Warm-Up | Measurement

Lesson Question How are things measured using the metric system?

Lesson Goals

Explain how things are measured using the metric system.

Identify the basic units and prefixes of the metric system.

Perform metric system conversions.

Measure length, mass, volume, and temperature.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

International System of Units (SI)	the modern form of the metric system; units of measurement built around seven base units
length	the distance from one point to another
mass	the amount of matter in an object

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Words to Know

meniscus	the curved upper surface of a column of liquid
temperature	a measure of the average kinetic energy of the particles in a substance
volume	the amount of space an object takes up

Scientific Inquiry

Scientific inquiry involves:

- asking a question.
- performing investigations.
- collecting data.
- providing explanations.
- communicating results.

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Slide 2

The Metric System

- The metric system originated in [France] in 1799.
- It uses the [International System of Units] (SI).
- Science uses the [metric system] for measurements.
- SI units are [simple] and [consistent].

Comparison of Units

- [Length] is the distance from one point to another.
- [Volume] is the amount of space an object takes up.
- [Mass] is the amount of matter in an object.
- [Temperature] is a measure of the average kinetic energy of the particles in a substance.

Fill in the missing information in the table.

Property	SI Unit	Symbol	English Unit
length	meter	m	yard or foot
volume	liter	L	quart
mass	kilogram	kg	pound
temperature	degrees Celsius	°C	degrees Fahrenheit
	kelvins	K	

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Slide 2

The Metric System: Multiples of 10

Fill in the missing information in the table.

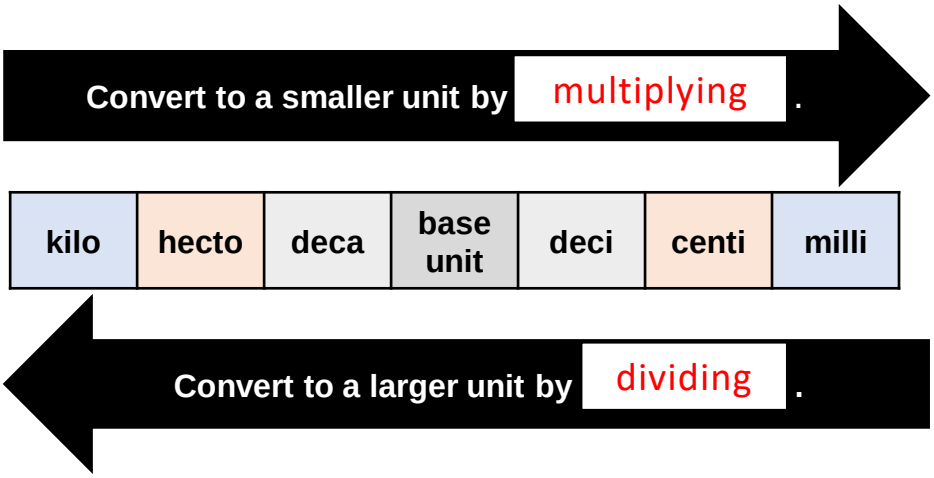
Prefix	Symbol	Multiple of 10
kilo-	k	1,000
hecto-	h	100
deca-	da	10
base unit		
deci-	d	0.1
centi-	c	0.01
milli-	m	0.001

To remember the order of prefixes and base units, you can use this memory device:

King **H**enry **D**ied **B**y **D**rinking **C**hocolate **M**ilk.

7

Metric Unit Conversions



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Slide 7

Metric Unit Conversions

Example: Convert from a Larger Unit to Smaller Unit

Convert 5.64 centimeters to millimeters.

- Decide whether to multiply or divide. In this example, you will multiply.
- Select the multiple of 10. In this example, the multiple is 10.

$5.64 \text{ cm} = 5.64 \times 10 = 56.4 \text{ mm}$

Here is another way to convert centimeters to millimeters. Since we are multiplying by 10, we can simply move the decimal place to the right one space (making the number larger). We move it one space because the number 10 contains one zero.

$5.64 \text{ cm} = 56.4 \text{ mm}$

Slide 9

Metric Unit Conversions

Example: Convert from a Smaller Unit to Larger Unit

Convert 25.3 grams to kilograms.

- Decide whether to multiply or divide. In this example, you will divide.
- Select the multiple of 10. In this example, the multiple is 1,000.

$25.3 \text{ g} \div 1{,}000 = 0.0253 \text{ kg}$

We can move the decimal place to make this conversion. Since we are dividing by 1,000, we can move the decimal place to the left three spaces (making the number smaller). We move it three spaces because the number 1,000 contains three zeros.

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Metric Unit Conversions

Example: Convert from a Smaller Unit to Larger Unit

Convert 91.7 kilowatts to milliwatts.

- To convert from a larger unit to smaller unit, we [multiply].

Step 1: Convert to the base unit first.

- To convert from kilowatts to watts, multiply by [1,000].
- The number 1,000 has [3] zeros.
- We are converting a larger unit to a smaller unit, so the decimal will move to the right three places.

$$91.7 \text{ kilowatts} = 91.7 \times [1{,}000] = 91{,}700 \text{ watts}$$

Step 2: Convert from the base unit to the smaller unit.

- To convert from a larger unit to smaller unit, we [multiply].
- To convert from watts to milliwatts, again multiply by 1,000.

$$91{,}700 \text{ watts} = 91.700 \times [1{,}000] = 91{,}700{,}000 \text{ [milliwatts]}$$

These two steps can be done as one. Multiplying by 1,000 twice means you have six zeros. So the decimal place will move six places to the right.

$$91.700 \text{ kilowatts} = 91.7 \times [1{,}000] \times 1000 = [91{,}700{,}000 \text{ mw}]$$

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Slide 14

Measurements of Length

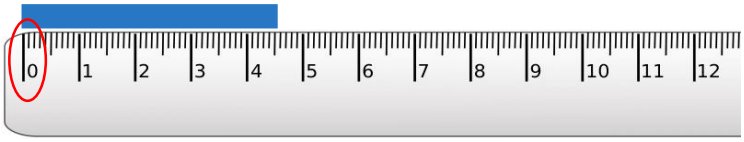
Length can be measured using:

- Ruler
- Caliper
- Micrometer
- Meter stick

Measurement with a Ruler

- Whenever possible, use SI units.
- Align the edge of the object with the "0" mark on the ruler.

Circle the "0" mark on the ruler.



The line is 4.6 cm long.

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Slide 16

Measurements of Mass

Mass can be measured using:

- Triple-beam balance
- Electronic balance
- Two-pan balance

Triple-Beam Balance

1. Move the sliders to the far left so the balance reads zero when the pan is empty.
2. Place the object on the pan .
3. Move the sliders separately until the pointer rests at the zero mark. (Always start with the 100 g marker.)
4. Add the numbers from the three sliders to find the mass of the object on the pan.

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Slide 18

Measurements of Volume of a Solid

- The volume of a regular solid is measured using a [ruler]
- The volume of an irregular solid is measured using [water displacement].
  - The irregularly shaped solid is placed into a known volume of water, and the volume change of the water is observed.
  - The change in volume is equal to the volume of the solid.

Measurements of Volume of a Liquid

The volume of a liquid can be measured using:

- [Graduated] cylinder
- Pipette
- [Beaker] and volumetric [flask]
- Buret

Graduated Cylinder

- Liquid forms a concave [meniscus].
- Measurement is taken at the [bottom] of the meniscus.
- The [displacement] of water measures the volume of irregular solids.

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Slide 20

Measurements of Temperature

The temperature can be measured using:

- Liquid thermometer
- Digital thermometer

Thermometer

- Handle carefully to prevent breakage.
- Completely submerge the bulb in the liquid.
- Keep the bulb away from surfaces.
- Do not use for stirring.
- Measure in degrees Celsius.

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Summary | Measurement

Lesson Question	How are things measured using the metric system?

Answer

Sample answer: Length is measured in meters. Volume is measured in liters. Mass is measured in grams. Temperature is measured in degrees Celsius or in kelvins.

Slide 2

Review: Key Concepts

Complete the table by writing the metric prefix represented by each word in the mnemonic device. Then write the symbol and multiple of 10 that each prefix represents.

	King	Henry	Died	By	Drinking	Chocolate	Milk
Prefix	kilo-	hecto-	deca-	base unit	deci-	centi-	milli-
Symbol	k	h	da		d	c	m
Multiple of 10	1,000	100	10		0.1	0.01	0.001

- Science uses the [metric] system for measurements.

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Summary | Measurement

Slide 2

Review: Key Concepts

Complete the table.

Property	SI Unit	Common Measuring Device
length	meter	ruler
volume	liter	graduated cylinder
mass	kilogram	triple-beam balance
temperature	degrees Celsius	thermometer
	kelvins	

Use this space to write any questions or thoughts about this lesson.

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