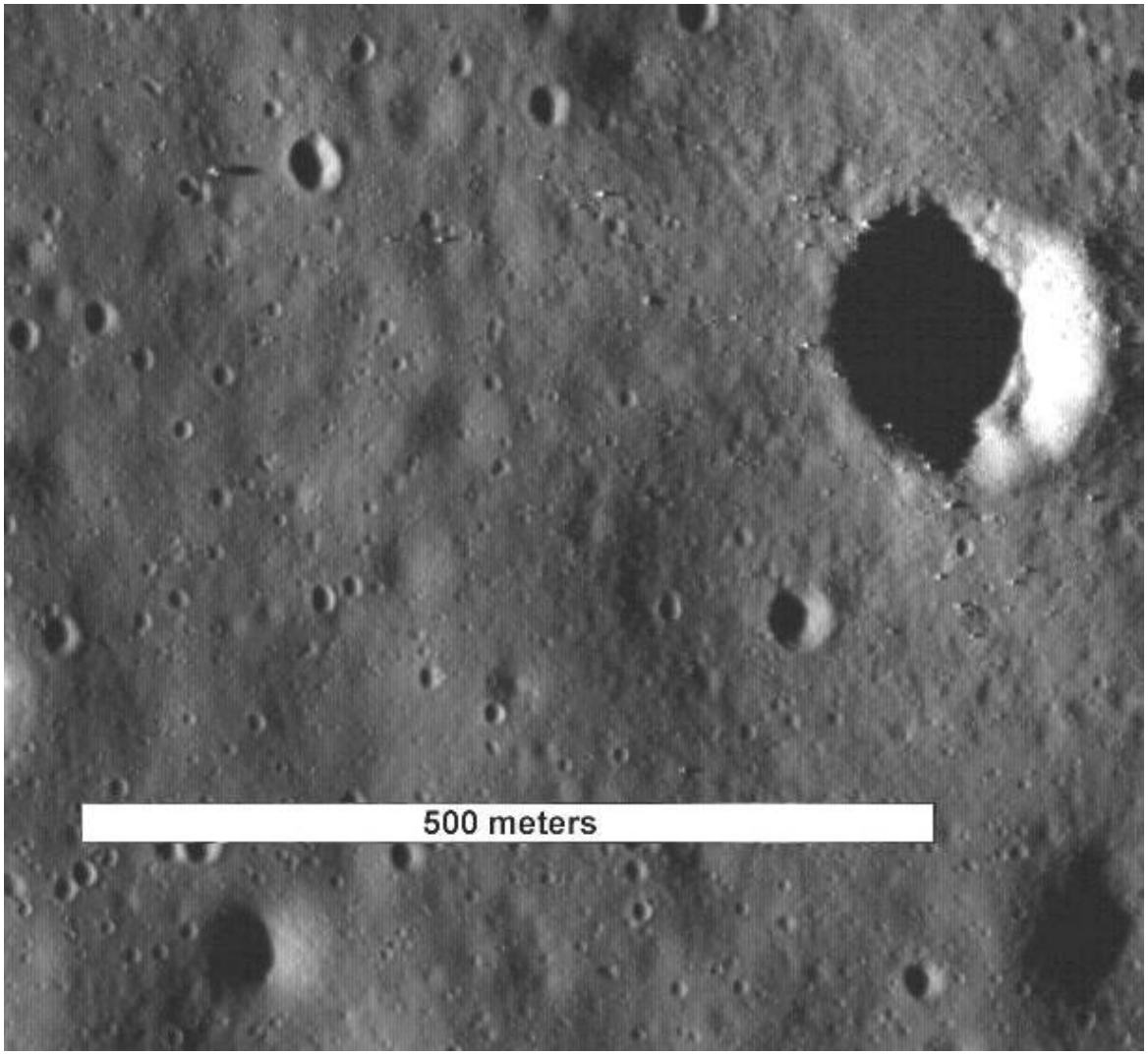

The LRO satellite recently imaged the surface of the moon at a resolution of 1.4 meters/pixel. The above image shows a region near the Apollo-11 landing site. The Lunar Module (LM) can be seen from its very long shadow near the large crater in the upper left corner of the image.

Problem 1 - With a millimeter ruler, determine the scale of this image in meters/mm. What is the total area of this image in square-kilometers?

Problem 2 - Measure all of the craters larger than or equal to 9 meters and create a histogram of the numbers of the craters. Divide the number of craters in each bin, by the total area of the field, to get $\mathbf{A_c}$: the Areal Crater Density (craters/km^2).

Problem 3 - The average distance between craters of a given size is found by taking the square-root of the reciprocal of $\mathbf{A_c}$. About what is the average distance between craters with a diameter close to 5 meters?

Problem 1 - With a millimeter ruler, determine the scale of this image in meters/mm. What is the total area of this image in square-kilometers?

Answer: The 500-meter bar is 111 millimeters long so the scale is 500 M/111mm = 4.5 meters/mm. The image has the dimensions of 149 mm x 136 mm or 670m x 612 m for an area of 0.41 kilometers^2.

Problem 2 - Measure all of the craters larger than 9 meters and create a histogram of the numbers of the craters. Divide the number of craters in each bin, by the total area of the field, to get $\mathbf{A_C}$: the Areal Crater Density (craters/km^2). Answer: The following table shows an example. Students bin intervals may differ.

Crater diameter (mm)	Crater diameter (meters)	Number of craters close to this size	Areal Density	**Problem 3** Average distance in kilometers
2 mm	9	70	70/0.41 = 171	0.08
4 mm	18	6	15	0.25
6 mm	27	3	7	0.38
8 mm	36	2	5	0.44
10 mm	45	1	2	0.71

Students may extend this table to include craters of 1-mm diameter and also the single, very large crater that is 35mm in diameter. The number of counted craters, especially in the smallest bins, will vary. Student data may be averaged together to improve accuracy in each bin.

Problem 3 - The average distance between craters of a given size is found by taking the square-root of the reciprocal of $\mathbf{A_C}$. About what is the average distance between craters with a diameter close to 5 meters?
Answer: See above table for tabulated values. Students may also convert the answers to meters. For example, '0.08 km' = 80 meters. Students will need to estimate the Areal Crater Density for craters just below the tabulated threshold of 9 meters. This can be done by estimating the shape of the plotted curve through the points, and extrapolating it to 5 meters. It is also possible to use Excel Spreadsheets by entering the data and plotting the 'scatter plot' with a trendline added. Reasonable values for the Areal Creater Density would range from 171 craters/km^2 to 1000 craters/km^2 ,which lead to distances between 80 meters and 30 meters, but probably closer to 30 meters given the rapidly decreasing trend of the curve based on the data in the bins for 18-meter and 9-meter crater diameters