4-5 Indirect Measurement
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Materials needed: Must bring book pages to class, tape measure, a marker, a pocket mirror, paper and pencil (to record data).

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Indirect Measurement: The technique that uses proportions to calculate measurement.

Assign each of the following roles to one member of your group (groups of 3)

1. Person who will "sight" the object in the mirror and be measured ("sighter")
2. Person who will do the measuring
3. Person who will record the data

**Note: For the following task: Students' eye sight should be parallel to the ground as your partner measures your eye level height (not looking at the mirror).

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Outside Task

Use the following steps to measure the height of the school flagpole or any other tall object outside . You will need a partner, a tape measure, a marker, and a flat mirror .

Step 1: Use a marker to create a dot near the center of the mirror.

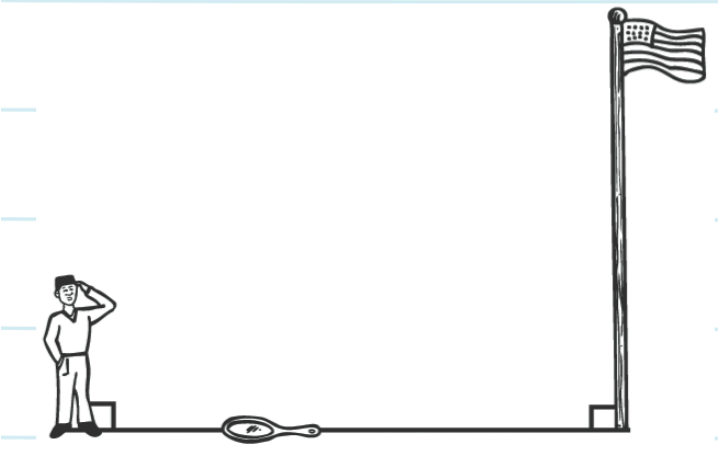
Step 2: Face the object you would like to measure and place the mirror between yourself and the object . You, the object, and the mirror should be collinear.

Step 3: Focus your eyes on the dot on the mirror and walk backward until you can see the top of the object on the dot, as shown.

Step 4: Ask your partner to sketch a picture of you, the mirror, and the object.

Step 5: Review the sketch with your partner . Decide where to place right angles, and where to locate the sides of the two triangles.

Step 6: Determine which segments in your sketch can easily be measured using the tape measure. Describe their locations and record the measurements on your sketch.



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Answer questions in book

1. How can similar triangles be used to calculate the height of the object?

2. Use your sketch to write a proportion to calculate the height of the object and solve the proportion.

3. Compare your answer with others measuring the same object. How do the answers compare?

4. What are some possible sources that could result when using this method?

5. Switch places with your partner and identify a second object to measure. Repeat this method of indirect measurement to solve for the height of the new object.

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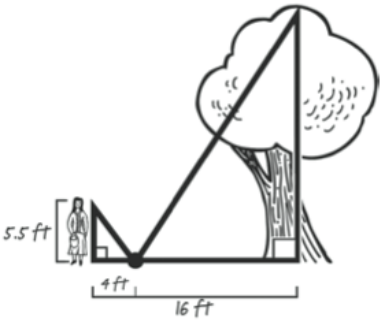
You can also do this outside.

How tall is that oak tree?

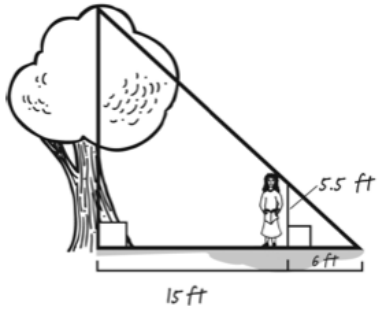
You go to the park and use the mirror method to gather enough information to calculate the height of one of the trees. The figure shows your measurement. Calculate the height of the tree.



If you don't have time to go outside, try this problem.

Stacey wants to try the mirror method to measure the height of one of her trees . She calculates that the distance between her and the mirror is 3 feet and the distance between the mirror and the tree is 18 feet . Stacey's eye height is 60 inches . Draw a diagram of this situation . Then, calculate the height of this tree .

Stacey notices that another tree casts a shadow and suggests that you could also use shadows to calculate the height of the tree . She lines herself up with the tree's shadow so that the tip of her shadow and the tip of the tree's shadow meet . She then asks you to measure the distance from the tip of the shadows to her, and then measure the distance from her to the tree . Finally, you draw a diagram of this situation as shown below . Calculate the height of the tree . Explain your reasoning .



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You stand on one side of the creek and your friend stands directly across the creek from you on the other side as shown in the figure .
Your friend is standing 5 feet from the creek and you are standing 5 feet from the creek . You and your friend walk away from each other in opposite parallel directions . Your friend walks 50 feet and you walk 12 feet.

a. Label any angle measures and any angle relationships that you know on the diagram . Explain how you know these angle measures .

b. How do you know that the triangles formed by the lines are similar?

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c. Calculate the distance from your friend's starting point to your side of the creek . Round your answer to the nearest tenth, if necessary.

d. What is the width of the creek? Explain your reasoning.

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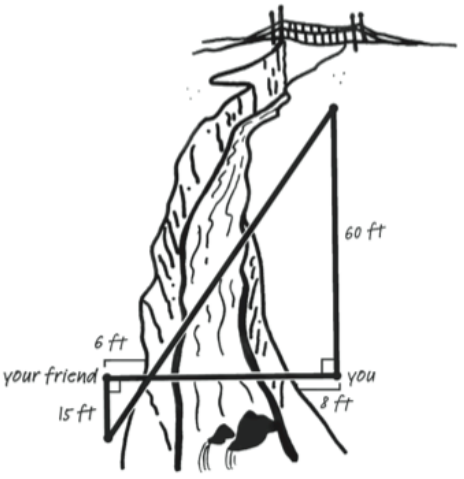
There is also a ravine (a deep hollow in the earth) on another edge of the park . You and your friend take measurements like those in Problem 3 to indirectly calculate the width of the ravine . The figure shows your measurements . Calculate the width of the ravine .



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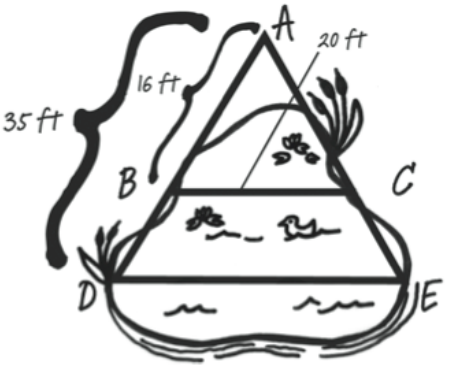
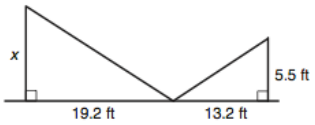
There is a large pond in the park . A diagram of the pond is shown below . You want to calculate the distance across the widest part of the pond, labeled as DE . To indirectly calculate this distance, you first place a stake at point A . You chose point A so that you can see the edge of the pond on both sides at points D and E, where you also place stakes . Then, you tie a string from point A to point D and from point A to point E . At a narrow portion of the pond, you place stakes at points B and C along the string so that BC is parallel to DE . The measurements you make are shown on the diagram . Calculate the distance across the widest part of the pond .



More practice
(optional)

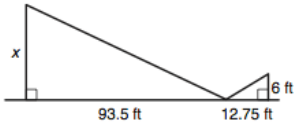
Keisha is visiting a museum. She wants to know the height of one of the sculptures. She places a small mirror on the ground between herself and the sculpture, then she backs up until she can see the top of the sculpture in the mirror.



What is the height of the sculpture?

More practice
(optional)

Micah wants to know the height of his school. He places a small mirror on the ground between himself and the school, then he backs up until he can see the highest point of the school in the mirror.



What is the height of Micah's school?