2.1 SI Measurement

November 1, 2018   1:47 PM

2.1 SI MEASUREMENT

Name:_____   Block_____

Although there have been many systems of measurement used over time, there are two that have emerged which the world has accepted and adopted. *USA / UK*

(metric)
① __International System (SI)__ *of Units* ② __Imperial System of Units.__

Most of the __scientific__ community of the world uses SI units *(metric)* while the __construction__ industry of North America largely uses the Imperial System. *football /*
Even though the Metric System has been introduced to Canada in 1976, most of you still know your weight in pounds, not in kilograms.

Measurement is something you will use often in everyday life. What are some common ways we use measurements?

• gas - Litre
• cooking/baking - *imp.* 1 cup = 250 mL *metric*
• woodworking
• bulk food (candy) - grams/mg / Pounds

A. Referents for Measurement Systems

A convenient way to measure is by using a __referent__ often referred to as a reference.

A referent is: something familiar to us (that stays about the same size) that we use to estimate the measure of something else.

For example if you are getting a haircut you may refer to how many inches you want off the length of your hair. A referent for one inch is approximately the distance from the tip of your thumb to the first joint.

"approx equal to"

Can you think of any other referents?
1 in ≅ thickness of hockey puck.
yard ≅ arm span to nose
1 ft ≅ wrist to elbow = 12 in = 30.48cm
≅ ruler length
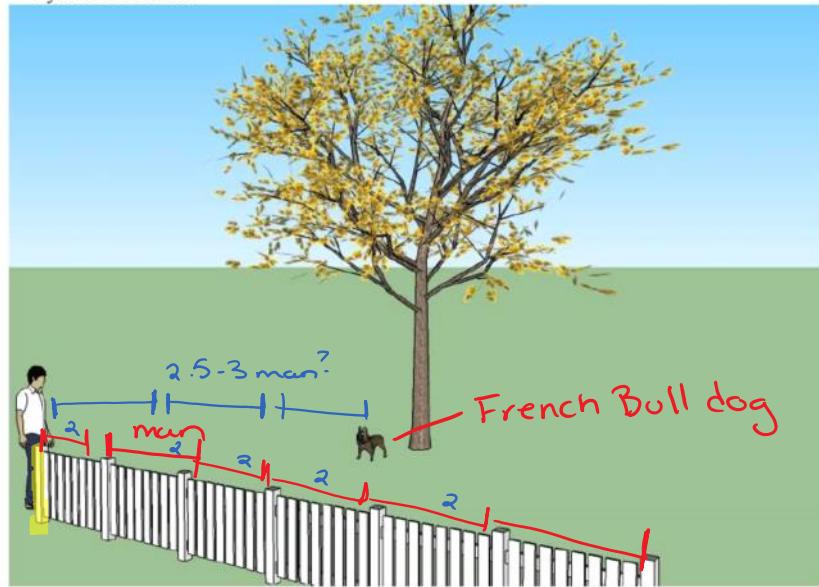
SI Measurement	Referent
millimeters	finger nail thickness
centimeters	width of a paperclip, black piano keys
meter	height of door-knob
kilometer	Reynolds → Braefoot (soccer) (998m)

**PRACTICE**

Use **referents** to estimate reasonable measurements for the following:

Estimation

106. For the list following the diagram, estimate a *reasonable* measurement for each system of units.

[Annotations on diagram: 2.5-3 man?, man, French Bull dog, with measurement marks labeled 2]

The International System of Units (SI) — metric

Height of man:	2m
Height of dog:	ruler? ≅ 30cm
Height of fence:	½ man ≅ 1m
Length of fence:	man = 2m ≅ 12m
Height of tree:	~4 man? ≅ 8m
Circumference of tree base:	2 x dog height ≅ 60cm
Width of fence post:	½ of a ruler ≅ 15cm
Distance from man to dog:	2.5-3 man ≅ 2.5-3m

Estimation
1. reasonable (make sense)
2. Appropriate units.

B. SI Measurements

International System of Units (SI) units are units you are familiar with, the metric system.

Can you think of any units we commonly use from the metric system?

milk - Litres (volume)   Driving - Km (distance)

PRACTICE ▶

The International System of Units (SI)

UNIT	QUANTITY MEASURED	REPRESENTATIVE EXAMPLE "Referant"	3 EXAMPLES OF OBJECTS YOU WOULD MEASURE USING THIS UNIT
Milligram (mg)	MASS? VOLUME? DISTANCE?	ONE GRAIN OF SALT	1. medication 2. chemistry 3. baking – spices
Gram (g)	MASS? VOLUME? DISTANCE?	ONE PAPER CLIP	1. bag of chips/food 2. postage 3. bulk candy /Marble Slab
Kilogram (kg)	MASS? VOLUME? DISTANCE?	ONE PINEAPPLE	1. watermelon 2. luggage – 23kg 3. Delivery Box
Millilitre (mL)	MASS? VOLUME? DISTANCE?	1 eyedropper	1. pop /juice 2. baking 3. milk .
Litre (L)	MASS? VOLUME? DISTANCE?	tall skinny milk carton	1. milk 2. shampoo 3. gas
Millimetre (mm)	MASS? VOLUME? DISTANCE?	fingernail (dime)	1. snow /rainfall 2. pencil "Lead" 3. knitting needles .ipad
Centimetre (cm)	MASS? VOLUME? DISTANCE?	-paperclip -width of pinky	1. snow 2. height 3. length of hair
Metre (m) *Base unit	MASS? VOLUME? DISTANCE?	floor → doorknob	1. Athletics events 2. pool length /depth 3. walking
Kilometre (km)	MASS? VOLUME? DISTANCE?	Reynolds → Barefoot	1. driving 2. airplane screen 3. running.

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Appropriate Units of Measure

When you are making measurements it is important to consider if you are measuring in units that *make sense.*

For example, it doesn't make sense to measure the length of your arm in km.

What would be a more appropriate unit of measure?

· cm (SI)
· in , feet (imperial)

PRACTICE

For the items below determine an *appropriate unit of measurement:*

| Length/distance	Appropriate unit of measure
Distance from Vancouver to Toronto	km
Length of a elephant	m
Length of an ant	mm (maybe cm)
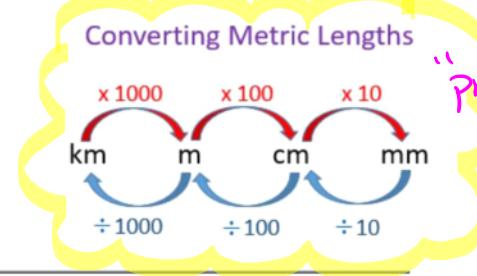
C. Converting SI Units

We will need to be able to convert between different metric units in this course.
To start off let's complete the chart below:

Equivalence Statements.

1 cm = 10 mm
1m = 100 cm
1 km = 1000 m

Converting Metric Lengths

x 1000   x 100   x 10

km   m   cm   mm

÷ 1000   ÷ 100   ÷ 10

"proportional reasoning"

Ratio

Converting Between Units in the Metric System (SI)

Conversion Factor: Multiplying or dividing by this number allows us to convert from one unit to another.

1cm = 10mm

Eg. Convert 230 mm to cm.

$$230\, mm \times \frac{1\, cm}{10\, mm} = 23\, cm$$

conversion factor

Use the conversions given

$$\frac{1\, cm}{10\, mm}$$

The unit on top is the one you are converting to!

unit on the bottom is the unit you started with. (want to cancel)

NOTES for using conversion factors:

Conversion factors are ratios made from Equivalence statements.

If 1 cm = 10 mm ⟹ $\frac{1cm}{10mm}$ or $\frac{10\,mm}{1\,cm}$

Equivalence Statement   conversion factors
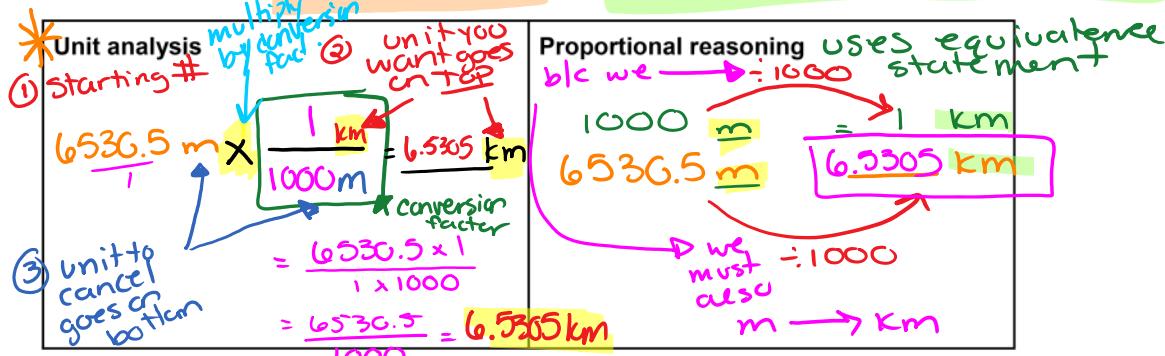
We are going to look at two different ways to convert units, **unit analysis** and **proportional** reasoning.

Example: Convert 6530.5 m into km

Equivalence statement:

1000 m = 1 km

Conversion Factors: $\dfrac{1000m}{1km}$ or $\dfrac{1km}{1000m}$

Unit analysis *multiply by conversion fac.*

① starting #   ② unit you want goes on top

$6530.5 \text{ m} \times \dfrac{1 \text{ km}}{1000 \text{ m}} = 6.5305 \text{ km}$

③ unit to cancel goes on bottom

conversion factor

$= \dfrac{6530.5 \times 1}{1 \times 1000}$

$= \dfrac{6530.5}{1000} = 6.5305 \text{ km}$

Proportional reasoning *uses equivalence statement*

b/c we → ÷1000

$\dfrac{1000}{6530.5} \dfrac{m}{m} = \dfrac{1}{6.5305} \dfrac{km}{km}$

we must also ÷1000

m → km

PRACTICE → HW Today

61. 1250 mm = _____ cm

$1250 \text{ mm} \times \dfrac{1 \ cm}{10 \ mm} = 125 \text{ cm}$

Or...simply move the decimal one place to the left.

62. 37.25 m = _____ cm

63. 0.8 cm = _____ mm.

64. 138 m = _____ mm

65. 1508 cm = _____ m

66. 3.28 cm = _____ mm

67. A circle has a radius of 10 cm. Find the circumference of the circle in millimetres.

$C = 2 \cdot \pi \cdot r$

68. A farmer builds a fence around a rectangular sheep pen. The pen is 5 metres long and 7 metres wide. What is the perimeter of the pen in centimetres?

69. Find the height of a triangle with a base of 12 cm and an area of 75 cm². Answer in millimetres.

$A = \dfrac{b \cdot h}{2}$

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x by a conversion factor

can't go directly mm → m
"Plan" mm → cm → m

Unit analysis is helpful when you are working with a conversion that involves *multiple steps.*

10 mm = 1 cm
100 cm = 1 m

Example: Convert 2333.3 mm into m
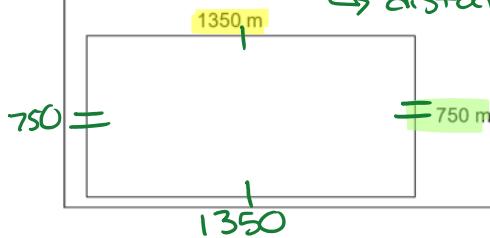
Unit analysis	Proportional reasoning
unit you want TOP	

plan mm → cm → m

unit to cancel out = Bottom

$$\frac{2333.3 \text{ mm} \mid 1 \text{ cm} \mid 1 \text{ m}}{\mid 10 \text{ mm} \mid 100 \text{ cm}}$$

conversion factors

$$= \frac{2333.3}{(10)(100)} = 2.3333 \text{ m}$$

Proportional reasoning:

$$\frac{2333.3 \text{ mm}}{? \text{ m cm}} = \frac{10 \text{ mm}}{1 \text{ cm}} \quad = 233.33 \text{ cm}$$

$$\frac{233.33 \text{ cm}}{? \text{ m}} = \frac{100 \text{ cm}}{1 \text{ m}} \quad = 2.3333 \text{ m}$$

Examples: Convert the following:

BASE UNIT

a) 32.5 km into mm   Plan: Km → m → cm → mm

3 convers.

$$32.5 \text{ km} \mid \frac{1000 \text{ m}}{1 \text{ km}} \mid \frac{100 \text{ cm}}{1 \text{ m}} \mid \frac{10 \text{ mm}}{1 \text{ cm}}$$

$$= \frac{(32.5)(1000)(100)(10)}{(1)(1)(1)} = 32\,500\,000 \text{ mm}$$

conversion factor

b) 10,237 mm into m   Plan: mm → cm → m

2 conv.

$$\frac{5}{12} \times \frac{3}{?} \times \frac{6}{9} = \frac{(5)(3)(6)}{(12)(9)}$$ units you WANT on top

$$10\,237 \text{ mm} \mid \frac{1 \text{ cm}}{10 \text{ mm}} \mid \frac{1 \text{ m}}{100 \text{ cm}}$$

units to cancel on Bottom

$$= \frac{10\,237}{(10)(100)} = 10.237 \text{ m}$$

c) 123.75 cm into mm

1 conv.   Plan cm → mm

$$123.75 \text{ cm} \mid \frac{10 \text{ mm}}{1 \text{ cm}} = \frac{(123.75)(10)}{(1)} = 1237.5 \text{ mm}$$

d) Calculate the perimeter, in km, for the diagram below.
↳ distance around whole shape

1350 m
750 =   = 750 m
1350

① Find the perimeter
1350 + 750 + 1350 + 750 = 4200 m

② Convert 4200 m → km

$$4200 \text{ m} \mid \frac{1 \text{ km}}{1000 \text{ m}} = \frac{(4200)(1)}{(1000)} = 4.2 \text{ km}$$

want
cancel

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 PRACTICE

Two (or three) Unit Conversions

Use two conversion factors to make necessary conversions. Round to the nearest tenth of a unit if necessary.

← 1 decimal place

70. Convert 3.45 m to mm.

$m \rightarrow cm \rightarrow mm$

3.45 m	100 cm	10 mm
	1 m	1 cm

= 3450 mm

71. Convert 12.357 km to m.

12.357 km	1000 m
	1 km

= 12357 m

72. Convert 176 mm to m.

$mm \rightarrow cm \rightarrow m$

176 mm	1 cm	1 m
	10 mm	100 cm

= 0.176 = 0.2

73. Convert 1.365 km to mm.

$km \rightarrow m \rightarrow cm \rightarrow mm$

1.365 km	1000 m	100 cm	10 mm
	1 km	1 m	1 cm

= 1 365 000 mm

74. Convert $17\frac{1}{5}$ m to mm.

$17\frac{1}{5} = 17.2$

$m \rightarrow cm \rightarrow mm$

17.2 m	100 cm	10 mm
	1 m	1 cm

= 17 200 mm

75. Convert $\frac{3}{4}$ km to cm. $\frac{3}{4} = 0.75$

$km \rightarrow m \rightarrow cm$

0.75 km	1000 m	100 cm
	1 km	1 m

= 75 000 cm

76. The poliovirus is about 30 **nanometers** in diameter. That is 0.000 000 030 m. How many **millimetres** in diameter is the virus?

30 nm = 0.000 000 030 m
← conversion factor

$nm \rightarrow m \rightarrow cm \rightarrow mm$

30 nm	0.00000003 m	100 cm	10 mm
	30 nm	1 m	1 cm

= 0.00003 mm

77. The Great Wall of Ming Dynasty in China has been measured to be 8851.8 km long. Approximately how many centimetres is this?

$km \rightarrow m \rightarrow cm$

8851.8 km	1000 m	100 cm
	1 km	1 m

= 885 180 000 cm

78. A standard volleyball court is 18 m long and 9 m wide. Find the area in square millimetres.

9 m = 9000 mm
18 m = 18000 mm

$A = \ell \cdot w$
$A = (9000 \text{ mm})(18000 \text{ mm})$
$A = 162\ 000\ 000 \text{ mm}^2$

area "squared"

79. 2 m + 30 cm + 4 mm

= 2304 mm

80. 1.35 km + 125 m + 40 cm

= 1475.4 m

81. 1.35 km + 125 m + 120 mm

= 1475.12 cm

 Homework

	Required Questions	Extra Practice	Extension
Assignment #1 Section 2.1 pg 44-45	1, 3, 4, 5, 6a, 7abc,	6bc, 7de, 10,	11ab

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