

**Laboratory Skills 3**

**Making Metric Measurements**

**Introduction**

In many biology investigations, precise measurements must be made before observations can be interpreted. For everyday measuring, we still use English units such as the inch, quart, and pound. For scientific work, and for everyday measuring in most countries, the International System of Units (SI) is used. Eventually our country will use SI units for everyday measuring too.

Like our money system, SI is a metric system. All units are based on the number 10. In the SI system it is easy to change one unit to another because all units are related to one another by a power of 10. In this investigation, you will review SI units for measuring length, liquid volume, and mass. You will also learn how to use some common laboratory equipment used for measuring.

**Problem**

How are metric units of measurement used in the laboratory?

**Pre-lab Discussion**

Read the entire investigation. Then, work with a partner to answer the following questions.

1. Why do scientists and other people in most countries use the metric system for measurements?  
\_\_\_\_\_
2. Why is it easy to change from one unit to another in the SI system?  
\_\_\_\_\_
3. What connections can you identify between the metric units for length and volume?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. Why is it difficult to convert miles to yards or feet?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Name several aspects of everyday life that will change when our country converts to SI units.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Materials (per group)**

- meter stick
- metric ruler
- small test tube
- rubber stopper
- coin
- triple-beam balance
- 50-mL beaker
- 100-mL graduated cylinder

**Safety**

Handle all glassware carefully. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to Safety Symbols on page 8.

**Procedure**

**Part A. Measuring Length**

1. Use the meter stick to measure the length, width, and height of your laboratory table or desk in meters. Record your measurements to the nearest hundredth of a meter in Data Table 1.
2. Convert the measurements from meters to centimeters and then to millimeters. Record these measurements in Data Table 1.
3. Use a metric ruler to measure the length of a small test tube and the diameter of its mouth in centimeters. Record your measurements to the nearest millimeter in Data Table 2.
4. Convert the measurements from centimeters to millimeters. Record these measurements in Data Table 2.

**Data Table 1**

Dimension	Lab Table Measurements		
	m	cm	mm
Length			
Width			
Height			

**Data Table 2**

Dimension	Test Tube Measurements	
	cm	mm
Length		
Diameter of mouth		

### Part B. Measuring the Volume of a Liquid

1. Fill the test tube to the top with water. Pour the water into the graduated cylinder.
2. The surface of the liquid will be slightly curved. This curved surface is called a meniscus. To measure the volume accurately, your eye must be at the same level as the bottom of the meniscus. See Figure 1. Record the volume of the water from the test tube to the nearest milliliter in Data Table 3.

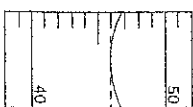
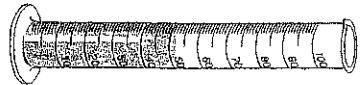


Figure 1



Data Table 3

Measurement of Volume	
Object	Volume (mL)
Water in test tube	

### Part C. Measuring Mass

1. Place the 50-ml beaker on the pan of the balance. Be sure that the riders on the triple-beam balance are moved all the way to the left and that the pointer rests on zero. See Figure 2.

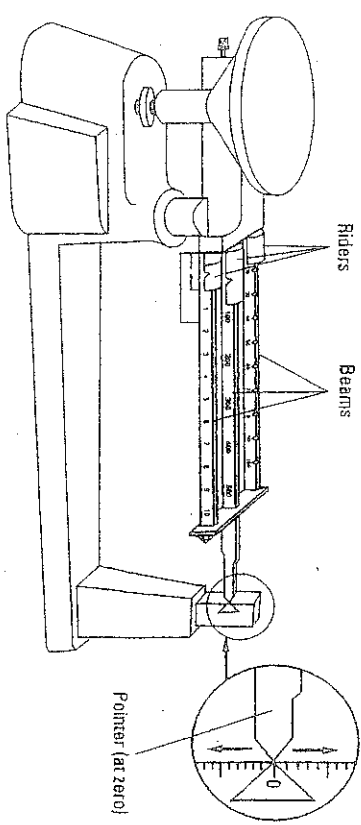


Figure 2

2. Move the rider on the middle beam to the right one notch at a time until the pointer drops below zero. Move the rider left one notch.
3. Move the rider on the back beam one notch at a time until the pointer again drops below zero. Move the rider left one notch.
4. Slide the rider along the front beam until the pointer stops at zero. The mass of the object is equal to the sum of the readings on the three beams.
5. Record the mass of the beaker to the nearest tenth of a gram in Data Table 4 on p. 30. Remove the beaker.

6. Repeat steps 2 through 5 using the rubber stopper and then the coin.

7. Use the graduated cylinder to place exactly 40 mL of water in the beaker. Determine the combined mass of the beaker and water. Record this mass to the nearest tenth of a gram in Data Table 4.

Data Table 4

Measurement of Mass	
Object	Mass (g)
50-ml beaker	
Rubber stopper	
Coin	
50-ml beaker plus 40 ml of water	

### Analysis and Conclusions

1. Calculating How do you convert meters to centimeters? Centimeters to millimeters?
2. Observing What is the largest volume of liquid your graduated cylinder can measure?
3. Observing What is the smallest volume of a liquid your graduated cylinder can measure?
4. Calculating What is the largest mass of an object your balance can measure?
5. Observing What is the smallest mass of an object your balance can measure?
6. Calculating What is the mass of 40 mL of water?
7. Predicting How would you find the mass of a certain amount of water that you poured into a paper cup?
8. Calculating In this investigation you found the mass of 40 mL of water. Based on your observations, what is the mass of 1 mL of water?

### Going Further

If other types of laboratory balances are available, such as an electronic balance or a double-pan balance, use them to find the masses of several different objects. Compare the accuracy of the different balances.