Name: _____ Date: _____

Problem Solving: Metric Conversions

Learning goals
After completing this activity, you will be able to …

- Convert from one metric unit to another.
- Use conversion factors to solve unit conversion problems.

Introduction: Metric prefixes
The metric system is based on powers of 10. No matter what quantity you are working with, converting between units will involve multiplying or dividing by a power of 10. The metric prefixes are listed at right. All of these prefixes can be used with any metric base unit, but the ones listed in red are the most common.

Prefix	Symbol	Meaning
giga-	G	1,000,000,000
mega-	M	1,000,000
kilo-	k	1,000
hecto-	h	100
deka-	da	10
deci-	d	1/10
centi-	c	1/100
milli-	m	1/1,000
micro-	μ	1/1,000,000
nano-	n	1/1,000,000,000

The prefix *kilo-* means “1,000.” There are 1,000 meters in a kilometer, and 1,000 grams in a kilogram. The prefix *centi-* means “1/100,” or “0.01.” There are 0.01 meters in a centimeter, or 100 centimeters in a meter. To convert meters into centimeters, multiply by 100. To convert centimeters to meters, divide by 100.

1. How many centimeters are in 0.45 meters? _____

2. How many kilograms are in 729 grams? _____

3. How many milliliters are in 2.6 liters? _____

Canceling units
A sprinter runs 100 meters in 9.8 seconds. A horse races 2 kilometers in 2 minutes. A car travels 100 kilometers in 1.7 hours. Who was going fastest?

To solve this problem, you need to convert each speed into the same units. This is done with a technique called canceling units. The idea is that a quantity is unchanged when multiplied by a factor equivalent to 1. Units cancel when they appear in the numerator and denominator.

For example, to convert the horse’s speed into meters per second, first convert into meters per minute:

$$\frac{2\ \cancel{\text{km}}}{2\ \text{min}} \times \frac{1{,}000\ \text{m}}{1\ \cancel{\text{km}}} = \frac{2{,}000\ \text{m}}{2\ \text{min}} = 1{,}000\ \text{m/min}$$

The *conversion factor*, 1,000 m/1 km, is equivalent to 1 because there are 1,000 meters in a kilometer. Therefore, multiplying by the conversion factor does not change the quantity because it is equivalent to multiplying by one. The red lines illustrate the fact that kilometers are canceled because they appear in the numerator and the denominator.

Next, convert meters per minute to meters per second. Notice that the minutes have to be in the numerator of the conversion factor in order to cancel the minutes in the denominator of the term that is being converted:

$$\frac{1{,}000\ \text{m}}{1\ \text{min}} \times \frac{1\ \text{min}}{60\ \text{s}} = 16.67\ \text{m/s}$$

After you have solved a problem, it is always important to look at your answer and check that it is reasonable. If you calculate that a person runs 1,000,000 kilometers per second, you may want to check your math! It is usually a good idea to estimate the answer before you calculate.

1. The human sprinter runs 100 meters in 9.8 seconds. What is the sprinter's speed in meters per second? _____

   Show your work here:

2. The car travels 100 kilometers in 1.7 hours. How fast is it going in km per h? _____

   Show your work here:

3. How fast is the car going in meters per hour? _____

   Show your work here:

4. How fast is the car going in meters per minute? _____

   Show your work here:

5. How fast is the car going in meters per second? _____

   Show your work here:

6. Which had the greatest average speed: the sprinter, the horse, or the car? _____