Exercise 5: Area and Frequency

CubeSats are research satellites that gather information, test out new technologies in space, and can fit inside a shoebox! During Artemis I, ten of these tiny-but-mighty satellites will fly with the Space Launch System (SLS) rocket. In the exercise below, learn how CubeSats (and math!) are important to lunar science.

Feel free to use a calculator for these exercises... unless you really love long multiplication and division.

Lean, Mean, Imaging Machines

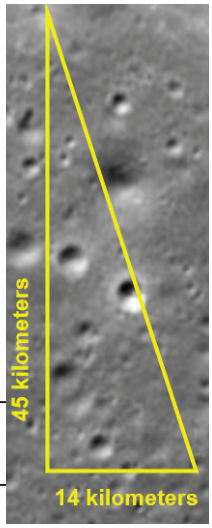
Three of the ten CubeSats hitching a ride on the SLS will map or capture images of the lunar surface. These maps and images will help us understand where ice and hydrogen are located on the Moon and will also help NASA determine future landing sites for crewed Artemis missions.

Dating a Lunar Surface

Dating the lunar surface doesn't mean sending it flowers and chocolates. It means estimating the age of various sections of the surface. One way to do this is by looking at the number of craters in a specific section—the older the section, the longer it's been exposed to asteroids and meteors, and the more craters it will have.

Problem 1: Let's say you are looking at a triangular region of the lunar surface. This section of the lunar surface has a base of 14 kilometers and a height of 45 kilometers. **What is the area of this section of the lunar surface?**

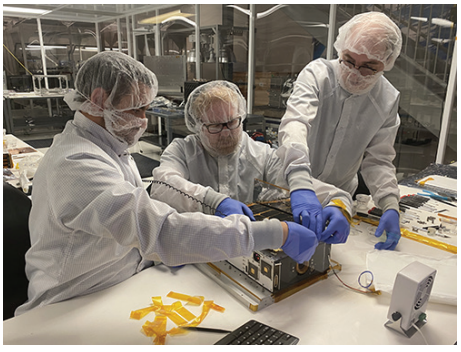
Base of the triangle: 14 kilometers
Height of the triangle: 45 kilometers
Formula for the area of a triangle: $\frac{\text{base} \cdot \text{height}}{2}$



This diagram is an example. It does not reflect a specific age and crater count of the lunar surface.

Problem 2: Let's say you spot 24 craters in the triangular region. **What is the number of craters per square kilometer? Based on the table below, approximately how old is this section of the lunar surface?**

Number of craters per square kilometer	0.0008	0.008	0.08	0.8	8.0	80.0	800.0
Estimated age of lunar surface (years)	1,000	10,000	100,000	1 million	10 million	100 million	1 billion



Meet the Artemis team

A whole team of students from Morehead State University are behind the Lunar IceCube CubeSat. During Artemis I, this CubeSat will investigate the surface of the Moon to map out the distribution of water. Read more about the team's work *here*.

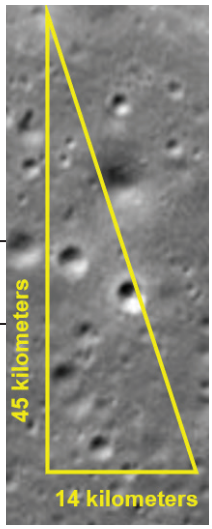
Additional Resources

Secondary Payloads Infographic
Make a Moon Crater Activity
Houston, We Have a Podcast episode: *Moon Geology*

Solutions to Exercise 5: Area and Frequency

Dating a Lunar Surface

Problem 1: Let's say you are looking at a triangular region of the lunar surface. This section of the lunar surface has a base of 14 kilometers and a height of 45 kilometers. **What is the area of this section of the lunar surface?**



This diagram is an example. It does not reflect a specific age and crater count of the lunar surface.

Measurements and formulas:

Base of the triangle: 14 kilometers

Height of the triangle: 45 kilometers

Area of the triangular region: $\frac{\text{base} \cdot \text{height}}{2}$

Solution:

Area of the triangular region: $\frac{\text{base} \cdot \text{height}}{2} = \frac{14 \text{ km} \cdot 45 \text{ km}}{2} = 315 \text{ km}^2$

Final solution: The area is 315 square kilometers.

Problem 2: Let's say you spot 24 craters in the triangular region. **What is the number of craters per square kilometer? Based on the table below, approximately how old is this section of the lunar surface?**

Table:

Number of craters per square kilometer	0.0008	0.008	0.08	0.8	8.0	80.0	800.0
Estimated age of lunar surface (years)	1,000	10,000	100,000	1 million	10 million	100 million	1 billion

Solution:

Number of craters per square kilometer: $\frac{\text{Number of craters}}{\text{Number of square kilometers}} = \frac{24}{315}$

$= 0.07619 \approx 0.08$ craters per square kilometer

Final solution: This section of the lunar surface has about 0.08 craters per square kilometer, which makes it approximately 100,000 years old.