Indirect Measurement

What You'll Learn
• Solve problems involving indirect measurement using shadow reckoning.
• Solve problems using surveying methods.

Real-World Link

Shadows Have you ever looked down and found that your shadow and the shadow of the person next to you were different lengths? This is because the length of your shadow is proportional to your height. So, unless you and the person next to you are the exact same height, your shadows will be different lengths.

Essential Question

How can you identify and represent proportional relationships?

Common Core State Standards

Content Standards
7.RP.2, 7.RP.2c

Mathematical Practices
1, 3, 4

Vocabulary

indirect measurement

Indirect Measurement

indirect measurement allows you to use the properties of similar triangles to find measurements that are difficult to measure directly. With *shadow reckoning*, two objects and their shadows form two sides of similar triangles.

Example 1

Watch | Tutor

The lead statue of the Korean War Memorial in Washington, D.C., casts a 43.5-inch shadow at the same time a nearby tourist casts a 32-inch shadow. If the tourist is 64 inches tall, how tall is the lead statue?

You need to find the statue's height h.

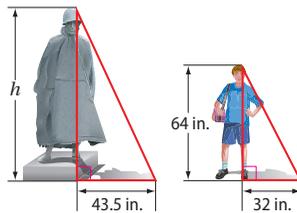Set up a proportion comparing the tourist's shadow to the statue's shadow.

tourist's height ·····▶ $\dfrac{64}{h} = \dfrac{32}{43.5}$ ◀····· tourist's shadow
statue's height ·····▶   ◀····· statue's shadow

$64 \cdot 43.5 = 32 \cdot h$ Find the cross products.
$2784 = 32h$ Multiply.
$87 = h$ Divide each side by 32.

The statue is 87 inches tall.

Got It? Do this problem to find out.

1. Suppose a bell tower casts a 27.6-foot shadow at the same time a nearby tourist casts a 1.2-foot shadow. If the tourist is 6 feet tall, how tall is the tower? **138 ft**

Surveying Methods

Surveyors also use similar triangles, but their method does not involve shadows. Notice in Example 2 that it is possible to measure three sides of the triangles directly.

Real World

Example 2

Tutor

In the figure, $\triangle STU \sim \triangle VQU$.
Find the distance across the pond.

Since the figures are similar, corresponding sides are proportional.

$\dfrac{UQ}{UT} = \dfrac{VQ}{ST}$ Write a proportion.

$\dfrac{16}{10} = \dfrac{x}{20}$ $UQ = 16$, $UT = 10$, $VQ = x$, and $ST = 20$

$10 \cdot x = 16 \cdot 20$ Cross products

$10x = 320$ Multiply.

$\dfrac{10x}{10} = \dfrac{320}{10}$ Divide each side by 10.
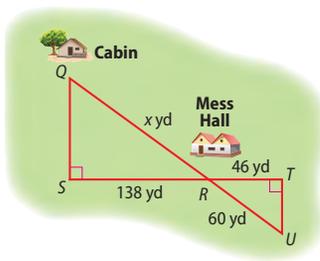
$x = 32$ Simplify.
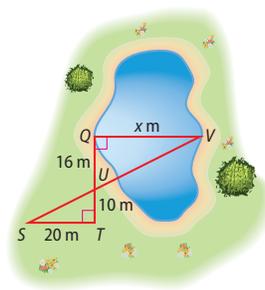
So, the distance across the pond is 32 meters.

Got It? Do this problem to find out.

2. In the figure, $\triangle QRS \sim \triangle URT$. Find the distance from the cabin to the Mess Hall.   **180 yd**

Guided Practice

Check

1. A basketball hoop in Miguel's backyard casts a shadow that is 8 feet long. At the same time, Miguel casts a shadow that is 4.5 feet long. If Miguel is 5.5 feet tall, how tall is the basketball hoop? Round to the nearest tenth. (Example 1)   **9.8 ft**

2. In the figure, $\triangle ABC \sim \triangle EBD$. Find the distance across Stallion Ravine. (Example 2)   **198 m**

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