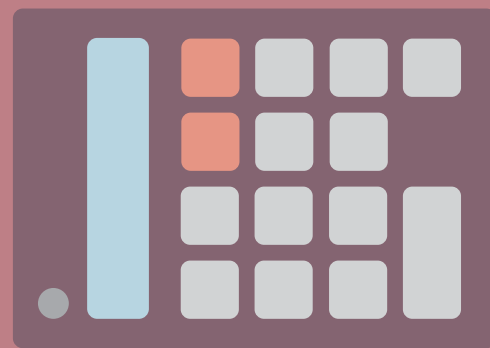




MATH

Student Book

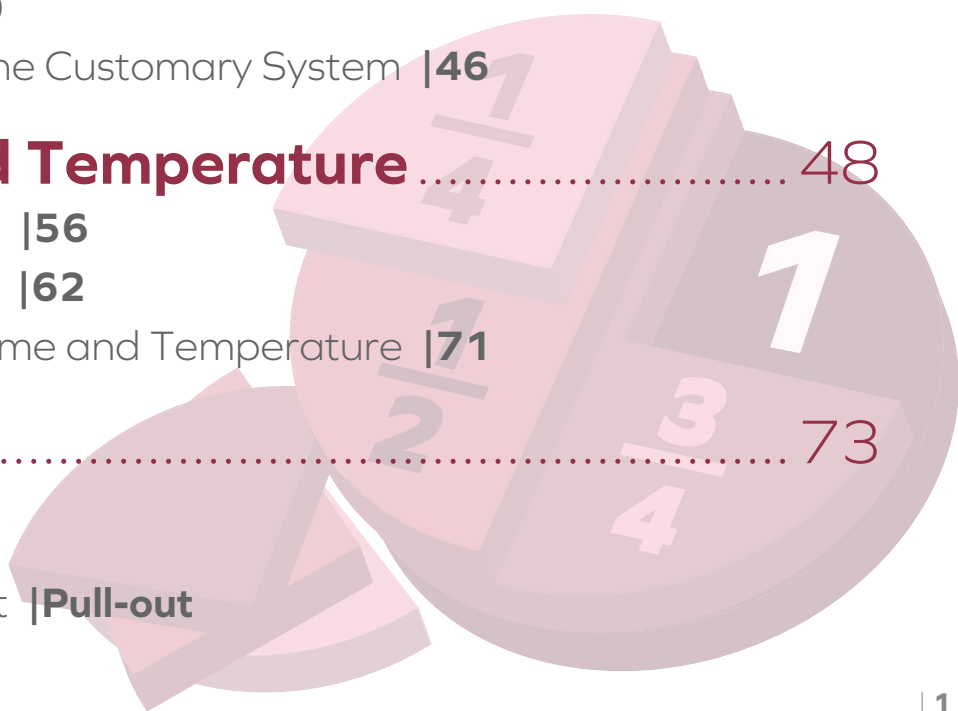


► **5th Grade | Unit 5**

MATH 505

MEASUREMENT

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MEASUREMENT

In this unit, you will learn about different kinds of measurement. You will learn about metric and customary units of length, mass, and capacity. You will become familiar with the various units by estimating with them and finding the appropriate unit for a measurement. You will learn how to convert between units to compare them, and to add and subtract them. You will also review telling time and converting units of time, and finding elapsed time. Finally, you will learn about the Fahrenheit and Celsius temperature scales and learn to convert from one to the other. You will find that converting between any units follows the same process, and this process can be used in conversions you will encounter later in your studies of mathematics.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAAC. When you have finished this LIFEPAAC, you should be able to:

- Compare and convert metric units.
- Compare and convert customary system units.
- Compare and convert units of time and find elapsed time.
- Compare and convert units of temperature.

1. THE METRIC SYSTEM

Did you know that the metric system of measurement (properly called the International System of Units) is based on a single measurement? A meter, the basic metric unit of length, is defined as one ten-millionth of the distance from the Equator to the North Pole!

All other measurements in the metric system are based on this one measure. Why was this system created, and how is it used today? In this lesson, you will learn about the different units in the metric system and how they are used.

Objectives

Read these objectives. When you have completed this section, you should be able to:

- Name metric units.
- Compare metric units.
- Compare units of length within the metric system.
- Convert units of length within the metric system.
- Compare units of mass within the metric system.
- Convert units of mass within the metric system.
- Compare units of capacity within the metric system.
- Convert units of capacity within the metric system.

Vocabulary

Study these new words. Learning the meanings of these words is a good study habit and will improve your understanding of this LIFE PAC.

capacity. The amount a container can hold.

centi. A prefix meaning one-hundredth.

centimeter. One-hundredth of a meter.

deca. A prefix meaning ten.

deci. A prefix meaning one-tenth.

gram. The basic metric unit for mass.

hecto. A prefix meaning one hundred.

International System of Units. The primary system of measurement used by most countries in the world; the modern metric system of measurement; abbreviated SI.

kilo. A prefix meaning one thousand.

kilogram. One thousand grams.

kilometer. One thousand meters.

liter. The basic metric unit for capacity.

mass. The amount of matter in an object.

meter. The basic metric unit for length.

milli. A prefix meaning one-thousandth.

milligram. One-thousandth of a gram.

milliliter. One-thousandth of a liter.

millimeter. One-thousandth of a meter.

Note: All vocabulary words in this LIFE PAC appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

Naming Metric Units

French mathematicians and scientists devised the metric system of measurement a little more than 200 years ago. As math and science were studied more and more around the world, they realized a common system of measurement was needed so that mathematicians and scientists would agree on results and understand each other.

The world did not immediately switch to the system as the French had hoped. More and more countries gradually adopted it though, and today the United States and two small countries are the only ones that don't use the metric system! The metric system is called the **International System of Units** (or SI for short), because it truly is internationally used.

To create the metric system, the French measured the length of an imaginary line that went from the Equator, through Paris, and to the North Pole. One ten-millionth of this length was defined as a **meter**, the basic unit of length.

Each of the other basic units is based on the meter. The **mass** of a cube of water, one-hundredth of a meter on each side, is defined as a **gram**, the basic unit of mass. That amount of water is called a **milliliter**, and 1,000 milliliters is called a **liter**, the basic unit of **capacity**. Because each basic unit (meter, gram, and liter) was based on the meter, it is called the metric system.

Make note!

Metric units are usually abbreviated, but do not use periods. The prefix letter and basic unit letter tell you the name of the unit.

The basic units—gram (g), liter (L), and meter (m)—are combined with the prefixes to form the different units. The letters for each part of the unit are combined to give an abbreviation. So, a kilogram is 1,000 grams and is written as kg.

Vocabulary

To remind yourself of the prefixes' meanings, think of other words that use them, and their meanings. For example, a decade is 10 years and a century is 100 years. Many of these words are also names for measurements.

Also, notice that the prefixes that are less than one all end in the letter i: deci-, centi-, and milli-.

PREFIX	LETTER	FACTOR
kilo-	k	1,000
hecto-	h	100
deca-	da	10
—	—	1
deci-	d	0.1
centi-	c	0.01
milli-	m	0.001

Let's try a few examples:

Example:

Find the name and abbreviation for the following quantities:

$\frac{1}{1,000}$ of a liter

$\frac{1}{100}$ of a meter

100 grams

Solution:

For each amount, we will use the table to find the correct prefix.

$\frac{1}{1,000}$ of a liter:

Looking at the table, milli- means $\frac{1}{1,000}$ (0.001). So, one-thousandth of a liter is a milliliter. The letter m is used for milli-, and L is used for liter, so mL is the abbreviation for milliliter.

$\frac{1}{100}$ of a meter:

Looking at the table, centi- means $\frac{1}{100}$ (0.01). So, one-hundredth of a meter is a centimeter. The letter c is used for centi- and m is used for meter, so cm is the abbreviation for centimeter.

100 grams:

Looking at the table, hecto- means 100. So, one hundred grams is a hectogram. The letter h is used for hecto- and g is used for grams, so hg is the abbreviation for hectogram.

Connections

There are other prefixes that are not used frequently and are sometimes applied in other areas.

- M stands for mega and means 1,000,000.
- G stands for giga and means 1,000,000,000.
- T stands for tera and means 1,000,000,000,000.

A byte (B) is a unit of computer memory, so a kilobyte is 1,000 bytes. One million bytes is called a megabyte (MB), and one billion bytes is called a gigabyte (GB). Some home computers today have one trillion bytes, called a terabyte (TB).

If you think about the different units, there are many that we use in everyday life:

- Soda comes in 2 L bottles.
- Pills are measured in milligrams, such as a 250 mg tablet.
- Longer running events are often measured in **kilometers**, such as a 10 km race, or commonly called a 10K.

Comparing Metric Units

Because the SI system of measurement is based on powers of 10, it makes it easier to convert between units. All we need to do is multiply or divide by 10, 100, or 1,000. For instance, to convert 2,000 meters to kilometers, we can divide by 1,000 because there are 1,000 meters in each kilometer. $2,000 \div 1,000 = 2$, so 2,000 meters is 2 kilometers.

So, $2,000 \div 1,000$ is the same as moving the decimal three places to the left, because there are three zeros in 1,000 and we are dividing. If we needed to divide 2,147 by 1,000 we would still move the decimal three places to the left: $2,147 \div 1,000 = 2.147$.

Let's practice multiplying and dividing by powers of ten, since we will use this skill when we convert metric measures.

This might help!

Remember, to multiply or divide by powers of 10, we move the decimal as many places as there are zeros. Move the decimal to the right for multiplication and to the left for division.

$$2.45 \times 100 = \underbrace{245.}$$

$$2.45 \div 100 = \underbrace{0.0245}$$

There are two zeros in 100, so the decimal point moves two to places to the right for 2.45×100 , and two places to the left for $2.45 \div 100$.

Example:

Solve the following:

$$3,450 \div 100 =$$

$$1.24 \times 10 =$$

$$23.7 \div 1000 =$$

Solution:

For each problem, we will count the zeros in the power of ten and move the decimal accordingly.

$$3,450 \div 100 =$$

There are 2 zeros in 100 and we are dividing, so the decimal moves 2 places to the left:

$$34.50, \text{ or } 34.5$$

$$1.24 \times 10 =$$

There is 1 zero in 10 and we are multiplying, so the decimal moves 1 place to the right:

$$12.4$$

$$23.7 \div 1,000 =$$

There are 3 zeros in 1,000 and we are dividing, so the decimal moves 3 places to the left:

$$0.0237$$

Reminder:

For whole numbers, the decimal is not usually shown, but is to the right of the number: $2,000 = 2,000.0$

Let's Review!

Before going on to the practice problems, make sure you understand the main points of this lesson.

- ✓ The metric system was created as a standard system of measurement based on the meter. It is now called the International System of Units (or SI).
- ✓ The metric system is based on powers of 10 and uses prefixes that mean 10, 100, and 1,000, and $\frac{1}{10}$, $\frac{1}{100}$, and $\frac{1}{1,000}$.



Complete this activity.

1.1

Match the terms with their definitions.

- | | |
|--|---|
| a. _____ capacity | 1. prefix meaning ten |
| b. _____ centi- | 2. prefix meaning one-hundredth |
| c. _____ deca- | 3. prefix meaning one thousand |
| d. _____ deci- | 4. the amount a container can hold |
| e. _____ gram | 5. prefix meaning one-thousandth |
| f. _____ hecto- | 6. the primary system of measurement used by most countries in the world; the modern metric system of measurement; abbreviated SI |
| g. _____ International System of Units | 7. the basic metric unit for mass |
| h. _____ kilo- | 8. the basic metric unit for capacity |
| i. _____ liter | 9. prefix meaning one-tenth |
| j. _____ mass | 10. prefix meaning one hundred |
| k. _____ meter | 11. the basic metric unit for length |
| l. _____ milli- | 12. the amount of matter in an object |



Circle the correct letter and answer.

- 1.2** Which prefix means 10?
 a. milli- b. deci- c. centi- d. deca-
- 1.3** What is a hectoliter?
 a. $\frac{1}{100}$ of a liter b. 100 grams c. 100 liters d. 1,000 liters
- 1.4** What is another way to say 230 mm?
 a. 230 millimeters b. 230 milliliters
 c. 230 centimeters d. 230 meters
- 1.5** A newspaper headline says that the average home uses about 30 kilowatt-hours per day. What is a kilowatt?
 a. 100 watts b. 1,000 watts c. $\frac{1}{100}$ of a watt d. 30 watts
- 1.6** What is the basic metric unit of capacity?
 a. meter b. gallon c. gram d. liter
- 1.7** Which unit is smallest?
 a. centimeter b. meter c. millimeter d. hectometer
- 1.8** Solve the following: $3.12 \times 1,000 = \underline{\hspace{2cm}}$
 a. 31.2 b. 312 c. 3,120 d. 31,200
- 1.9** Solve the following: $45.2 \div 100 = \underline{\hspace{2cm}}$
 a. 4.52 b. 0.452 c. 452 d. 4,520
- 1.10** Which amount is largest?
 a. 100 g b. 1 kg c. 1,000 mg d. 1 dg



Complete this activity.

- 1.11** Match each prefix with the number it represents.
- | | |
|-----------------|----------------------|
| a. _____ deca- | 1. $\frac{1}{100}$ |
| b. _____ kilo- | 2. 1,000 |
| c. _____ milli- | 3. 10 |
| d. _____ centi- | 4. 100 |
| e. _____ hecto- | 5. $\frac{1}{1,000}$ |

Length

Whitney drives her car 104 kilometers per hour.

Steve is 1.5 meters tall.

Laura's math book is about 20 centimeters wide.

If you are not familiar with metric measurements, these statements have little meaning. In this lesson, we will explore metric units of length and become more comfortable using these units.



Comparing Units of Length within the Metric System

You know that the meter is the basic unit of length in the metric system (the International System of Units). In this lesson, we will focus on the following commonly used units of length:

- kilometer = 1,000 meters
- meter = basic unit of length
- centimeter = $\frac{1}{100}$ of a meter
- millimeter = $\frac{1}{1,000}$ of a meter (1,000 millimeters = 1 meter)

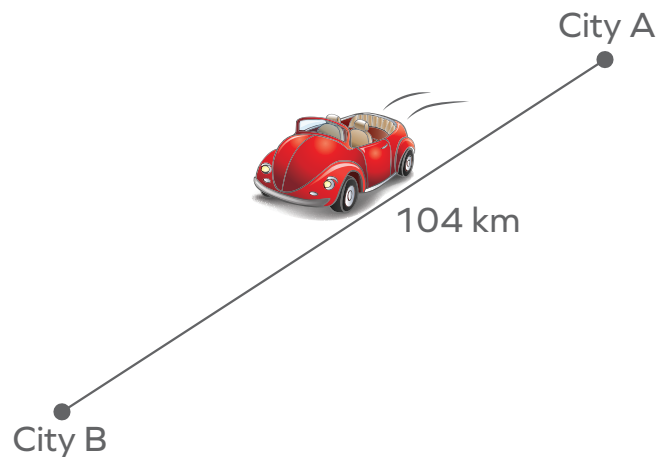
Let's see if we can get an idea of the size of these units.

The **kilometer** is the largest unit and is similar to, but shorter than, a mile (1 km \approx 0.62 miles). If Whitney drove her car 104 kilometers, she would be driving about 65 miles per hour. We would use kilometers to measure the distance between cities.

A **meter** is about 39 inches, a little longer than a yardstick (1 yard = 36 inches). So, if Steve is about 1.5 meters tall, he is about 60 inches, or 5 feet tall. We would measure the width or height of a room in meters.

A **centimeter** is $\frac{1}{100}$ of a meter so it is a fairly short length—similar to, but smaller than, an inch (1 cm \approx 0.4 inches). Your pinkie finger is about a centimeter wide. So, if Laura's book is 20 centimeters wide, it's about 8 inches wide. The length of a pencil would be measured in centimeters.

A **millimeter** is 10 times smaller than a centimeter (10 millimeters make 1 centimeter). Millimeters are used for small measurements. A dime is about 1 millimeter thick. You could measure the width of a pencil in millimeters.



Let's try to estimate the length of a few objects.

Example:

Estimate the length of the following, using metric units:

- the height of a flagpole
- the width of a postage stamp
- the distance from your home to the airport

Solution:

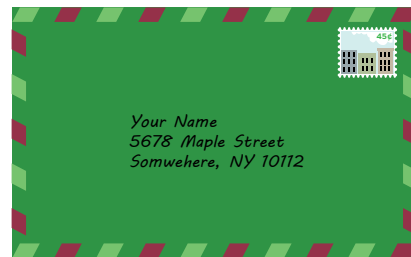
For each length, first we'll decide the appropriate unit and then make the estimate.

The height of a flagpole:

You are probably about 1.5 meters tall. A flagpole would be taller than you, so meters are the appropriate unit. How many of "you" stacked up would be the height of the flagpole? Flagpoles come in different sizes, but most are about 6 or 7 meters tall.

The width of a postage stamp:

A postage stamp is fairly small, so we need a small unit such as centimeters. How many pinkie finger widths would a stamp be? Most postage stamps are about 2.5 cm wide.



The distance from your home to the airport:

This length will be different for everybody, but mostly likely would be measured in kilometers since airports are usually located a reasonable distance from residential areas. Remember, a kilometer is 1,000 meters, so it is used for longer distances. Let's say that the airport is 3.5 km away from your home. What would that distance be, expressed in meters? Remember, the metric system is based on powers of 10, so to convert between different units, we either multiply or divide by 10, 100, or 1,000 (in most cases).

This might help!

To multiply or divide by a power of 10 move the decimal as many times as there are zeroes. Move the decimal to the right for multiplication and to the left for division.

SELF TEST 1: THE METRIC SYSTEM

Each numbered question = 6 points

Circle the correct letter and answer.

- 1.01** Which prefix means 100?
a. hecto- b. deci- c. centi- d. deca-
- 1.02** Which unit is the largest?
a. decameter b. millimeter c. meter d. centimeter
- 1.03** What is another way to say 345 centimeters?
a. 345 mm b. 345 cm c. 34.5 dl d. 345 cg
- 1.04** Which pair of measurements is *not* equivalent?
a. 340 mm, 0.34 m b. 720 cm, 7.2 m
c. 9.6 cm, 96 mm d. 1256 m, 12.56 km
- 1.05** Which unit would you use to measure the length of a football field?
a. mm b. cm c. m d. km
- 1.06** Which measurement is *most* accurate to describe the width of a penny?
a. 19 mm b. 8 cm c. 1 m d. 0.3 km
- 1.07** Convert 7.5 kilometers to meters.
a. 0.00675 m b. 75 m c. 750 m d. 7,500 m
- 1.08** Which pair of measurements is equivalent?
a. 8,600 mg, 86 g b. 2,500 g, 250 kg
c. 3.4 kg, 3,400 g d. 480 g, 4.8 mg
- 1.09** Which unit would you use to measure the weight of an aspirin?
a. mg b. g c. kg d. km
- 1.010** Which measurement is *most* accurate to describe the weight of a dime?
a. 25 mg b. 120 g c. 0.5 kg d. 5,700 mg
- 1.011** Convert 3.2 grams to milligrams.
a. 0.0032 mg b. 32 mg c. 320 mg d. 3,200 mg
- 1.012** Which pair of measurements is *not* equivalent?
a. 8,600 mL, 8.6 L b. 250 mL, 0.25 L
c. 5.7 L, 570 mL d. 12 L, 12,000 mL

- 1.013** Which unit would you use to measure the amount of milk in a half-gallon carton?
a. mL b. g c. cm d. L
- 1.014** Which measurement is *most* accurate to describe the amount that a teacup can hold?
a. 175 mL b. 1 L c. 6 mL d. 125 L
- 1.015** Convert 7.8 liters to milliliters.
a. 0.0078 mL b. 78 mL c. 780 mL d. 7,800 mL

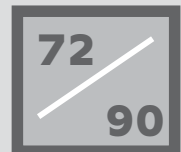


Teacher check:

Score _____

Initials _____

Date _____





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www.aop.com

MAT0505 - Jan '16 Printing

ISBN 978-0-7403-3485-6



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