

# Activity 1 — Thinking about measuring

## ABOUT THIS ACTIVITY

Before students begin working with measuring and calculating we ask students to first make sense of the system of measurement that we use. We ask them to think about which units and instruments are appropriate for measuring in which contexts.

In this millennium, it is perhaps more important that people develop the skills of looking up information, than that they learn information. In this first activity students are asked to look up and make sense of information provided in different tables. It may initially be difficult for students to make sense of how some of the tables work, but once they have developed the skill of decoding the tables it will be much easier for them to do on other occasions.

This activity prepares students to meet the following outcomes of Unit Standard 12444:

- SO 1: Estimate, measure, and calculate physical quantities to solve problems in practical situations: AC 2, 3, 4, 5

This activity also prepares students to meet the following outcomes of Unit Standard 8982:

- SO 1: Demonstrate understanding of and carry out calculations with rational numbers and irrational numbers: AC 2, 3, 4, 5, 6
- SO 2: Demonstrate knowledge and understanding of the different representations of rational numbers: AC 4
- SO 3: Demonstrate understanding of and use scientific notation: AC 3

## MANAGING THIS ACTIVITY

As with all the measuring activities there are things that you can do to make the questions more real or more meaningful to the students with whom you work. In this activity we provide some examples of each kind of measurement (mass, capacity, length and distance, area, volume, speed, temperature etc.) The questions may make more sense to students if you adapt them to objects that they can see or to contexts with which your particular group of students are familiar. For instance in question 1.5.2, ask about the width of the road outside their college – then they can go outside and have a look, also ask them about measuring objects that they can see in the classroom etc.

Many office diaries (as well as most encyclopedias) have information on the metric system and how units are related. Students need to have the experience of working with these tables, but it is also important for them to know where to find these tables. If possible, find similar tables in diaries for your students. These need not be current diaries – diaries from previous years will also have tables in them. But the experience of looking up in the information in the diary is an important skill for them to take into the world of work.

These questions require students to make sense of the table: there are two skills involved:

- o students need to read the table,
- o they also need to interpret the information provided.

1 The first 3 questions are fairly straightforward. Students should be able to complete them on their own or by working in pairs.

1.1 These are some possible answers to the questions. Students may also provide other examples.

Distance and length	Mass	Capacity	Volume	Area
Length of room Height of person Distance between towns Distance to a place you want to go Length of string, piping, fencing, material, wooden planks etc when making things	Mass of a person Mass of ingredients when cooking Mass of a parcel for posting.	Amount of liquid when cooking Amount of liquid medicine Capacity of a car engine Amounts of liquids when mixing substances e.g. insecticides for garden	Volume of a box, cupboard or storage room when needing to pack or store things	Surface area of walls for painting or tiling or wall papering Surface area of floors for carpeting or tiling

- 1.2 Before starting with this activity check that students understand what the term “units” means in the context of measurement. As with so many words in mathematics “unit” can mean different things outside the maths classroom. Students may think of kitchen units i.e. cupboards; unit trusts or they may also think of tens and units. Students do not need to define units, rather ask them to brainstorm any units of measurement that they can think of.

Distance and length	Mass	Capacity	Volume	Area
Centimetre	Kilogram	Litre	Cubic metre	Square centimetre
Yard	Gram	Kilolitre		
Kilometre	Tonne	Pint		
Inch	Pound	Millilitre		
		Gallon		

- 1.3 Students may still find themselves in situations where imperial measures are used. One such situation is talking with older people. Another is if they work for a business that has international clients or suppliers.

1.3.1 Metric system: litre, kilogram, centimetre, kilolitre, millilitre, kilometre, gram, tonne, cubic metre, square centimetre.

1.3.2 Imperial: ounce, pint, yard, inch, gallon, pound.

- 1.4 It is important that students are able to estimate and have some sense of size. Regular practice with estimating measurements can improve ones estimation skills. It is better for students to do a little bit of estimation regularly than do a lot all at once. It is also useful for student’s to have a set of objects or practices of known length against which they can compare other lengths. For example the following are all about 1 metre:

- o a standard pace
- o the length from ones shoulder to the opposite finger tip of an outstretched arm
- o the height of an average window.
- o ½ the height of an average door.

These are useful for students to refer to when considering and estimating the lengths and heights of other things. Let students have regular practice in using these and other common referents to estimate size.

You may need to explain the following terms to students:

- o body measures
- o informal referents i.e. everyday things against which you can compare the measurements of other objects

1.4.1 Pace it out.

1.4.2 The length from ones shoulder to the opposite finger tip of an outstretched arm.

1.4.3 For many people the width of their closed flat hand is about 10 cm at some point.

- 1.5 If students are not able to think of the appropriate units then you could supply a range of units. If measuring length then include some units that can be used for measuring length or distance but are not suitable for the object or distance given, as well as units which cannot be used for measuring the object e.g. litres or square centimetres.

To know what units to use, students first need to know whether they are measuring length/distance; mass; capacity; area; volume; time or speed. Then they need to think about the size of what they are measuring to choose whether to use, for example, millilitres, litres or kilolitres. However, there some social conventions that break the rule e.g. building materials are usually measured in millimeters (glass, nails, etc) while body measurements are usually given in centimetres (clothing, body lengths, etc).

1.5.1 Kilometres

1.5.2 Metres

1.5.3 Centimetres

1.5.4 Square centimetres

1.5.5 Kilograms

1.5.6 Kilograms

1.5.7 Grams

1.5.8 Litres

- 1.5.9 Millilitres
- 1.5.10 Millimetres - it is conventional to measure glass and other building materials in millimeters. Here it is not the size that determines the unit of measurement.
- 1.5.11 Millimetres – paper sizes are given in millimeters by convention. Here too it is not the size that determines the unit of measurement e.g. an A4 size of paper is 210 mm × 297 mm, an A0 size of paper is 841 mm × 1189 mm.
- 1.5.12 Millilitres
- 1.5.13 Litres
- 1.5.14 Kilolitres
- 1.5.15 Square metres
- 1.5.16 Millimetres
- 1.5.17 Millimetres
  
- 1.6.1 Thermometer
- 1.6.2 Bathroom scale
- 1.6.3 Measuring tape
- 1.6.4 Measuring jug or cups
- 1.6.5 Kitchen scale, measuring jug or measuring cups
- 1.6.6 Measuring spoon
- 1.6.7 Tape measure
- 1.6.8 Tape measure
- 1.6.9 Odometer
- 1.6.10 Speedometer
  
- 1.7 The handout provides tables in some of the forms that are commonly found in commercial diaries. Students may take some time to make sense of the tables. It is important that they learn this skill because in the world of work they will not always find information presented in forms that are exactly suitable for their particular purpose at the time. Some information is given in more than one table. They can then choose the easiest form of table to read, or use the simpler of the two tables to help them decode the less obvious one.
- 1.7.1 Metre
- 1.7.2 Kilograms
- 1.7.3 Seconds

Most FET students do not have any sense of imperial measures. It is useful for them to have some sense of the size of some imperial measures relative to metric and other everyday units of measurement. It is important to stress that these are only approximations. Let them compare the approximations with the accurate tables to see how rough the approximations are.

- 1.8.1 Inch
- 1.8.2 Metre
- 1.8.3 Mile
  
- 1.9.1 Kilogram
- 1.9.2 Ounce
  
- 1.10 Litre
  
- 1.11 About 12. One ruler length is about 1 foot and there are 3 feet in a yard, so there are about 12 ruler lengths in a yard.
- 1.12 Less than 4 metres.
- 1.13 About 3 litres.
- 1.14 About 2 kilograms.

- 1.15 About 25 cm.
- 1.16.1 A six inch nail is a 152mm nail.
- 1.16.2 2 pints of milk is 1 137 millilitres or about 1 litre.
- 1.16.3 3 pounds of butter is 1 361 grams or about 1,4 kg.
- 1.16.4 5 yards is 4 572 mm or about 4,5 m.
- 1.16.5 80 miles per hour is 128 km per hour.
- 1.16.6 105°F is 40°C.
- 1.16.7 9 × 12 carpet is 9 feet by 12 feet. This is almost the same size as 3 m × 4 m.
- 1.17 Most people will find the table on page 1 of the Handout easier to read, but the other table provides much more information. Students need to understand that they can start with the number in the middle. If they are converting inches to centimetres, then they can say 1 inch equals 2,540 cm by reading off the centimetres on the right hand side. If they are converting centimetres to inches then they can say 1 cm = 0,394 inches by reading the inches off the left hand column.
- Check also that students know how to convert between related metric units e.g. centimetres to metres etc.

## Activity 1 — Thinking about measuring

Before we look at how measuring can help us at work and at home, let's first think what we already know about measuring and measurements.

- 1.1 Copy the table below. Fill in two examples of when you use each kind of measurement e.g. you measure mass when standing on a bathroom scale.

Distance and length	Mass	Capacity	Volume	Area

- 1.2 In the box below are different units of measurement. Copy the table in 1.1 again and fill in the units of measurement in the correct columns.

litre ( <i>l</i> )	kilogram (kg)	centimetre (cm)	ounce (oz)
kilolitre (Kl)	pint (pt.)	yard (yd)	millilitre (ml)
kilometre (km)	gram (g)	tonne (T)	inch (in)
pound ( <i>lb</i> )	gallon (gal)	cubic metre (cm <sup>3</sup> )	square centimetre (cm <sup>2</sup> )

- 1.3 Some of the units above are part of the metric system. Some are part of the imperial system which we used in South Africa before 1960.

1.3.1 Which units above are part of the metric system?

1.3.2 Which units above are part of the imperial system?

- 1.4 Often we only need to have a rough idea of the size of things. Whenever we measure it is important to estimate first. Talk to a partner and then say how you would estimate the following using informal body measures:

1.4.1 The length of the room

1.4.2 The length of a piece of material

1.4.3 The length of a piece of paper

- 1.5 What units would you use if you wanted to measure:

1.5.1 The distance between Cape Town and Worcester?

1.5.2 The width of Broad Road in Wynberg?

1.5.3 The length and width of your desk?

1.5.4 The size of your kitchen table if you wanted to make a table cloth?

1.5.5 How heavy a cow is?

1.5.6 How heavy a newborn baby is?

1.5.7 How much a packet of herbs or spices contains: for example cardomon or bay leaves?

1.5.8 The amount of water a bucket can hold?

1.5.9 The amount of water a milk jug can hold?

1.5.10 The length and breadth of your bedroom window if you want to replace a broken pane of glass?

1.5.11 The length and width of a piece of paper

1.5.12 How much a kitchen cup or wine glass can hold?

1.5.13 How much water it takes to fill a bath?

1.5.14 How much water your family uses in a month?

1.5.15 What the size of a property is that you live on?

1.5.16 The size of a nail or a drill bit?

1.5.17 The size of a button hole?

- 1.6 What instrument would you use to measure:
- 1.6.1 Temperature?
  - 1.6.2 Your own mass?
  - 1.6.3 A piece of glass for a picture?
  - 1.6.4 The amount of milk for a cake you are making?
  - 1.6.5 Flour for a recipe you are making?
  - 1.6.6 The amount of medicine to give to a young child?
  - 1.6.7 The area of your bedroom walls if you wanted to paint them?
  - 1.6.8 The distance around someone's waist if you were making her a pair of trousers?
  - 1.6.9 The distance you have travelled in a car?
  - 1.6.10 The speed of the car you are travelling in?
- 1.7 Handout 1 gives lists of measurements.
- 1.7.1 Which table shows the metric system that we use? Write down what the standard units of measurement are for:
  - 1.7.2 Length
  - 1.7.3 Mass
  - 1.7.4 Time

The table with the pictures shows handy ways to remember the approximate sizes of Imperial measurements. Use this table to answer the following questions:

- 1.8 Which is longer:
  - 1.8.1 An inch or a centimetre?
  - 1.8.2 A yard or a metre?
  - 1.8.3 A mile or a kilometer?
- 1.9 Which is heavier:
  - 1.9.1 A pound or a kilogram?
  - 1.9.2 An ounce or a gram?
- 1.10 Which is more: a litre or a pint?
- 1.11 About how many ruler lengths is 4 yards?
- 1.12 Is 4 yards more or less than 4 metres?
- 1.13 About how many litres is 6 pints?
- 1.14 About how many kilograms is 4 pounds?
- 1.15 About how many centimetres is 10 inches?
- 1.16 Sometimes we need to convert between the metric system and the old imperial system. Use the tables in the handout to say what your granny means when she talks about:
  - 1.16.1 A six inch nail.
  - 1.16.2 2 pints of milk.
  - 1.16.3 3 pounds of butter.
  - 1.16.4 5 yards.
  - 1.16.5 80 miles per hour.
  - 1.16.6 The temperature of a feverish person at 105 degrees Fahrenheit.
  - 1.16.7 A carpet that is  $9 \times 12$ .

Here you must first think what unit granny is using and then think what unit we would convert it into.

- 1.17 Now talk about the tables. Which table was easiest for you to use? Explain to a partner how you understood the table that had 3 columns

**METRIC AND IMPERIAL MEASURES****Length**

1 centimetre (cm)	= 10 mm	= 0,3937 in
1 metre (m)	= 100 cm	= 1,0936 yd
1 kilometre (km)	= 1 000 m	= 0,6214 mile
1 inch (in)		= 2,54 cm
1 yard (yd)	= 36 in	= 0,9144 m
1 mile	= 1 760 yd	= 1,6093 km

**Surface or Area**

1 sq cm (cm <sup>2</sup> )	= 100 mm <sup>2</sup>	= 0,1550 in <sup>2</sup>
1 sq metre (m <sup>2</sup> )	= 10 000 cm <sup>2</sup>	= 1 1960 yd <sup>2</sup>
1 sq km (km <sup>2</sup> )	= 100 ha	= 0,3861 mile <sup>2</sup>
1 sq in (in <sup>2</sup> )		= 6,4516 cm <sup>2</sup>
1 sq yard (yd <sup>2</sup> )	= 9 ft <sup>2</sup>	= 0,8361 m <sup>2</sup>
1 sq mile (mile <sup>2</sup> )	= 640 acres	= 2,59 km <sup>2</sup>

**Volume and Capacity**

1 cu cm (cm <sup>3</sup> )		= 0,0610 in <sup>3</sup>
1 cu metre (m <sup>3</sup> )	= 1 000 dm <sup>3</sup>	= 1,3080 yd <sup>3</sup>
1 litre (l)	= 1 dm <sup>3</sup>	= 0,2200 gal
1 hectolitre (h l)	= 100 l	= 21,997 gal
1 cu inch (in <sup>3</sup> )		= 16,387 cm <sup>3</sup>
1 cu yard (yd <sup>3</sup> )	= 27 ft <sup>3</sup>	= 0,7646 m <sup>3</sup>
1 pint (pt)	= 20 fl oz	= 0,5683 l
1 gallon (gal)	= 8 pt	= 4,546 l

**Weight**

1 gram (g)	= 1 000 mg	= 0,0353 oz
1 kilogram (kg)	= 1 000 g	= 2,2046 lb
1 tonne (t)	= 1 000 kg	= 0,9842 ton
1 ounce (oz)	= 437,5 grains	= 28,35 g
1 pound (lb)	= 16 oz	= 0,4536 kg
1 ton	= 20 cwt	= 1,016 t

**US Measures**

1 US dry pint	= 33,60 in <sup>3</sup>	= 0,5506 l
1 US liquid pint	= 0,8327 imp pt	= 0,4732 l
1 US gallon	= 0,8327 imp gal	= 3,785 l
1 short cwt	= 100 lb	= 45,359 kg
1 short ton	= 2 000 lb	= 907,19 kg

**Temperatures**

°C	0	5	15	20	30	40	50	60	70	80	90	100
°F	32	41	59	68	86	104	122	140	158	176	194	212

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$







$$^{\circ}\text{F} = 9/5 ^{\circ}\text{C} + 32$$

**Speeds**

mph	20	30	40	50	60	70	80	90	100
km/h	32	48	64	80	96	112	128	144	160

**The Seven Base Units of the SI**

<i>Name of unit</i>		<i>Symbol</i>
metre	(length)	m
kilogram	(mass)	kg
second	(time)	s
ampère	(electric current)	A
kelvin	(thermodynamic temperature)	K
candela	(luminous intensity)	cd
mole	(amount of substance)	mol

<b>Imperial unit</b>	<b>What it measures</b>	<b>Rough guide to size</b>	<b>Metric unit</b>
feet	length	 1 ruler is about 1 foot	3 feet are about 1 metre 30 cm is about 1 foot
inches (in)	length	 top joint of thumb is about an inch	1 inch is about 2 ½ cm
yard (yd)	length	 tip of nose to end of finger	1 yd is slightly less than 1 metre
ounces (oz.)	mass	 100g bar of chocolate is about 1 oz.	100g is a bit less than 4 oz.
pound (lb)	mass	 500g of margarine	500g is a bit more than 1 pound
pint (pt.)	volume	 500ml of milk	½ a litre is a bit less than 1 pint.

Metric Conversion

<b>LINEAR</b>	<b>INCHES</b>		<b>CENTIMETRES</b>	<b>YARDS</b>		<b>METRES</b>	<b>MILES</b>		<b>KILOMETRES</b>
	0,394	<b>1</b>	2,540	1,094	<b>1</b>	0,914	0,621	<b>1</b>	1,609
	0,787	<b>2</b>	5,080	2,187	<b>2</b>	1,829	1,243	<b>2</b>	3,219
	1,181	<b>3</b>	7,620	3,281	<b>3</b>	2,743	1,864	<b>3</b>	4,828
	1,575	<b>4</b>	10,160	4,374	<b>4</b>	3,658	2,485	<b>4</b>	6,437
	1,968	<b>5</b>	12,700	5,468	<b>5</b>	4,572	3,107	<b>5</b>	8,047
	2,362	<b>6</b>	15,240	6,562	<b>6</b>	5,486	3,728	<b>6</b>	9,656
	2,756	<b>7</b>	17,780	7,655	<b>7</b>	6,401	4,350	<b>7</b>	11,265
	3,149	<b>8</b>	20,320	8,749	<b>8</b>	7,315	4,971	<b>8</b>	12,875
	3,543	<b>9</b>	22,860	9,843	<b>9</b>	8,230	5,592	<b>9</b>	14,484
<b>AREA</b>	<b>SQ INCHES</b>		<b>SQ CENTIMETRES</b>	<b>SQ YARDS</b>		<b>SQ METRES</b>	<b>SQ MILES</b>		<b>SQ KILOMETRES</b>
	0,155	<b>1</b>	6,452	1,196	<b>1</b>	0,838	0,386	<b>1</b>	2,590
	0,310	<b>2</b>	12,903	2,392	<b>2</b>	1,672	0,772	<b>2</b>	5,180
	0,465	<b>3</b>	19,355	3,588	<b>3</b>	2,508	1,158	<b>3</b>	7,770
	0,620	<b>4</b>	25,806	4,784	<b>4</b>	3,345	1,554	<b>4</b>	10,360
	0,775	<b>5</b>	32,258	5,980	<b>5</b>	4,181	1,930	<b>5</b>	12,950
	0,930	<b>6</b>	38,710	7,176	<b>6</b>	5,017	2,317	<b>6</b>	15,540
	1,085	<b>7</b>	45,161	8,372	<b>7</b>	5,853	2,703	<b>7</b>	18,130
	1,240	<b>8</b>	51,613	9,568	<b>8</b>	6,689	3,089	<b>8</b>	20,720
	1,395	<b>9</b>	58,064	10,764	<b>9</b>	7,525	3,475	<b>9</b>	23,310
<b>VOLUME</b>	<b>CU YARDS</b>		<b>CU METRES</b>	<b>PINTS</b>		<b>LITRES</b>	<b>GALLONS</b>		<b>LITRES</b>
	1,308	<b>1</b>	0,765	1,760	<b>1</b>	0,568	0,220	<b>1</b>	4,546
	2,616	<b>2</b>	1,529	3,520	<b>2</b>	1,137	0,440	<b>2</b>	9,092
	3,924	<b>3</b>	2,294	5,279	<b>3</b>	1,705	0,660	<b>3</b>	13,638
	5,232	<b>4</b>	3,058	7,039	<b>4</b>	2,273	0,880	<b>4</b>	18,184
	6,540	<b>5</b>	3,823	8,799	<b>5</b>	2,841	1,100	<b>5</b>	22,730
	7,848	<b>6</b>	4,587	10,559	<b>6</b>	3,410	1,320	<b>6</b>	27,277
	9,156	<b>7</b>	5,352	12,318	<b>7</b>	3,978	1,540	<b>7</b>	31,823
	10,464	<b>8</b>	6,116	14,078	<b>8</b>	4,546	1,760	<b>8</b>	36,369
	11,772	<b>9</b>	6,881	15,838	<b>9</b>	5,114	1,980	<b>9</b>	40,915
<b>WEIGHT</b>	<b>OUNCES</b>		<b>GRAMS</b>	<b>POUNDS</b>		<b>KILOGRAMS</b>	<b>TONS</b>		<b>KILOGRAMS</b>
	0,035	<b>1</b>	28,350	2,205	<b>1</b>	0,454	0,001	<b>1</b>	1018,0
	0,071	<b>2</b>	56,699	4,409	<b>2</b>	0,907	0,002	<b>2</b>	2032,1
	0,106	<b>3</b>	85,049	5,614	<b>3</b>	1,361	0,003	<b>3</b>	3048,1
	0,141	<b>4</b>	113,398	8,818	<b>4</b>	1,814	0,004	<b>4</b>	4064,2
	0,176	<b>5</b>	141,748	11,023	<b>5</b>	2,268	0,005	<b>5</b>	5080,3
	0,212	<b>6</b>	170,097	13,228	<b>6</b>	2,722	0,006	<b>6</b>	6096,3
	0,247	<b>7</b>	198,447	15,432	<b>7</b>	3,175	0,007	<b>7</b>	7112,3
	0,282	<b>8</b>	226,796	17,637	<b>8</b>	3,629	0,008	<b>8</b>	8128,4
	0,317	<b>9</b>	255,146	19,842	<b>9</b>	4,082	0,009	<b>9</b>	9144,4

The key figure printed in **BOLD** in the centre column can be read as either the metric or the British measure, thus 1 metre = 1,09 yards or 1 yard = 0,91 metre