



ECLIPSE CLASSROOM ACTIVITIES

MEASURING SHADOWS USING AN ANCIENT METHOD

OBJECTIVES

- Engage in exploration and critical thinking to better understand how shadows are used to measure tall objects.
- Strengthen understanding of the mathematics behind measuring tall objects using shadows.

TIME FRAME

- Tall object measurement should be done outdoors and should take about 30 minutes.
- The math can be done indoor or outdoors and should take around 20 min.
- So total activity time is about 1 hour.
- Would be best to do this activity **before** viewing the eclipse.

LET'S GET STARTED!

Long ago, there was no reliable way to measure tall objects. Eventually, out of necessity and brilliance, one of the most reliable ways to measure tall objects was developed: shadow measurement. This method requires very little equipment and can still accurately predict the height of tall objects to this day. Let's dive in!

MATERIALS

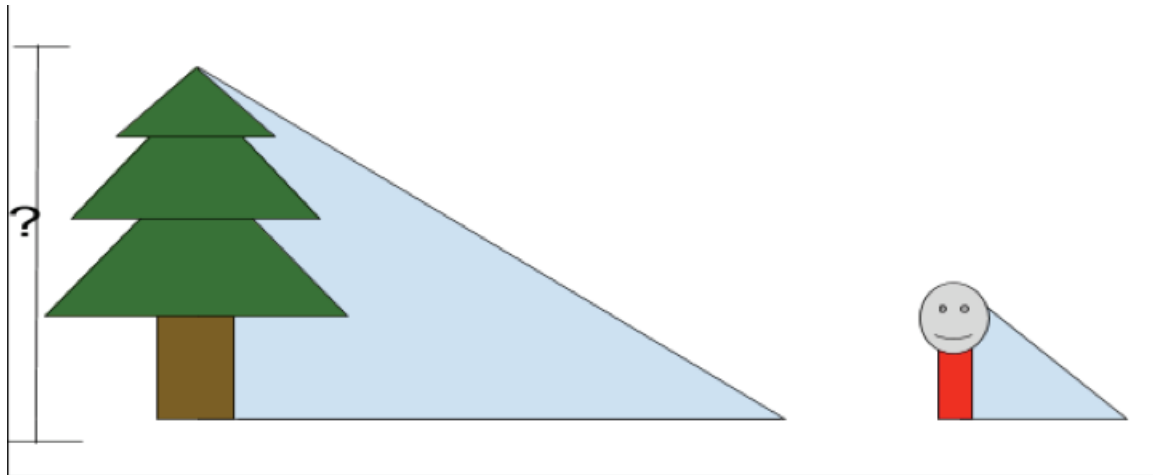
- Measuring tape/yard stick
- Outdoor trees/tall objects of unknown height

STEP-BY-STEP

1. Choose a partner, as this activity is best done in pairs.
2. On a sunny day, find a tree (or other tall object) that casts a shadow. Measure the length of that shadow and write it down.
3. Immediately afterward (so the Sun is still in about the same position in the sky), measure the length of your partner's shadow. (Both partners should do this.)
4. Now that you have the tree's shadow length and your shadow length, measure your partner's height.
5. You should now have the following three measurements:
 - The length of the tree's shadow _____
 - The length of your shadow _____
 - Your height _____



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DO THE MATH

Put on your thinking caps and work with your partner to try to formulate a mathematical equation that gives you the tree's height from the three measurements you've made. Some brief hints:

1. It helps to draw a diagram of the two shadows you are comparing, much like the diagram shown above.
2. Notice that you will have drawn two right triangles, and that one side of each (the hypotenuse) points toward the Sun in each case.
3. This means you are dealing with similar triangles, because the Sun is at the same angle in the sky in both cases.

Now use your equation to calculate the tree's height, then write one or two sentences in the space below to explain why your equation makes sense and how this would have been useful to ancient people.

Tree Height: _____

Now, briefly explain in one or two sentences in the space below why this equation makes sense.



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NOTE FOR TEACHERS

Here's the final equation that students should find:

$$\text{Tree height} = (\text{Tree Shadow Length} / \text{Your Shadow Length}) \times \text{Your Height}$$

*NGSS Standards fulfilled

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)