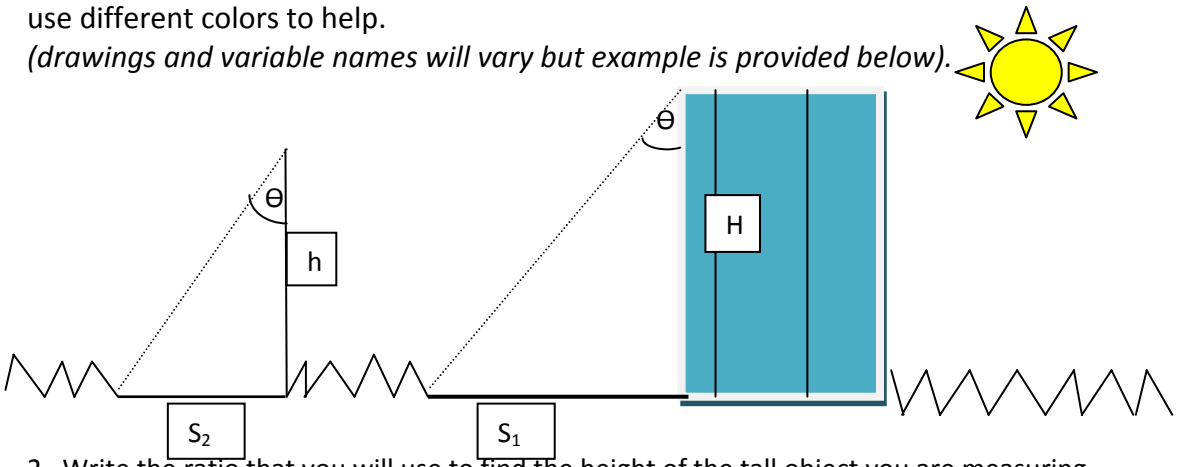
Similarity with Shadows Student Page TEACHER EDITION WITH SAMPLE RESPONSES

1. Draw a picture below of the information you see on Page 1.3. Be sure to label each measurement and use different colors to help.
(drawings and variable names will vary but example is provided below).



2. Write the ratio that you will use to find the height of the tall object you are measuring.

Possible answers include: $\frac{H}{S_1} = \frac{h}{s_2}$ *OR* $\frac{H}{h} = \frac{S_1}{s_2}$

3. Explain the above ratio in your own words.

Page 1.6 to 1.8:

1. Give at least 5 different ***height:shadow*** ratios for objects measured by you and/or your classmates.

Object Name	Object Height(cm) **Column E**	Object Shadow (cm) **Column D**	Height: Shadow Ratio

2. What do you notice about these ratios? Will they change as the sun changes location? Explain your reasoning.
Answers will vary but class data should be similar. Be sure that class makes their measurements at the same time of day. This could lead to a very rich discussion about how the ratio changes as the angle of the sun/shadow changes.

3. Use this information to answer the following: You know that your height to shadow ratio is 0.48. What is the height of a tall building if the shadow is 10,700 cm? Be sure to show your math.

0.48 = $\frac{height}{10,700}$ *10,700 (.48) = 5,136 cm*

Problem 2:

1. Angle (degrees) for my height/shadow: _____

Object Name	Height (cm)	Shadow (cm)	Distance from top to end of shadow (cm) (Use Pythagorean Theorem)	Angle (degrees) (Use ctrl $\tan^{-1}$ keys and then insert your value of shadow/height.)	Angle (From drawing in problem 2 below)

Answers will vary. Be sure to have students check for reasonableness.

2. Use your handheld to create the drawing of each triangle on Page 2.3 using the steps below:

Make a line segment to represent the height of the object. (Make sure that your scale is appropriate). Measure this segment and then adjust the length by double clicking on the length and changing this. Make a perpendicular to this segment to represent the shadow. Make a line segment on top of your perpendicular line and do your best to get the length as close to the shadow measurement (this cannot be adjusted). Use the angle measurement tool to measure the angle . Record this in the last column of the last table.

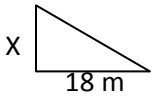
Pick one of the graphs and make a quick sketch in the space below. Be sure to record each measurement on the drawing.

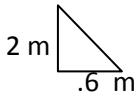
3. Were your measurements exact using both methods? If not, what can you contribute the difference to? If they were, explain why?

Measurements should be close to the same. The fact that students cannot set the shadow length to be exact will contribute to a difference in the angle measurements. However, this should be minimal, especially if students are rounding to the nearest degree.

Problem 3 Questions:

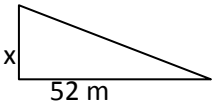
1. Suppose you measure the shadow of a flag pole to be 18 meters long and the shadow of a 2 meter tall stick is .6 meters long. How tall is the flag pole? Draw a picture and show your math/proportion.

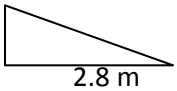




$\frac{x}{18} = \frac{2}{.6}$ *x=60 meters*

2. The shadow of a tall building is 52 meters long. The shadow that is cast by a 1.6 meter tall boy is 2.8 meters long. How tall is the building to the nearest meter? Draw a picture and show your math/proportion.

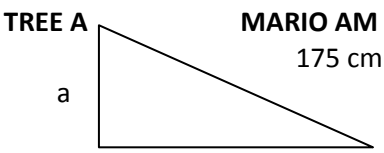


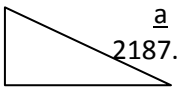


$\frac{x}{52} = \frac{1.6}{2.8}$ *x = 30 meters*

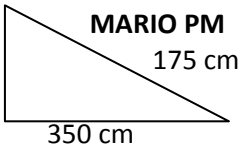
3. It is a sunny day and 175 cm tall Mario is bored. He decides to use shadow measurements to find the heights of two trees in his backyard. Mario measures Tree A in the morning when his own shadow is 437.5 cm and the shadow of the tree is 2187.5 cm long. A friend came over and he didn't have time to measure Tree B until later in the afternoon when his own shadow was 87.5 cm and the tree's shadow was 350 cm. Find the height of each tree and tell which one is taller.

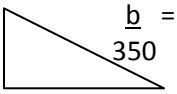
TREE A **MARIO AM** $\frac{a}{2187.5} = \frac{175}{437.5}$ **TREE B** **MARIO PM** $\frac{b}{350} = \frac{175}{87.5}$





a = 875 cm





b = 700 cm

TREE A IS TALLER

4. Jane and Jerry have a bet on which building is taller. Jane's building casts a shadow that is 9.9 meters long and Jerry's building casts a 8.8 meter long shadow. The shadow to height ratio at the time of measurement is 3.2. How tall is each building? Who wins the bet? Show your proportions.

Jane $3.2 = \frac{x}{9.9}$ *Jerry* $3.2 = \frac{x}{8.8}$

Jane's Building is 31.68 meters tall and Jerry's is 28.16 meters tall. Jane wins the bet.

Problem 4-Extensions/Homework

1. If you repeated the experiment at different times of the day, would this impact your data? Why or why not? What would happen to the shape of your right triangle?
2. Give 2-3 examples of how this method could be helpful in the real world.
3. Explain this activity to a 2nd grader. Be sure to focus on the mathematics and vocabulary (similarity, right triangles, proportions, etc.).
4. List and explain at least two other ways in which you can use similar triangles to help find unknown values.
5. List three things you learned today.