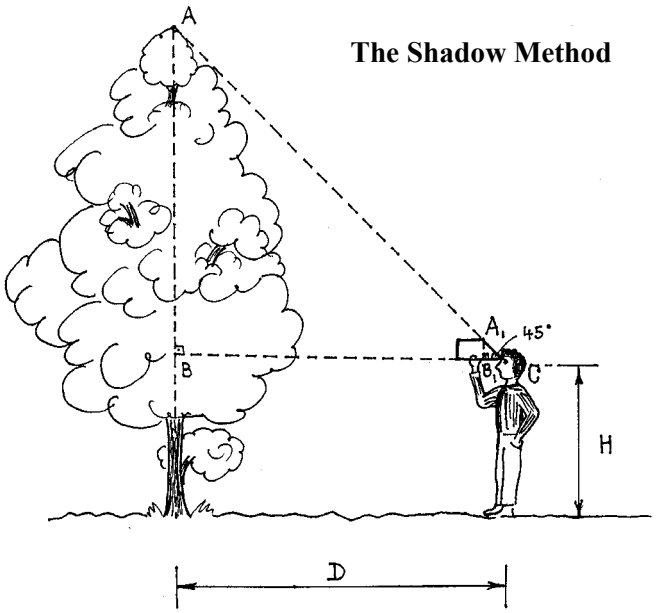
CHAPTER 5 — Estimation, Measurement, and Verification

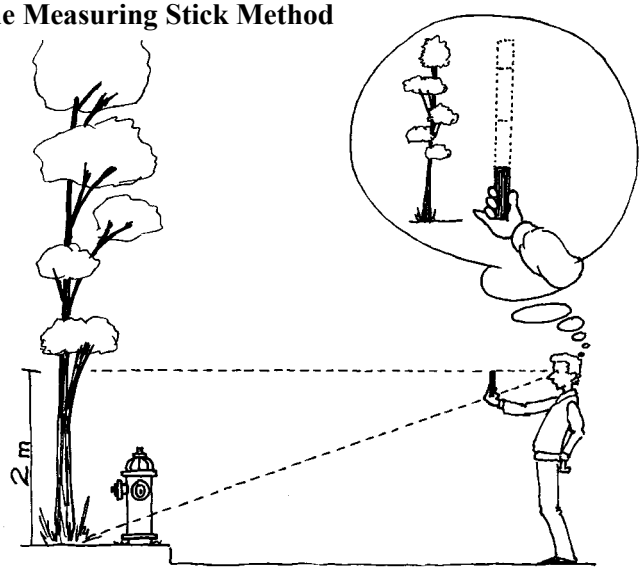
There are several ways to estimate and measure the heights of trees, poles, buildings, and other objects in your environment. Working with a partner, you can try three of those ways. The first involves the use of shadow. The second involves using a measuring stick. The third involves the use of a simple instrument known as a tangent.

The Shadow Method



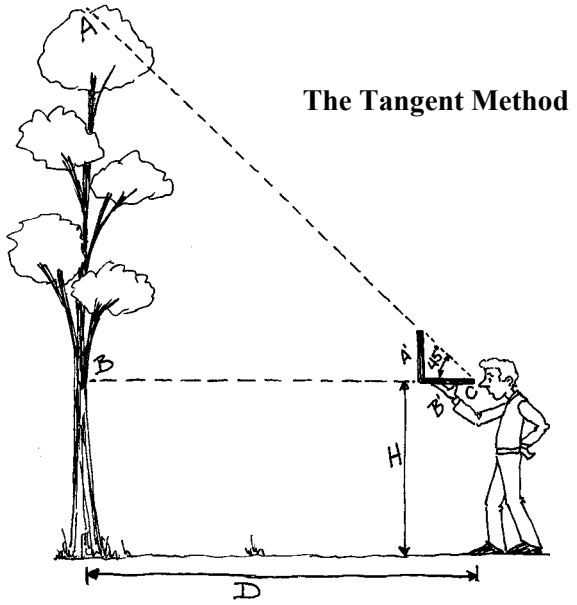
The shadow method *is quite simple. You need to know your own height, or the height of a stick or other object that you use to cast a shadow. Then you need to measure the length of the shadow. For example, if you are five feet tall and you cast a shadow that is two feet long, you have a ratio of 5:2. If the tree or other object's shadow is seven feet long, then you have a ratio of ?:7. So, 5/2 = 2.5. The object's shadow is 7 feet long, so 7 x 2.5 = 15.5. The object is 15.5 feet tall.*

The Measuring Stick Method

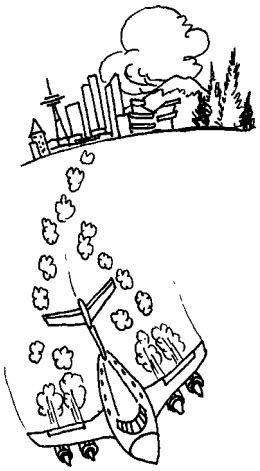


The measuring stick method *creates two similar triangles, one small and one large, as you can see in the picture. Once you've set the length of the stick, you can use a "stacking" method as shown in the diagram to estimate the object's height. This is so because if we set the height of our sight line at 2 meters (200 centimeters) and our stick is 30 meters, then we know that each 30 centimeter "stack" represents 200 centimeters of the object's total height. Thus our ratio is 20:3 or 6.67. Notice in the picture above the student's head there are about 3 1/2 "stacks." So, 3.5 x 6.67 = 23.3. The tree is 23.3 meters in height..*

The Tangent Method *uses the similarity of two rectangular isosceles triangles (▲ A, B, C and ▲ A, B). It is achieved when the top of the tree and two sight rings form one line for the observer, and the device is leveled.*



The Tangent Method



A. Estimate the heights of two objects in your environment: a building and a tree or flagpole. How will you do this? If you know how tall you are, you can measure your shadow and the shadow of the object.

B. Work with a partner to first estimate and then measure and record the distance between where you live and where your partner lives. Then estimate how long it would take you to walk from your place to your partner's place assuming you will walk at a speed of 5 kilometers per hour.

C. Locate a field or a square block in your area. Work with a partner and estimate the square units (meters or feet) in the field or block. After you have done that, figure out a way to roughly verify your estimation.

D. If an airplane leaves Seattle, Washington, for Shanghai, China, and travels at an average speed of 850 kilometers per hour, approximately how long will the flight take?

E. By the time you graduate from high school, approximately how many hours will you have attended school from the first grade through the twelfth grade?