

How Far, the Moon? Exploration

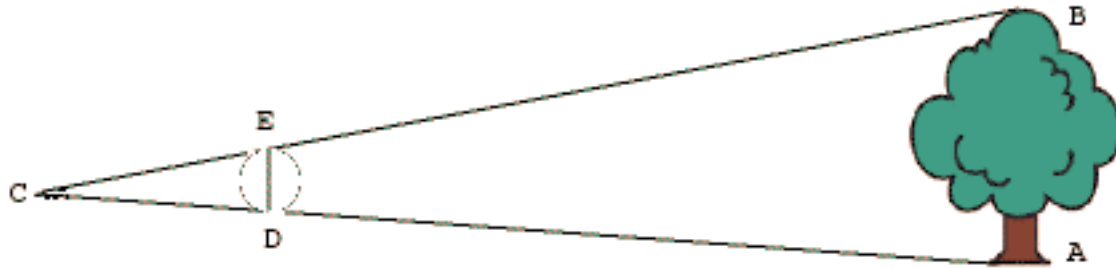
Challenge: How can you use simple materials to calculate the distance to the moon?

Materials: small circular object calculator
meter stick visible moon

Let's Dig In: Using the concept of similar triangles and the fact that the moon is 3476 km in diameter, calculate the distance to the moon.

Go Figure:

1. Sketch the similar triangles that you will use to find the distance to the moon. Label all the important measurements on your sketch.
2. Calculate the distance to the moon. Show how you used measurements to figure this out.
3. Using similar triangles develop a method of calculating the distance between earth and the sun. Draw a diagram of this method.
4. Generalize this procedure to find the distance to any object. Write directions that can be easily followed by one of your classmates.
5. Using what you know about similar triangles, develop a method to determine the size of a distant object. Explain your method, including drawings in your explanation.



In this diagram $\triangle CED$ is similar to $\triangle CBA$. This means the ratio of one side to another on one triangle is equal to the ratio of the corresponding sides on the other triangle.

$$\frac{\text{Distance from eye to thumb}}{\text{Size (height) of thumb}} = \frac{\text{Distance to tree}}{\text{Size (height) of tree}} \quad \frac{CD}{ED} = \frac{CA}{BA}$$

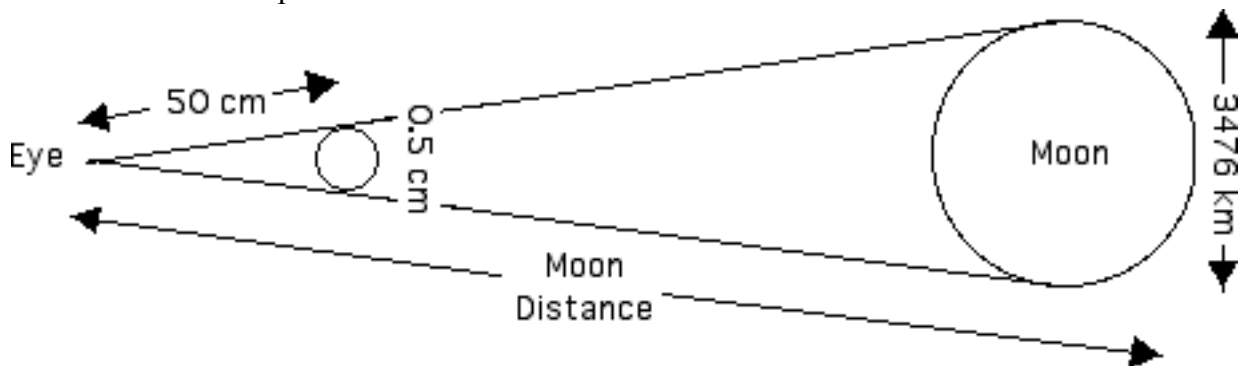
If you know any 3 of these segments of the triangle, you can calculate the length of the fourth segment using cross multiplication.

When student are ready to measure either their distance from disk to eye, or the diameter of the small disk, they need to use their personal eye to disk distance. Therefore they will need someone to measure their eye to disk distance for them as they are holding their disk to cover the moon or whatever object they are measuring.

Sample Data: If a student uses a circle 0.5 cm in diameter and holds it at a distance of 50 cm from their eye to barely cover the moon, they will find the distance to the moon to be 350,000 km. This is very close to the actual distance of 380,400 km to the moon. Sample calculations are provided in the Go Figure answers.

Sample Responses to Go Figure:

1. Here is an example of a sketch:



2. Sample calculation of the distance to the moon:

$$\frac{50 \text{ cm}}{0.5 \text{ cm}} = \frac{X}{3476 \text{ km}} \quad X = 350,000 \text{ km}$$

3. The students should suggest aligning the small disk with the sun. They should then request the diameter of the sun in order to actually find the distance. Their diagram should resemble the diagram drawn for the distance to the moon, replacing the moon with the sun.

4. Any object could replace the moon in the diagram. This would allow the observer to calculate the distance from them to any object as long as height/diameter is known.
5. To determine the size of a distant object, the distance to the object must be known. The size could be calculated using ratios. The procedure is the same as finding the distance.

$$\text{Example: } \frac{50 \text{ cm}}{0.5 \text{ cm}} = \frac{350,000 \text{ km}}{X} \qquad X = 3476 \text{ km}$$