Using SI Units

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How many inches equal one foot? How many feet equal one yard? Almost everybody can answer these questions. But how many yards equal one rod?

Is there any one number that is common for changing inches to feet, feet to yards, or yards to rods? A problem with the English system for measuring is that there is no common number for changing one unit to another. As a result, you may have had difficulty remembering that there are 5½ yards to a rod.

Biologists and other scientists use the SI system of measuring rather than the English system. SI is an abbreviation for the International System of Measurement. SI is a more modern version of the old metric system.

In this investigation, you will
- (a) identify and use SI units of length and volume to measure several objects.
- (b) learn two important rules for converting from one SI unit to another.

Materials

metric ruler
50-mL graduated cylinder
microscope slide

Procedure

Part A. Measuring Length in SI Units

How tall are you? How wide is your classroom? What is the size of your desk top? How long are pine tree needles? Getting answers to these questions involves measurements of distance or length. What unit in the SI system is used to measure length?

● Examine a metric ruler. Starting at the left edge, locate the smallest division or mark. This unit is the millimeter (mm). Ten millimeters are equal to a unit called the centimeter (cm). The ruler will have a longer line and the number 1 marked at the 1 cm length (Figure 5-1).
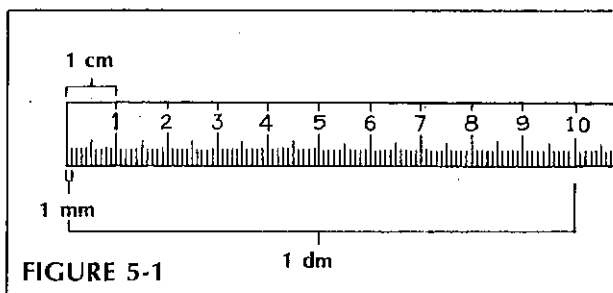
FIGURE 5-1

1. How many millimeters equal 1 cm? _____

2. How many millimeters equal 3 cm? _____

**3.** What number is used in changing the number of millimeters to centimeters? _____

Ten centimeters are equal to one decimeter (dm). Ten decimeters are equal to one meter (m).

4. What number is used when changing

(a) centimeters to decimeters? _____

(b) decimeters to meters? _____

● Measure a microscope slide in millimeters. Use Figure 5-2 as a guide to length, width, and height. Record these values in the column marked "mm" of Table 5-1.

● To convert your millimeter numbers to centimeters, divide the millimeter numbers by 10. Record the length, width, and height of your slide in centimeters. Use the column marked "cm" of Table 5-1.

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FIGURE 5-2

FIGURE 5-2

width height
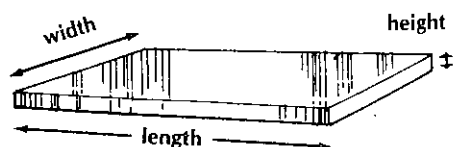
length

● To convert your centimeter numbers to decimeters, divide the centimeter numbers by 10. Record the length, width, and height of your slide in decimeters. Use the column marked "dm" of Table 5-1.

● To convert decimeters to meters, divide decimeters by 10. Record your slide measurements in meters on Table 5-1 in the column marked "m."

TABLE 5-1. MICROSCOPE SLIDE MEASUREMENTS					
	mm	cm	dm	m	km
Length					
Width					
Height					

A unit, kilometers, often is used to measure long distances. 1000 meters equal 1 kilometer (km).

● To convert meters to kilometers, divide meters by 1000 (not by 10). Record your slide measurements in kilometers in the column marked "km" of Table 5-1.

5. Can you divide millimeter figures by 100 to change directly to decimeters?_____

6. Can you divide millimeter figures by 1000 to change directly to meters?_____

7. What number do you divide by when changing centimeters to meters?_____

8. As a review, to change

   (a) mm to cm, divide by_____.

   (b) mm to dm, divide by_____:

   (c) mm to m, divide by_____.

   (d) mm to km, divide by_____.

(e) cm to m, divide by_____.

(f) cm to km, divide by_____.

● Measure the length and width of your lab table or desk.

● Record these dimensions in meters in Table 5-2. Record your answers in decimals. If your desk or lab table measures 1 m plus 14 cm, record this measurement as 1.14 m. If it measures less than 1 m, such as 83 cm, record this measurement as 0.83 m. Because 1 m equals 100 cm, 83 cm is the same as 83/100 or 0.83 m.

● Convert your meter measurements to decimeters. Do this conversion by multiplying meter figures by 10. Record the decimeter values in the proper column of Table 5-2. Convert your decimeter values in Table 5-2 to centimeters. Do this conversion by multiplying decimeter figures by 10. Record the centimeter values in the proper column of Table 5-2.

TABLE 5-2. LAB TABLE MEASUREMENTS			
	m	dm	cm	mm
Length				
Width				

9. What number is used to convert centimeter measurements to millimeters?_____

● To convert your centimeter values to millimeters, multiply centimeter figures by 10. Record the millimeter values in the proper column of Table 5-2.

10. According to Table 5-2, can you multiply meter figures by 100 to change directly to centimeters?_____

11. Can you multiply meter figures by 1000 to change directly to millimeters?_____

12. As a review, to change

   (a) m to dm, multiply by_____.

   (b) m to cm, multiply by_____.

   (c) m to mm, multiply by_____.

(d) cm to mm, multiply by_____.

(e) km to m, multiply by_____.
(Be careful.)

● When converting from one SI unit to another, you must either multiply or divide. Is there any pattern which will always allow you to decide whether to divide or multiply? Yes, there is.

13. (a) What operation is used in Table 5-1 to go from millimeters to centimeters? (Millimeters are small in size, centimeters are larger units in size.)_____

(b) When changing from small SI units to large units, what mathematical operation (multiplying or dividing) is used?_____

14. Which unit is smaller in size:

(a) decimeter or meter?_____

(b) centimeter or kilometer?_____

(c) meter or kilometer?_____

15. (a) When changing from large SI units to smaller units, what mathematical operation (multiplying or dividing) is used?

_____

(b) What operation is used in Table 5-2 to go from meters to centimeters?_____

16. Which unit is larger in size:

(a) kilometer or millimeter?_____

(b) decimeter or millimeter?_____

(c) centimeter or decimeter?_____

When changing from one unit to another, you must remember:

(a) If you are changing from a small unit to a larger unit, you must divide. What number to divide by is determined by what new units are being asked for. For example, if changing millimeters to centimeters, divide by 10; if changing millimeters to decimeters, divide by 100 again.

(b) if you are changing from a large unit to a smaller unit, you must multiply. What number to multiply by is determined by what new units are being asked for. For example, if changing kilometers to meters, multiply by 1000; changing meters to millimeters, multiply by 1000; changing kilometers to centimeters, multiply by 100 000.

The meter is the main unit for measuring length or distance in the SI system. All changes from one unit to another involve a change of 10, or some multiple of 10.

17. Fill in the blanks.

(a) 29 mm = _____cm

(b) 4 dm = _____m

(c) 44 dm = _____cm

(d) 1205 cm = _____dm

(e) 27 km = _____m

18. Fill in the blanks.

(a) 103 dm = _____m

(b) 0.29 dm = _____mm

(c) 1202 mm = _____cm

(d) 48 mm = _____m

(e) 7.2 m = _____cm

Part B. Measuring Volume in SI Units

How much air do you inhale in one breath? How much water do you normally drink in one day? Can you measure the amount of space occupied by a bean seed? Getting answers to these questions involves the measuring of volume. What unit is used in the SI system to measure volume?

● Examine a graduated cylinder with volume markings of 50 units. Each single line represents a unit of volume called a milliliter (mL). DO NOT confuse this word with millimeter (mm).

● Fill the cylinder with water to the 25 mL line and place the cylinder on your desk.

● Compare the level of water in your cylinder with Figure 5-3. On close examination, the water rides up along the edges of the cylinder. The proper reading of volume is judged by the bottom level of water.

Adjust the volume of water if necessary so that it is exactly 25 mL. Convert your 25 mL volume to centiliter (cL) units. Use the same rule as established for length units. Are you changing from small to large units? If yes, then divide.

TABLE 5-3. VOLUME OF WATER IN CYLINDER

	mL	cL	dL	L
Volume				

FIGURE 5-3

26 mL
25 mL
24 mL
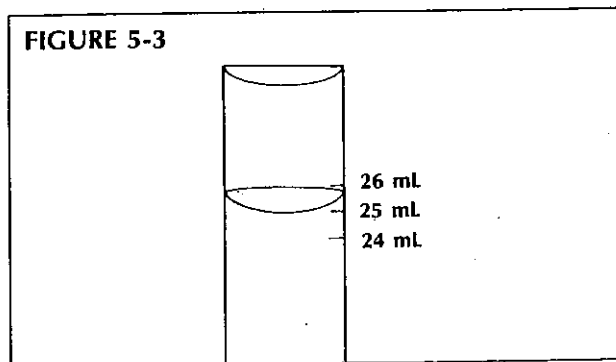
● Fill in Table 5-3 for centiliters, deciliters (dL), and liters (L). There are 10 centiliters in a deciliter, and 10 deciliters in a liter.

19. Complete the following chart based on the numbers filled in for you. "kL" stands for kiloliter.

	kL	L	dL	cL	mL
Volume	.032	32			

The liter (L) is the main unit for measuring volume in the SI system.

20. Fill in the blanks:

(a) 1.4 L = _____ mL

(b) 5520 mL = _____ cL

Analysis

1. What SI units studied can be used for measuring length?_____

2. What SI units studied can be used for measuring volume?_____

3. Why is it easier to convert meters to centimeters or millimeters than to convert miles to feet or

    inches?_____

4. Give the symbol for each of the following units.

    millimeter = _____ kiloliter = _____   centimeter = _____ liter = _____

5. What units are represented by each of the following symbols?

    dL = _____   km = _____   dm = _____   cL = _____

6. Circle the larger unit in each of the following pairs.

    (a) kiloliter or liter   (c) decimeter or millimeter   (e) millimeter or kilometer

    (b) centimeter or meter   (d) centimeter or millimeter   (f) centiliter or deciliter

7. Which mathematical process (multiplying or dividing) is used to change

    (a) centiliters to liters?_____

    (b) centiliters to deciliters?_____

    (c) meters to centimeters?_____

    (d) millimeters to meters?_____