Name_____ Class_____ Date _____

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

Lab Table Measurements			
Dimension	m	cm	mm
Length			
Width			
Height			

Data Table 2

Test Tube Measurements		
Dimension	cm	mm
Length		
Diameter of mouth		

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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.

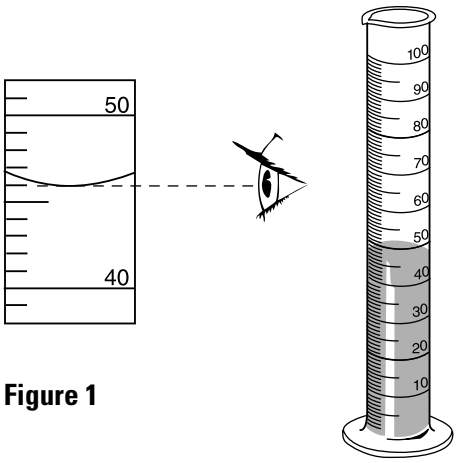

Figure 1

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.

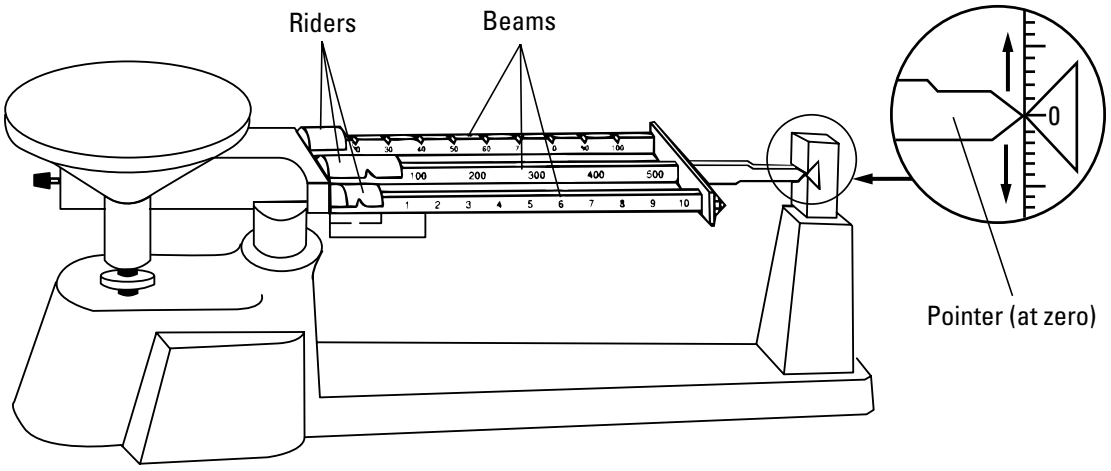

Figure 2

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	

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Laboratory Skills 5

Using a Compound Light Microscope

Introduction

Please write a formal introduction and make sure you cover all the parts, scientists involved, histroy of the microscope, different types, and usage of the microscope.

At the time of writing the formal lab report, be sure to incorporate the answers to Analysis and Conclusion section. You may NOT simply state the question or answer, they shall be written as one continuous and flowing part of the Conclusion section. However, you will be required to complete the Analysis and Conclusion section during your lab periods.

Problem

What is the proper use of a compound light microscope?

Pre-Lab Discussion

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

1. Why might it be a good idea to keep your microscope at least 10 cm from the edge of the table?

_____

2. Why should a microscope slide and coverslip be held by their edges?

_____

_____

3. Why do scientists use microscopes?

_____

4. Why should you use lens paper only once?

_____

_____

5. Why is it important to eliminate air bubbles from the slide?

_____

Materials *(per group)*

compound light microscope
prepared slide
lens paper
soft cloth (or cheesecloth)
newspaper
microscope slide
coverslip
dissecting probe
dropper pipette
scissors

Safety

Put on a laboratory apron. Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling microscope slides, as they can break easily and cut you. Never use direct sunlight as a light source for a compound light microscope. The sunlight reflecting through the microscope could damage your eye. Be careful when handling sharp instruments. Observe proper laboratory procedures when using electrical equipment. 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. Care of the Compound Light Microscope

1. Figure 1 shows the proper way to carry a microscope. Always carry the microscope with both hands. Grasp the arm of the microscope with one hand and place your other hand under the base. Always hold the microscope in an upright position so that the eyepiece cannot fall out. Place a microscope on your worktable or desk at least 10 cm from the edge. Position the microscope with the arm facing you.

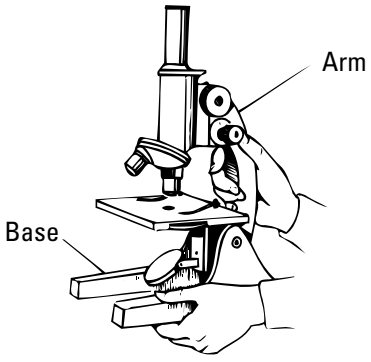

Figure 1

2. Notice the numbers etched on the objectives and on the eyepiece. Each number is followed by an "X" that means "times." For example, the low-power objective may have the number "10X" on its side, as shown in Figure 2. That objective magnifies an object 10 times its normal size. Record the magnifications of your microscope in the Data Table. The total magnification of a microscope is calculated by multiplying the magnification of the objective by the magnification of the eyepiece. For example:

magnification of objective	×	magnification of eyepiece	=	total magnification
10X	×	10X	=	100X

Use the formula to complete the Data Table.

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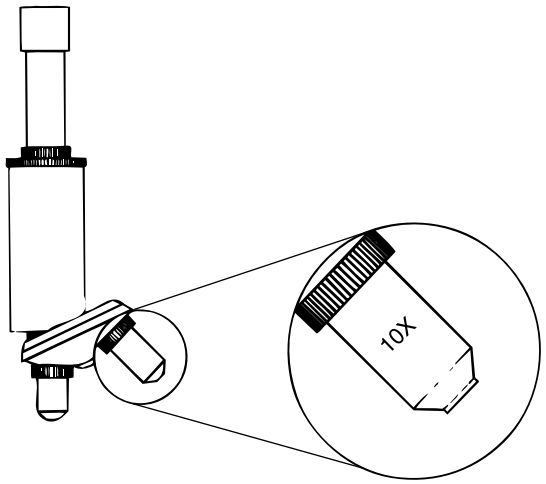

Figure 2

Data Table

Objective	Magnification of Objective	Magnification of Eyepiece	Total Magnification
Low power			
High power			
Other			

4. Before you use the microscope, clean the lenses of the objectives and eyepiece with lens paper. **Note:** *To avoid scratching the lenses, never clean or wipe them with anything other than lens paper. Use a new piece of lens paper on each lens you clean. Never touch a lens with your finger. The oils on your skin may attract dust or lint that could scratch the lens.*

Part B. Use of a Compound Light Microscope

1. Look at the microscope from the side. Locate the coarse adjustment knob that moves the objectives up and down. Practice moving the coarse adjustment knob to see how it moves the objectives with each turn.

2. Turn the coarse adjustment so that the low-power objective is positioned about 3 cm from the stage. Locate the revolving nosepiece. Turn the nosepiece until you hear the high-power objective click into position. See Figure 3. When an objective clicks into position, it is in the proper alignment for light to pass from the light source through the objective into the viewer's eye. Now turn the nosepiece until the low-power objective clicks back into position. **Note:** *Always look at the microscope from the side when moving an objective so that the microscope does not hit or damage the slide.*

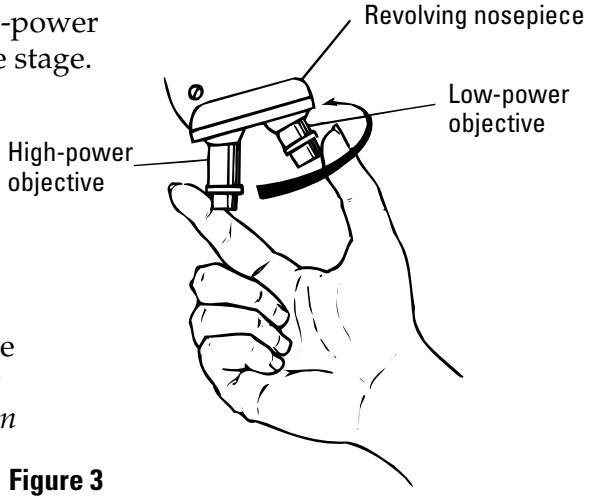

Figure 3

3. If your microscope has an electric light source, plug in the cord and turn on the light. If your microscope has a mirror, turn the mirror toward a light source such as a desk lamp or window. **CAUTION:** *Never use the sun as a direct source of light.* Look through the eyepiece. Adjust the diaphragm to permit sufficient light to enter the microscope. The white circle of light you see is the field of view. If your microscope has a mirror, move the mirror until the field of view is evenly illuminated.

4. Place a prepared slide on the stage so that it is centered over the stage opening. Use the stage clips to hold the slide in position. Turn the low-power objective into place. Look at the microscope from the side and turn the coarse adjustment so that the low-power objective is as close as possible to the stage without touching it.

5. Look through the eyepiece and turn the coarse adjustment to move the low-power objective away from the stage until the object comes into focus. To avoid eyestrain, keep both eyes open while looking through a microscope. **CAUTION:** *To avoid moving the objective into the slide, never lower the objective toward the stage while looking through the eyepiece.*

6. Turn the fine adjustment to bring the object into sharp focus. You may wish to adjust the diaphragm so that you can see the object more clearly. In the appropriate space below, draw what you see through the microscope. Record the magnification.

7. Look at the microscope from the side and rotate the nosepiece until the high-power objective clicks into position. Look through the eyepiece. Turn the fine adjustment to bring the object on the slide into focus. **CAUTION:** *Never use the coarse adjustment when focusing the high-power objective lens. This could break your slide or damage the lens.* In the appropriate space below, draw what you see through the microscope. Record the magnification.

Low-power magnification _____

High-power magnification _____

8. Remove the slide. Move the low-power objective into position.

Part C. Preparing a Wet Mount

1. Use a pair of scissors to cut a letter "e" from a piece of newspaper. Cut out the smallest letter "e" you can find. Position the "e" on the center of a clean glass slide.

2. Use a dropper pipette to place one drop of water on the cut piece of newspaper. See Figure 4B.

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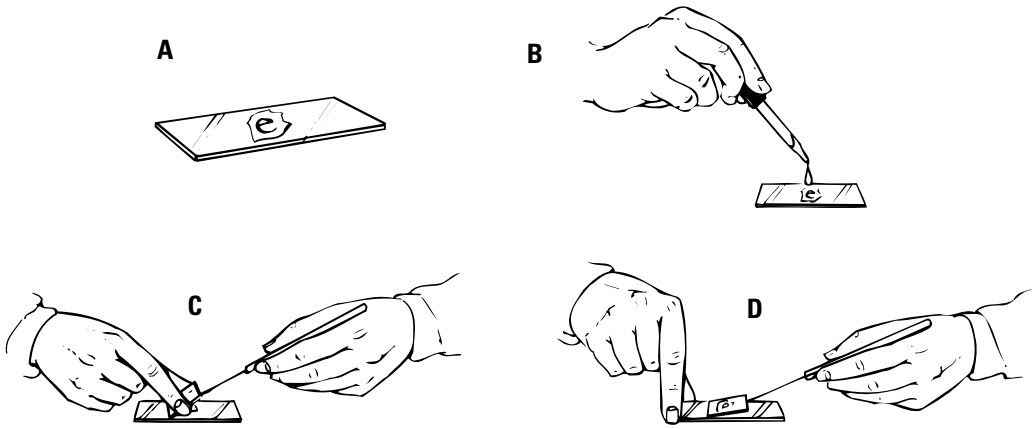

Figure 4

3. Hold a clean coverslip in your fingers as shown in Figure 4C. Make sure the bottom edge of the coverslip is in the drop of water. Use a dissecting probe to slowly lower the coverslip onto the wet newspaper. Slowly lowering the coverslip prevents air bubbles from being trapped between the slide and the coverslip. The type of slide you have just made is called a wet mount. Practice making a wet mount until you can do so without trapping air bubbles on the slide.
4. Center the wet mount on the stage with the letter "e" in its normal upright position. **Note:** *Make sure the bottom of the slide is dry before you place it on the stage.* Turn the low-power objective into position and bring the "e" into focus. In the appropriate place below, draw the letter "e" as seen through the microscope. Record the magnification.
5. While looking through the eyepiece, move the slide to the left. Notice the way the letter seems to move. Now move the slide to the right. Again notice the way the letter seems to move. Move the slide up and down and observe the direction the letter moves.
6. Turn the high-power objective into position and bring the letter "e" into focus. In the appropriate place below, draw the letter "e" as seen through the microscope. Record the magnification.

Low-power magnification _____

High-power magnification _____

7. Take apart the wet mount. Clean the slide and coverslip with soap and water. Carefully dry the slide and coverslip with paper towels and return them to their boxes.
8. Rotate the low-power objective into position and use the coarse adjustment to place it as close to the stage as possible without touching. Carefully pick up the microscope and return it to its storage area.

Analysis and Conclusions

1. **Inferring** Why do you place one hand under the base of the microscope as you carry it?

2. **Observing** How is the image of an object seen through the high-power objective different from the image seen through the low-power objective?

3. **Observing** How does the letter "e" as seen through the microscope differ from the way an "e" normally appears?

4. **Inferring** Explain why a specimen to be viewed under the microscope must be thin.

5. **Inferring** Why should you never use coarse adjustment when focusing the high-power objective lens?

6. **Drawing Conclusions** Suppose you were observing an organism through the microscope and noticed that it moved toward the bottom of the slide and then it moved to the right. What does this tell you about the actual movement of the organism?

Going Further

View some common objects, such as thread or a small piece of a color photograph from a magazine under the low-power and high-power objectives of the microscope. Make a drawing for each object. Describe the appearance of the objects when viewed under a microscope.