Handy Measuring Ratio

Use your hand as a tool for indirect measurement.

Materials
- playground or other area that includes some vertical structures
- your Stride Ruler 📄 (Stride Ruler should be done first as a separate activity) *Alternative:* several metersticks for the group to share
- pencil
- clipboard or book to create a sturdy writing surface

Group Size
individuals

Related Activity
- Stride Ruler 📄

Math Reminder
When using your Stride Ruler, remember to multiply your number of baby steps by the length in centimeters of your average baby step to find a distance in centimeters.

Background
You don't have to climb to the top of a tree to figure out how tall it is. You can estimate the height of a tree, a flagpole, or even a tall building using only your hand and a little bit of math. In this activity, you'll learn how to use ratios to figure out the approximate height of something that can't be measured directly by first measuring something that can be directly measured.

Try This
1. Choose a vertical object you want to measure.

2. Close one eye. Then hold out your opposite arm, keeping your elbow straight, and spreading out your fingers. Notice that your open eye is directly above the top of your arm.

3. Walk toward or away from the object until the thumb and little finger of your outstretched hand line up with the top and bottom of the object.

4. Use your Stride Ruler or a meterstick to measure your distance to the object, and write that distance in centimeters:

   The distance to the object is_____cm

5. Measure the length of your outstretched arm with the spread-apart fingers of your opposite hand. You should find that your arm is about 3 hand-lengths long, which is a ratio of 1:3, the *handy measuring ratio*. That means the height of the object is 1/3 of your distance to the object.
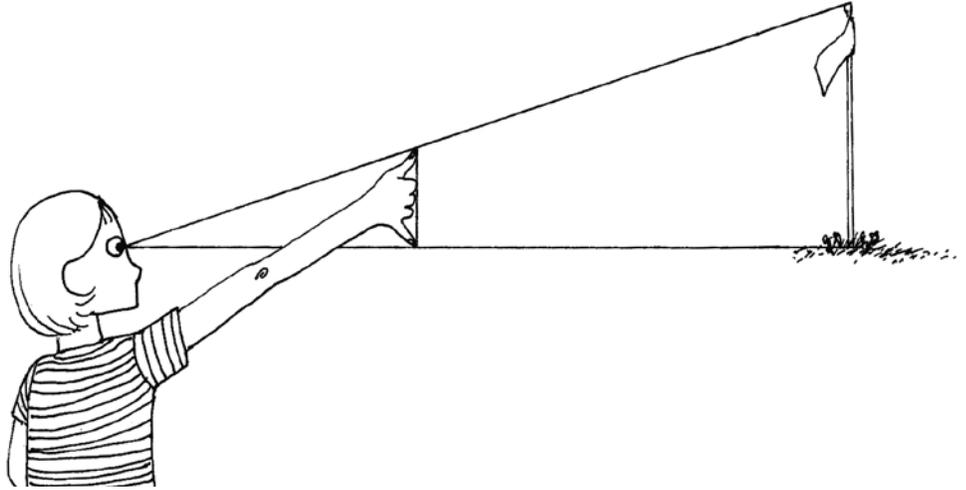
6. Multiply the distance by 1/3:

   _____cm x 1/3 =_____cm

   That's a good estimate of the object's height.

What's Going On?

Look at the diagram and notice that it contains two triangles. One triangle is formed by the eye, the thumb, and the little finger; the other is formed by the eye, the top of the distant flagpole, and the bottom of the flagpole.

These two triangles are called *similar triangles.* They have the same angles and the same shape. The larger triangle is a scaled-up version of the smaller one. So if the height-to-distance ratio (height of hand to distance from eye to hand) of the smaller triangle is 1:3, then the height-to-distance ratio (height of flagpole to distance from eye to flagpole) of the larger triangle is also 1:3. The height-to-distance ratio of any object that you can just cover with your outstretched hand will be 1:3 because you'll be creating another similar triangle. Therefore, the height of the object will be 1/3 of your distance to it.

So What?

There are many things in the universe that are too far away, too large, or too small to measure directly. Scientists use indirect measurement to determine distances to faraway stars, the diameter of the moon, and the number of bacteria in a certain volume of liquid.