

CHAPTER 2 Critical Thinking

DIRECT AND INDIRECT MEASUREMENTS

Materials

100-mL graduated cylinder vernier caliper or metric ruler
dried beans

Procedure

Use a vernier caliper or metric ruler to measure the thickness of three different beans. Record your data in Table 1 and find the average thickness. Use a graduated cylinder to measure the volume of some beans. Then spread the beans in a single layer on a tabletop, and arrange the beans so that they form the smallest possible circle. You have formed a cylinder with a height equal to the thickness of one bean. Measure the diameter of this cylinder. Repeat this procedure twice, using different numbers of beans each time. Record your data in Table 2. The equation for the volume of a cylinder is $V = \pi r^2 h$. Solve the equation for h , and find the average value.

Results

Table 1 Sample data are given.

Bean	h (cm)
1	_____
2	_____
3	_____
Average	_____

Table 2

Trial	Volume (cm ³)	Diameter (cm)	Radius (cm)	h (cm)
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
Average	_____	_____	_____	_____

1. Which measurement is a direct measurement?

