

# Spike's Science Spot

## Technology101

Indirect Measurements & Math Applications

<https://afrlnm.com/stem/stem-101/>

### Extension Activity

**Use Similar Triangle Method to Determine Height of an Object**

- Measure shadow length.
- Use ratios.
- Based on the geometry of similar triangles.
- Grades 5-8

### Additional Advanced Mathematical Methods of Indirect Measurement

Both methods will include making and using a clinometer to measure angles of inclination

**Grades 8-10**

#### **Geometry: Tangent Function**

- A student-made video demonstrates making clinometer and doing the math.  
<https://www.youtube.com/watch?v=sKOz0G58xgw>
- Method 3 at this site has simple step by step instructions for making a protractor clinometer. <https://www.wikihow.com/Make-a-Clinometer>
- Excellent lesson plan. The Parallax Activity: Measuring distance to the stars - <https://www.youtube.com/watch?v=vHBuLUgxoOM>

**Grades 11-12**

#### **Trigonometry: Law of Sines**

- Trigonometry class example.  
<https://www.youtube.com/watch?v=n7rkGUNkav8>
- Excellent lesson plan. The Parallax Activity: Measuring distance to the stars - <https://www.youtube.com/watch?v=vHBuLUgxoOM>
- If distances are too far to measure with tape measure, try Google maps 'Measure distance'.

# Extension Activity

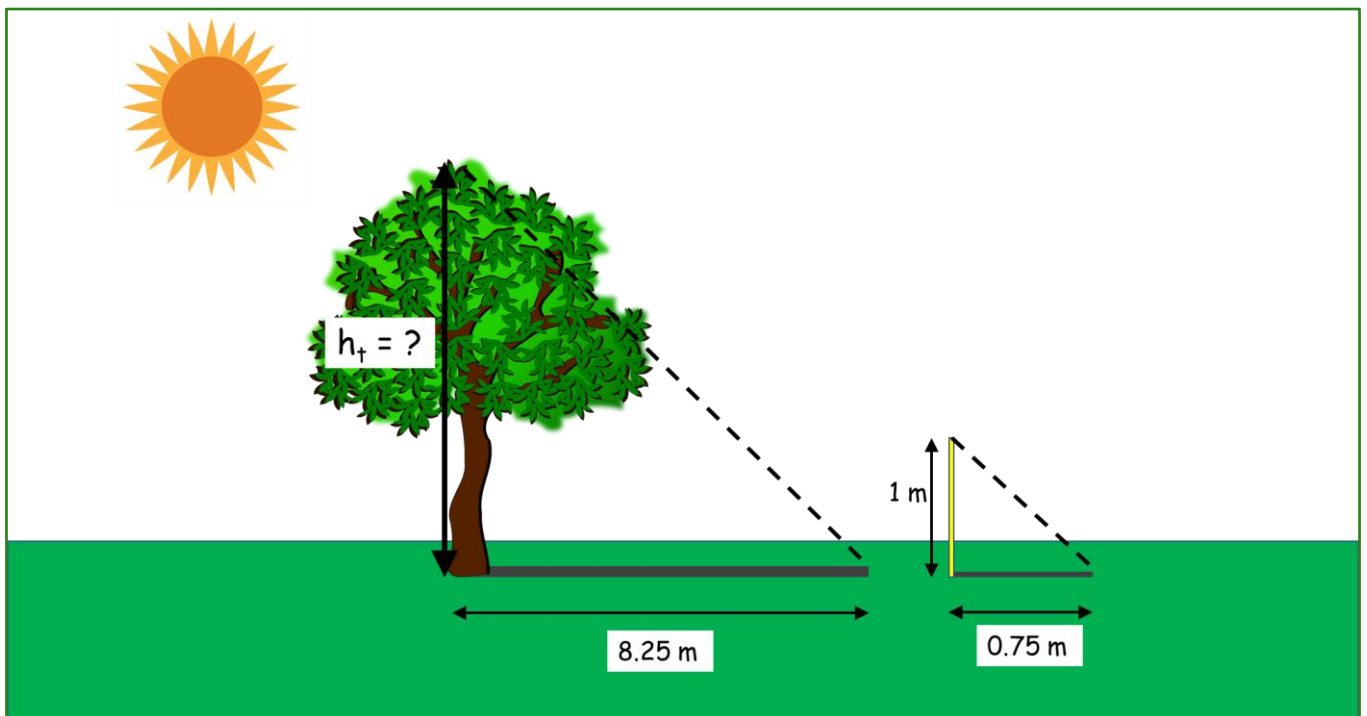
## Use Similar Triangle Method to Determine Height of an Object

**Materials:** Known object (e.g. meter stick)  
Long tape measure or measuring wheel  
Sunny day

1. Choose object, tree, flagpole, lamp post, building to measure
2. Measure length of shadows for unknown and known objects
3. Record measurements
4. Use the equation below to determine height of object

Additional information:

<https://www.youtube.com/watch?v=LhEe0kB4QIs>



# Extension Activity, continued

## Use Similar Triangle Method to Determine Height of an Object

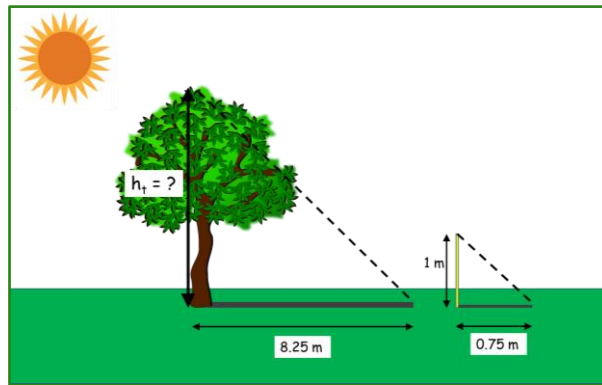
To determine height of tree ( $h_t$ ) = ?

Measure and record length of tree's shadow ( $s_t$ ) = \_\_\_\_\_

Measure and record height of known object ( $h_o$ ) = \_\_\_\_\_

Measure and record length of object's shadow ( $s_o$ ) = \_\_\_\_\_

**Example:**



$$\begin{aligned}h_t &= ? \\s_t &= 8.25 \text{ m} \\h_o &= 1.0 \text{ m} \\s_o &= 0.75 \text{ m}\end{aligned}$$

$$\frac{\text{height of tree, } h_t}{\text{length of tree's shadow, } s_t} = \frac{\text{height of known object, } h_o}{\text{length of object's shadow, } s_o}$$

$$\text{Insert measured values} \rightarrow \frac{h_t}{8.25\text{m}} = \frac{1\text{m}}{0.75\text{m}}$$

$$\text{Multiply both sides by } 8.25\text{m} \rightarrow \frac{h_t}{8.25\text{m}} \times 8.25\text{m} = \frac{1\text{m}}{0.75\text{m}} \times 8.25\text{m}$$

$$\text{Rearrange} \rightarrow h_t \times \left(\frac{8.25\text{m}}{8.25\text{m}}\right) = \frac{1\text{m}}{0.75\text{m}} \times 8.25\text{m}$$

$$\text{And} \rightarrow \frac{8.25\text{m}}{8.25\text{m}} = 1$$

$$\text{Rearrange} \rightarrow h_t = \frac{8.25\text{m}}{0.75\text{m}} \times 1\text{m}$$

$$\boxed{h_t = 11\text{m}}$$