SKILLS INTRODUCTION

Calculating

Scientists must often solve problems that involve very large or very small numbers. For example, astronomers study galaxies with millions of stars that are at great distances from Earth. Microbiologists measure organisms or parts of organisms that can be seen only with the most powerful microscopes. Physicists investigate particles that are even smaller. Making calculations is important in the work of these and other scientists. **Calculating** is a process in which a person uses mathematical operations such as addition, subtraction, multiplication, and division to manipulate numbers and symbols.

One important type of calculation you will need to make is converting units of measure. That means changing one unit of measure into a different unit of measure that represents the same amount. For example, if you have 220 dimes, how many dollars do you have? Because you know there are 10 dimes in a dollar, you can easily convert the dimes to dollars with this procedure.

$$220 \text{ dimes} \times \frac{\$1}{10 \text{ dimes}} = \frac{\$220}{10} = \$22$$

In science, you will need to convert between SI, or metric, units. Like the dollar system, the SI system is a decimal system. The table below lists some common metric conversions.

Common Metric Conversions	
Length	1 km = 1,000 m
	1 m = 100 cm
	1 m = 1,000 mm
	1 cm = 10 mm
Liquid volume	1 L = 1,000 mL
Mass	1 kg = 1,000 g

For example, suppose you need to convert 117 millimeters into centimeters. One way to make the conversion is to follow the procedure that was just used to convert dimes to dollars:

$$117 \text{ millimeters} \times \frac{1 \text{ centimeter}}{10 \text{ millimeters}} = \frac{117}{10} \text{ centimeters} = 11.7 \text{ centimeters}$$

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Calculating *(continued)*

▶ Tips for Calculating

Follow these steps when converting between units.

1. Begin by writing down the measurement you want to convert on the left side of the equation. Suppose you want to convert 1.6 liters to milliliters. Write:

1.6 liters ×

2. Write a conversion factor that represents the relationship between the two units you are converting: *1 liter = 1,000 milliliters.* Writing this conversion factor as the correct fraction is an important step.

1.6 liters × $\dfrac{1,000 \text{ milliliters}}{1 \text{ liter}}$

Make sure you place the units you are starting with—liters, in this example—in the denominator. In the next step, you will see why that is important.

3. Multiply the measurement you want to convert by the conversion factor. When you multiply these two terms, the units in the first measurement will cancel out with the units in the denominator. The result will be a fraction.

1.6 ~~liters~~ × $\dfrac{1,000 \text{ milliliters}}{1 \text{ ~~liter~~}}$ = $\dfrac{1,600.0}{1}$ milliliters

4. Divide the numerator of the fraction by the denominator. Your answer will be in the units you are trying to find.

1.6 ~~liters~~ × $\dfrac{1,000 \text{ milliliters}}{1 \text{ ~~liter~~}}$ = $\dfrac{1,600.0}{1}$ milliliters = 1,600 milliliters

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☑ ***Checkpoint*** Convert between the following units.

3 kilometers = _____ meters

2,082 grams = _____ kilograms

SKILLS PRACTICE

Calculating

Convert between the following units. Fill in your answers in the spaces provided. Show your work below or on the back of this sheet.

1. 382 milliliters = _____ liters

6. 3.7 liters = _____ milliliters

2. 2.2 decimeters = _____ millimeters

7. 4.1 grams = _____ milligrams

3. 4.5 meters = _____ centimeters

8. 211 centimeters = _____ meters

4. 0.67 liters = _____ milliliters

9. 0.5 kilograms = _____ milligrams

5. 303 grams = _____ kilograms

10. 17 meters = _____ centimeters

11. Think About It Look over all the conversions you just made. Try to find a shortcut method for converting between one metric unit and another, for example, from milliliters to liters. (*Hint:* Examine how the position of the decimal point changed in each example.)

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