Name_____ Class_____ Date _____

Measuring Length, Mass, Volume, and Temperature

Introduction

Doing experiments is an important part of science. Most experiments include making measurements. Many different quantities can be measured. Some examples are length, mass, volume, temperature, and time. Some quantities, such as length, can be measured directly. Others, such as speed, are calculated from other measurements. In science you will probably use metric units to estimate, measure, and record data. The three fundamental metric units are the meter for length, the gram for mass, and the liter for capacity. In this investigation you will carry out different types of measurements.

Problem

What types of measurements are used to describe quantities?

Pre-Lab Discussion

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

1. Which of the measurements in the investigation are familiar to you? Which will be new to you?

_____

2. How will you record a distance that is 2 centimeters longer than 5 meters? 2 centimeters shorter?

_____

_____

3. How will you choose an object to measure in millimeters?

_____

_____

4. Why would you measure the contents of a paper cup in milliliters (mL) rather than in liters?

_____

_____

_____

5. Estimating quantities is a useful and practical skill. Describe a plan you can use to improve your ability to estimate quantities.

_____

_____

_____

Materials *(per group)*

meter stick
millimeter ruler
250-mL graduated cylinder
laboratory balance and metric masses
thermometer
2 paper cups
30 cm of string
table-tennis ball
golf ball

Safety

Wear your lab apron and safety goggles at all times during this lab. Be careful not to break any glassware. Note all safety alert symbols next to the steps in the Procedure and review the meaning of each symbol by referring to Safety Symbols on page 8.

Procedure

1. Find an object whose length can be easily measured in centimeters. Make a sketch of the object in the space below. Then measure and record its length.

USE A STREAK PLATE!

length: _____

2. Picture in your mind a familiar distance nearby that you think is 5 m long. Write a description of this distance below (for example, "The distance from our classroom to room 203 down the hall"). Then measure the distance with a meter stick and record your result. How good was your estimate?

_____

_____

_____

length: _____

3. Find an object whose width can be easily measured in millimeters. Make a sketch of the object in the space below. Then measure the object and record its length.

USE A TEXTBOOK!

length: _____
width: _____
area: _____

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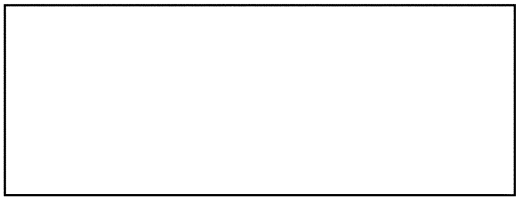
4. Find a small object that fits easily on the pan of the balance scale. Make a sketch of the object in the space below, then find its mass in grams.



USE A RUBBER STOPPER WITH HOLES!

mass: _____

5. Fill a paper cup up to the top line with water. Pour the water into the graduated cylinder and record its volume in mL. **CAUTION:** *Be careful not to break glassware.*

volume: _____

6. The volume of a rectangular solid is measured in cubic centimeters (cm^3). Find an object that is a rectangular solid. Then devise a way to find the volume of the object. What measurements will you need to make? Record each measurement and the volume of the object below.

USE A RUBBER STOPPER WITHOUT HOLES (IRREGULAR SHAPED OBJECT)!

_____

_____

_____

_____

volume: _____

7. Fill a paper cup about two-thirds full with cool tap water. Place the thermometer in the water and find its temperature. Record your measurement below. Spill out the water. Now fill the cup with warm tap water. Use the thermometer to find the temperature of the water. Record your measurement.

THE WARM WATER IS ALREADY ON THE HOT PLATE ON THE TEACHER'S DESK!

cool tap water: _____

warm tap water: _____

8. Use the balance to find the mass of the golf ball. Record your measurement below. Then find and record the mass of the table-tennis ball.

mass of golf ball: _____

mass of table-tennis ball: _____

Now take a piece of string and use it to measure the circumference of the golf ball at its widest point. You can do this by wrapping the string exactly once around the golf ball, then measuring the length of the string. Record your measurement below. Repeat this procedure for the table-tennis ball.

circumference of golf ball: _____

circumference of table-tennis ball: _____

Analysis and Conclusions

1. **Comparing and Contrasting** Which of the measurements did you find easiest to make? Which did you find most difficult? Why do you think so?

_____

_____

Comparing and Contrasting One student measured the height of a plant as 52 mm. Another student measured the same plant to the nearest tenth of a centimeter. What was the second student's measurement? Was one method more precise? Explain your answer.

_____

_____

Calculating A cube measuring 1 cm in each dimension holds 1 milliliter of water. Describe the dimensions of a cube that could hold 1 liter of water. What is the volume of this cube in cubic centimeters?

_____

_____

4. **Measuring** Why might two people measuring the same temperature get very different results?

_____

5. **Inferring** Why might it be a good practice to measure a quantity several times and average the results?

_____

_____

6. **Comparing and Contrasting** Look at the measurements that you recorded in step 8. In what way are these two balls similar? In what way are they quite different?

_____

_____

Forming Operational Definitions Describe a single measurement that would describe the similarity and difference that exists between the golf ball and table-tennis ball.

_____

Going Further

Find a local map that shows distances to the nearest tenth of a mile. Then have a friend with a car drive a short distance, such as 3 miles. Your friend should try to drive at a constant speed; for example, 30 miles per hour. Time the trip with a stop watch or watch with a second hand. Calculate the speed (distance divided by time) and compare the calculated speed with the speed shown on the car's speedometer. Do you think it is more accurate to calculate speed or to measure it? Give reasons for your opinion.