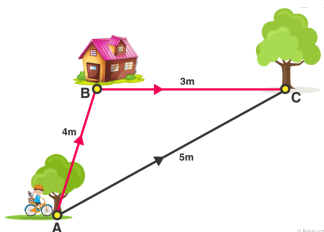


## Introduction to Measurements

### Measurement

A method to get **quantitative** (*number based*) information about a physical or chemical system in nature



The meter (*m*) or the yard (*yd*) can be used to measure the distance between points A and B (*park to house*), B to C (*house to tree*), or A to C (*park to tree*)

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## Introduction to Measurements

### Two Types of Data Analysis

#### Quantitative Measurements

Measurements where data is collected using a measuring tool to compare to other measurements of the same type

#### Qualitative Measurements

Measurements where no data is collected but comparisons are made using the main human senses (*sight, smell, touch, sound, taste*)

### Examples

Weight (*mass*)  
Size (*volume*)  
Temperature (*heat*)  
Length

Comparing reaction speed or color made  
Smell, texture  
(*touch*), Sound

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## Introduction to Measurements

### Two Types of Data Analysis

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(*touch*), Sound

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## Introduction to Measurements

### Types of Quantitative Measurements

#### Mass

How heavy matter is (*weight*)

#### Volume

How many space matter takes up

#### Length

How long a side of matter is

#### Time

The duration of a measurement

#### Temperature

How fast (*speed*) matter is moving

#### Heat

How much energy matter has

#### Pressure

How many collisions per time

#### Color

The distance between light waves

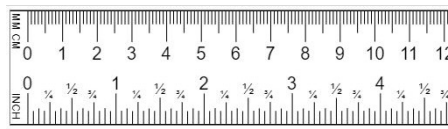
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## Introduction to Measurements

### The *unit* of quantitative measurements

#### Unit (of measure)

The basic division we can break a measurement down into for comparison to other measurements of the same type.



#### Length Measurements

The ruler is broken down into inch (*imperial, bottom*) or centimeter/millimeter (*metric, top*) segments

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## Introduction to Measurements

### Measurement Systems

#### Metric System

Worldwide measurement system with units based on prefixes, or divisions of 10 to distinguish large and small measurements

Length can be measured on a ruler in either meters (*m*), the *base* unit, centimeters (*cm*), 100x smaller than the meter, or the millimeter (*mm*), 1000x smaller than the meter.



1 meter *stick* (*m*) = 100 centimeters (*cm*) = 1000 millimeters (*mm*)

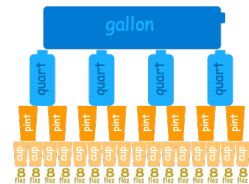
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## Introduction to Measurements

### Measurement Systems

#### Imperial System

United States measurement system using fractional relationships between units of measure over divisions of 10 in the metric system



Imperial volume measurements includes units based on  $\frac{1}{2}$  sized smaller units based on the standard gallon (*gal*) unit. (*tbsp* = *tablespoons*,  $16\text{tbsp} = 1\text{cup}$ )

$1\text{gal} = 4\text{qts} = 8\text{pts} = 16\text{cups} = 256\text{tbsp}$

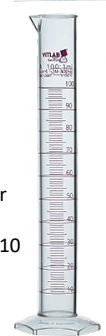
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## Introduction to Measurements

### Metric vs. Imperial Measurements



The graduated cylinder is used to take volume measurements in milliliter units (*metric unit*), separated by divisions of 10



The measuring cup takes volume measurements in cups and fluid ounces (*imperial unit*), divided into fractions of cup or whole fluid ounces

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## Introduction to Measurements

### Units in Imperial and Metric Systems

<b>Mass</b> How heavy matter is ( <i>weight</i> )	<b>Metric:</b> gram ( <i>g</i> ), kilogram ( <i>kg</i> ) <b>Imperial:</b> pound ( <i>lb</i> ), ounce ( <i>oz</i> )
<b>Volume</b> How many space matter takes up	<b>Metric:</b> liter ( <i>L</i> ), milliliter ( <i>ml</i> ) <b>Imperial:</b> gallon ( <i>gal</i> ), cup ( <i>cup</i> )
<b>Length</b> How long a side of matter is	<b>Metric:</b> meter ( <i>m</i> ), centimeter ( <i>cm</i> ) <b>Imperial:</b> foot ( <i>ft</i> ), yard ( <i>yd</i> ), inch ( <i>in</i> )
<b>Time</b> The duration of a measurement	<b>Metric:</b> second ( <i>s</i> ) <b>Imperial:</b> second ( <i>s</i> ), minute ( <i>min</i> ), hour ( <i>hour</i> ), day ( <i>day</i> )

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## Introduction to Measurements

### Units in Imperial and Metric Systems

<b>Temperature</b> How fast ( <i>speed</i> ) matter is moving	<b>Metric:</b> Celsius ( $^{\circ}\text{C}$ ), Kelvin ( <i>K</i> ) <b>Imperial:</b> Fahrenheit ( $^{\circ}\text{F}$ )
<b>Heat</b> How much energy matter has	<b>Metric:</b> British Thermal Unit ( <i>BTU</i> ) <b>Imperial:</b> Joule ( <i>J</i> ), kilojoule ( <i>kJ</i> )
<b>Pressure</b> How many collisions per time	<b>Metric:</b> Pounds per Square In ( <i>psi</i> ) <b>Imperial:</b> atmospheres ( <i>atm</i> )
<b>Color</b> The distance between light waves	<b>Metric:</b> nanometers ( <i>nm</i> ) <b>Imperial:</b> None

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## Introduction to Measurements

### Parts of a Measurement Examples

<b>Quantity</b> The actual number of the measurement	1.30 cups water Quantity: 1.30 Unit: cups ( <i>volume</i> ) Label: water
<b>Unit</b> The system of measurement used by a measurements ( <i>ex: length = meter, m</i> )	235.3mm stick Quantity: 235.3 Unit: millimeter ( <i>length</i> ) Label: stick
<b>Label</b> The description of the measurement	

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