

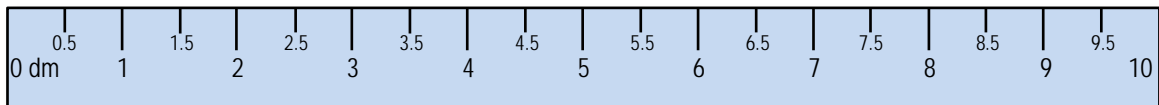
## Module 3: Understanding the Metric System

### 3.1 The Metric System

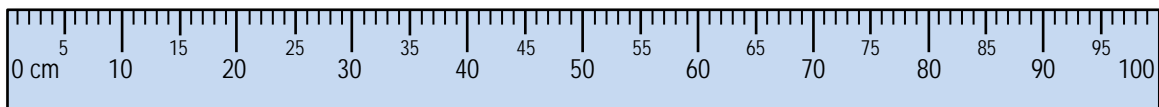
#### 1. Understand the Basic Units of Length used in Health Care Careers

The metric system is the most commonly used system of measurement in the Health Care career field. A **meter** is the basic unit of length in the metric system and 1 meter (abbreviated 1 m) is approximately 3 inches longer than 1 yard. Both larger and smaller units of measure are expressed using a prefix on the word *meter*. Below are diagrams of meter sticks whose lengths are scaled with markings of unit measures that are less than 1 meter. The abbreviations for the prefix on the word meter are shown in the parenthesis.

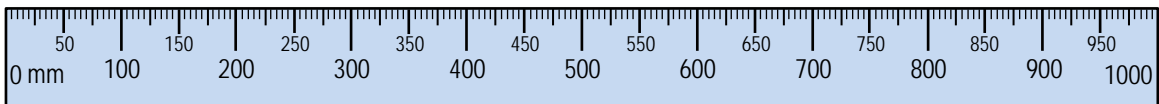
1 meter = 10 **decimeters** (dm)



1 meter = 100 **centimeters** (cm)



1 meter = 1,000 **millimeters** (mm)



Use the above meter sticks and previous content to answer the following questions.

- 1) Write down the abbreviations for *meters*, *decimeters*, *centimeters*, and *millimeters*.
- 2) How does the abbreviation for miles differ from the abbreviation for meters?
- 3) Order the following lengths of measure from smallest to largest.  
1 dm, 1 mm, 1 m, 1 cm
- 4) Order the following lengths of measure from largest to smallest.  
450 mm, 40 cm,  $\frac{1}{2}$  m, 6 dm, 1 yd
- 5) A length of 3 dm is equal to a length of how many millimeters?
- 6) A length of 70 cm is equal to a length of how many decimeters?
- 7) A length of  $\frac{1}{4}$  m is equal to a length of how many millimeters?
- 8) A length of  $\frac{1}{5}$  m is equal to a length of how many decimeters?

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Many of the things we use on a daily basis can help us estimate lengths of other objects. For example, the length of a dollar bill is 6.14 inches and its width is 2.61 inches. In metric units its length is approximately 16 cm and its width approximately 7 cm. A mechanical pencil is slightly smaller than the length of a dollar bill, and therefore its length can be approximated as 15 cm.



Here are some other items that we may use on a daily basis that can help us estimate metric lengths.

The diameter of a quarter is about 25 mm.



A dime is about 1 mm thick.



A USB plug is about 1 cm wide.



The diameter of a DVD is about 14 cm.



Using an incorrect metric prefix to represent measurements of quantities such as length, mass (weight), or drug dosages, can result in dangerous errors. In order to determine if a given or calculated quantity makes sense, we need to develop good estimation skills. Let's now begin developing our estimation skills by doing problems that require us to write in an appropriate metric unit.

Fill in the blank with the appropriate metric unit. Choose m, dm, cm, or mm.

9) The width of the palm of your hand is  
10 \_\_\_\_\_.



10) The height of a soda can is 12 \_\_\_\_\_.



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11) The length of a key is 50 \_\_\_\_.



12) The diameter of a nickel is about 2 \_\_\_\_.

13) The length of your index finger is about 7 \_\_\_\_.

14) The average length of an adult female femur bone is about 45 \_\_\_\_.

15) A cellular phone is approximately 120 \_\_\_\_ in length.

16) A plastic fork is approximately 16 \_\_\_\_ in length.

17) Your teacher is about 1.7 \_\_\_\_ tall.

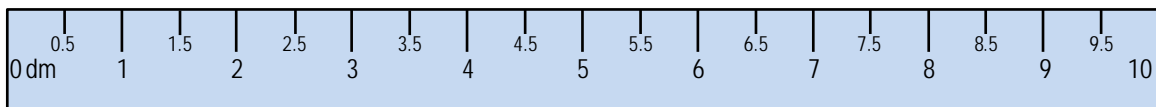
18) A CD-ROM disk has a thickness of 1.2 \_\_\_\_.

### 2. Converting between Metric Units using Powers of 10

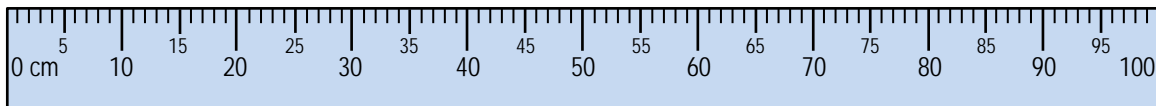
Looking at the meter stick diagrams below, we notice that the prefix *deci* is used to represent unit lengths that are  $\frac{1}{10}$  of a meter and therefore  $10 \text{ dm} = 1 \text{ m}$ . Similarly, we see that *centi* is used to represent unit lengths that are  $\frac{1}{100}$  of a meter. Therefore,  $100 \text{ cm} = 1 \text{ m}$ . Finally, we see that *milli* is used to represent unit lengths that are  $\frac{1}{1,000}$  of a meter and therefore  $1,000 \text{ mm} = 1 \text{ m}$ .

You may have noticed that one-half of a meter, or 0.5 m, is equal to 5 dm. The diagrams below show us that 5 dm is equal to 50 cm, and that 50 cm is equal to 500 mm. Summarizing this, we get the relationship  $0.5 \text{ m} = 5 \text{ dm} = 50 \text{ cm} = 500 \text{ mm}$ . Do you see a pattern?

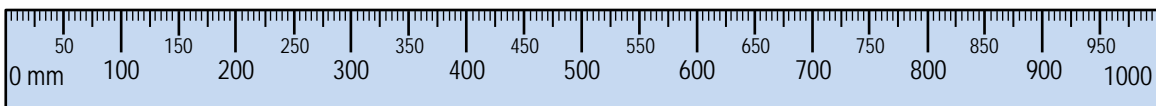
1 meter = 10 *deci*meters (dm)



1 meter = 100 *centi*meters (cm)



1 meter = 1,000 *milli*meters (mm)



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Let's now complete a table to demonstrate the pattern. Fill in the blank cells.

Equivalent Lengths	0.5 m	5 dm	50 cm	500 mm
	0.7 m	dm	cm	mm
	m	dm	35 cm	mm
	m	dm	cm	625 mm

When moving across each row to the right, we see that the numbers are multiplied by a factor of 10. When moving across each row to the left, the numbers are divided by a factor of 10. Remember that multiplying a number by 10 moves the decimal point to the right one place value. Dividing a number by 10 moves the decimal point to the left one place value.

Now let's apply what we have learned to the following questions.

Convert each measure to the indicated unit.

19) 25 cm to mm

23) 7.6 dm to cm

27) 1.5 m to cm

20) 35 dm to mm

24) 278 mm to cm

28) 17.5 dm to m

21) 0.2 m to cm

25) 3.2 dm to m

29) 1,578 mm to m

22) 0.7 cm to mm

26) 5 mm to dm

30) 349 cm to m

### 3. Understand Units of Length Greater Than 1 Meter

Up to this point we have mainly dealt with lengths that measure less than 1 meter. What about lengths that are more than 1 meter? In this case we again use a prefix on the word *meter* to represent measures of length that are greater than 1 meter.

The prefix *deka* is used to represent a length that is 10 meters.

1 **deka**meter = 10 meters

The prefix *hecto* is used to represent a length that is 100 meters.

1 **hecto**meter = 100 meters

The prefix *kilo* is used to represent a length that is 1,000 meters.

1 **kilo**meter = 1,000 meters

Again you may notice that there is a pattern involving powers of 10. Notice that the prefix *deka* is used to represent unit lengths that are 10 times that of a meter. Therefore, 1 dekameter = 10 m.

Next, we see that *hecto* is used to represent unit lengths that are 100 times that of a meter.

Therefore, 1 hectometer = 100 m. Finally, we see that *kilo* is used to represent unit lengths that are 1,000 times that of a meter and therefore 1 kilometer = 1,000 m.

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Let's again complete a table to demonstrate the pattern. Fill in the blank cells. The abbreviations for the prefix on the word meter are shown in the parenthesis.

	kilometers (km)	hectometers (hm)	dekameters (dam)	meters (m)
Equivalent Lengths	2 km	hm	dam	m
	km	hm	86.5 dam	m
	km	hm	dam	4,675 m
	km	10.09 hm	dam	m

Again we can see that when moving across each row to the right, the numbers are multiplied by a factor of 10. When moving across each row to the left, the numbers are divided by a factor of 10. Remember that multiplying a number by 10 moves the decimal point to the right one place value. Dividing a number by 10 moves the decimal point to the left one place value.

Let's now continue to develop our estimation skills by doing problems that require us to write in an appropriate metric unit.

Fill in the blank with the appropriate metric unit. Choose m, dam, hm, or km.

31) The length of a car is about 5 \_\_\_\_\_.



35) The height of the Statue of Liberty is about 1 \_\_\_\_\_.



32) The height the Empire State Building is about 45 \_\_\_\_\_.



36) The traveled length across the Golden Gate Bridge is about 2 \_\_\_\_\_.



33) The radius of the earth is approximately 6,000 \_\_\_\_\_.

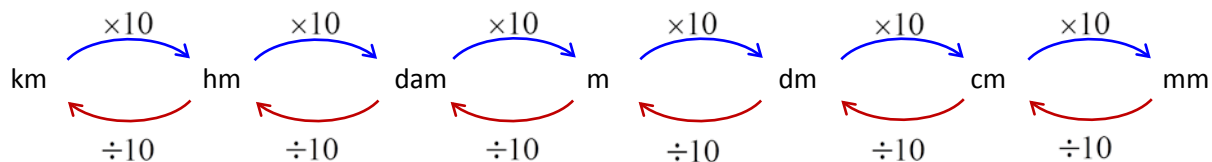
37) A Boeing 747 Jumbo Jet is approximately 6.4 \_\_\_\_\_ in length.

34) The distance from New York to Los Angeles is about 4,000 \_\_\_\_\_.

38) The length of a NFL football field is approximately 9.1 \_\_\_\_\_ in length.

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The following diagram organizes the unit measures covered in this section in order from largest to smallest. Notice how the powers of ten are used to move from one unit measure to the next. Each arrow represents the movement of the decimal point one time. Use this diagram to answer the following questions.



Convert each measure to the indicated unit by moving the decimal point appropriately. Write down the number of times you moved the decimal point and the direction you moved it.

39) 3.8 hm to dm

43) 80.04 cm to hm

47) 3,498 dm to km

40) 2,385 mm to hm

44) 31.08 m to hm

48) 0.164 km to cm

41) 0.7 cm to m

45) 19 hm to m

49) 0.028 dam to dm

42) 0.91 dam to dm

46) 31 dam to cm

50) 1,578 mm to dm

### Review Exercises

Evaluate the expression.

51)  $\frac{2}{3} - \frac{5}{6} + 8$

52)  $-3 + 8\left(\frac{3}{2}\right)^3 \div 9$

Simplify the expression as much as possible.

53)  $-16 - 12x - 5 + 3x$

54)  $8 - 5(2x - 3) + 6x$

55)  $-2|-3 - 8| + 7$

56)  $6 - |-5 + 12| + 11$

Fill in the blank with the appropriate metric unit.

57) The length of a paper clip is approximately 3.2 \_\_\_\_.

58) The diameter of a nickel is approximately 21 \_\_\_\_.

Answer True or False.

59) Dividing a number by 1,000 is the same as multiplying by  $\frac{1}{1,000}$ .

60) 220 cm is 20 cm more than 2 dm.