Teacher Subject Specialist Training
Secondary Mathematics

Numbers in Context

National Teaching School

Farlingaye High School

Wymondham College

encompass
The Inclusive Teaching School

Golden Threads

- Expand your conceptual and procedural understanding
- Raise awareness of mathematical misconceptions
- Questioning to extract reasoning and problem solving
- Connections between mathematical topics
- Language and vocabulary
- Examples of formative and summative assessment
- Ideas for using technology

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Objectives of the session

- To understand how measures and statistics are numbers in a context.
- To investigate ideas in relation to numbers in context
- To understand how reasoning and problem solving encompass numbers in context.

Aims of the National Curriculum

The national curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- can **solve problems** with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions

Mathematics

- Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas.
- Pupils should make rich connections across mathematical ideas to develop fluency, reasoning and competence in solving increasingly sophisticated problems.

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Statistics – points to consider

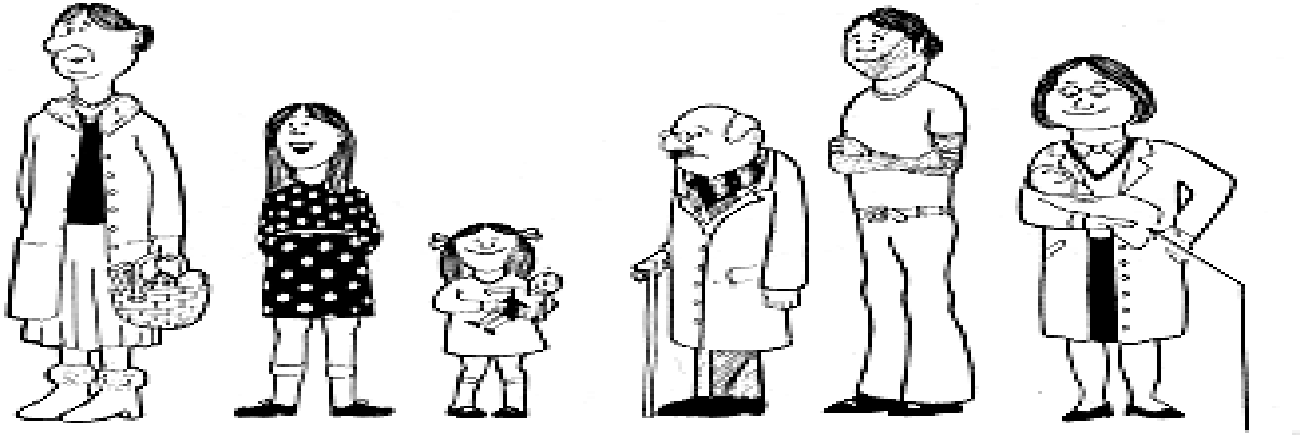
- To what extent have your class been involved in carrying out simple surveys or experiments in mathematics? Compare your experiences
- To what extent are the children used to posing questions for themselves and for others to answer?
- What problems are likely to arise when your class collect, organise and handle data?

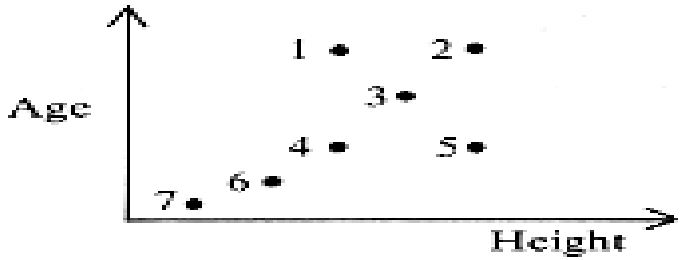
Possible problems

- Aimless activities – they just seem to rush about gathering data without knowing what they want
- Inefficient methods – surveys take up a lot of time…. The outcome isn't worth the effort put in.
- Emphasis on mechanical skills – handling data always degenerates into drawing a bar chart, and answering the same kinds of questions
- Management problems – practical work when collecting data is just too chaotic
- Lack of ideas – where can we get interesting data?
- Cross-curricular implications – experimental work? Shouldn't we leave that to science? Don't they do that in history and geography?

1. The Bus Stop Queue

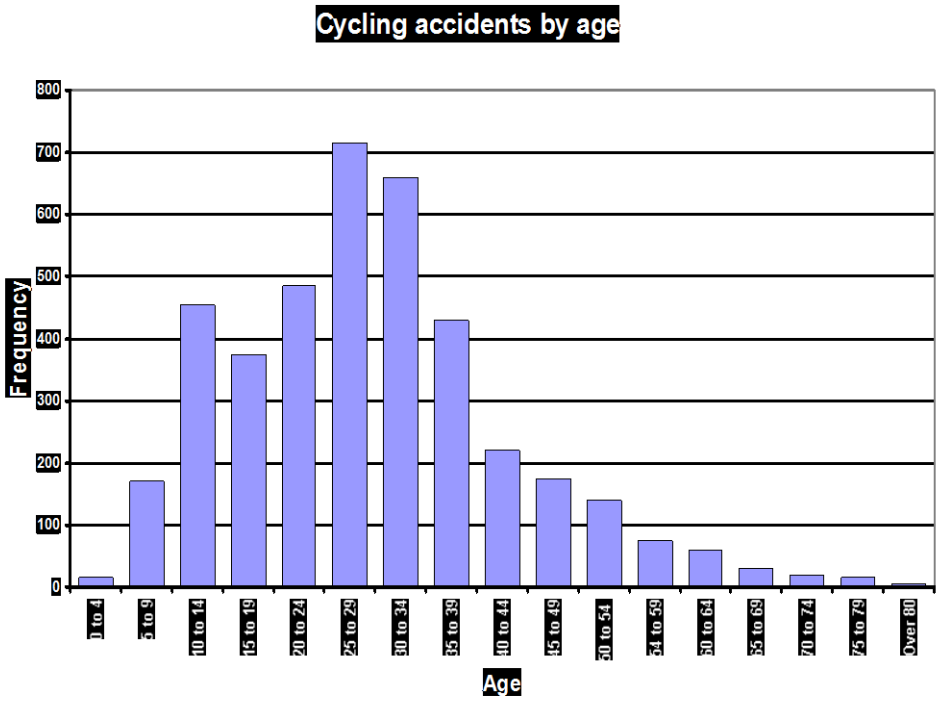
Who is represented by each point on the scattergraph, below?





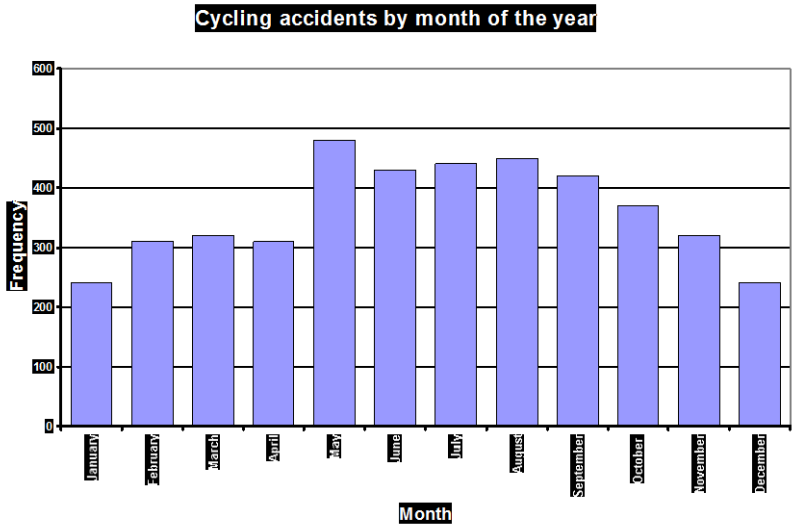
Data Representation

Cycling accidents in London by age	
Age	No of accidents
0 to 4	15
5 to 9	170
10 to 14	455
15 to 19	375
20 to 24	485
25 to 29	715
30 to 34	660
35 to 39	430
40 to 44	220
45 to 49	175
50 to 54	140
54 to 59	75
60 to 64	60
65 to 69	30
70 to 74	20
75 to 79	15
Over 80	5



What questions might you ask the children? When is which format most useful?

Month	Number of accidents
January	240
February	310
March	320
April	310
May	480
June	430
July	440
August	450
September	420
October	370
November	320
December	240
	4330



17 Seven children measured their heights.

Children	Height (cm)
Stefan	144
Lara	136
Olivia	142
Chen	143
Maria	152
Dev	148
Sarah	150

What is the mean height of the children?

Show your method

cm

What can you tell from this chart?

- The pie chart represents the proportions of the four ingredients in a smoothie drink.
- Strawberries are 22%
- Apple is twice as much as strawberries.
- Yoghurt and bananas have the same proportion of the whole smoothie.

Data

- *Without context, data is useless, and any visualisation you create with it will also be useless. Using data without knowing anything about it, other than the values themselves, is like hearing an abridged quote second-hand and then citing it as a main discussion point in an essay. It might be okay, but you risk finding out later that the speaker meant the opposite of what you thought.*
- You have to know the who, what, when, where, why, and how -- the metadata, or the data about the data -- before you can know what the numbers are actually about.

Who, what, when, where, why & how?

- Who – A quote in a major newspaper carries more weight than one from a celebrity gossip site that has a reputation for stretching the truth. Similarly, data from a reputable source typically implies better accuracy than a random online poll. Also consider the number of the sample… is it really representational
- What - "What does the data represent in the world; does it make sense; and how does this relate to other data?"
- When - it's a common mistake to take old data and pass it off as new because it's what's available. Things change, people change, and places change, and so naturally, data changes.
- Where - it's best to avoid global generalizations when the data comes from only a few countries. The same logic applies to digital locations. Data from websites, such as Twitter or Facebook, encapsulates the behaviour of its users and doesn't necessarily translate to the physical world.
- Why - you must know the reason data was collected, Sometimes data is collected, or even fabricated, to serve an agenda, and you should be wary of these cases.
- How - how will you know if it's any good? Do you trust it right away, or do you investigate?

Measure

- Length
- Mass/weight
- Volume/capacity
- Time
- Money

Changing the way we teach?

- How do we teach measures?
  - Length
  - Are/perimeter
  - Volume/capacity
  - Time
  - Money
- Where are the obvious links to number?
- How we ensure fluency, reasoning and problem solving when teaching measure?

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Same/different?

Mastery

- Sarah is 0.2m taller than Jack.
- Ella is 15 cm taller than Sarah.

- Who is the tallest person?
- What is the difference in height between the tallest and the shortest person

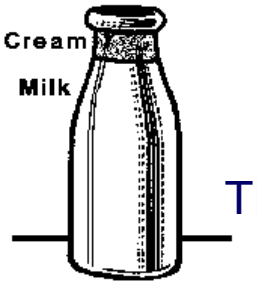
Mastery with greater depth

- Sarah is 0.2 taller than Jack.
- Ella is 15 cm taller than Sarah.
- Their combined height is 3.25 m.

- How tall is Ella?

Pints to litres

Pints	Litres
1	
2	
3	
4	2.272
5	
6	
7	
8	



This milk bottle states that
2.272 litres = 4 pints

Caitlyn thinks 11.38 litres is the same as 20 pints.
Do you agree? Prove it.

Here are 3 amounts: 4.5 pints, 3.65 litres, 1875millitres.
If you wanted to work out the total amount, what unit of measurement would you convert them all to? Explain why.

Pouring the punch drink

a) There are *four jugs*.
The largest holds exactly 9 litres of drink, and is filled to the top.
The 7 litre, 4 litre and 2 litre jugs are empty.
Find a way to pour the drink from *one jug to another* until you are left with exactly 3 litres in *three of the jugs*.
b) You have *three jugs one of* which is full and holds 8 litres.
The capacity of other jugs is not known. But, it is known that when using them every whole number quantity from 1 litre to 8 litres can be accurately measured out.
What could be the capacities of the 2 other jugs?
How would you measure all the whole number quantities from 1 to 8 litres?

Sensible weights

- 10 000kg — an envelope
- 1000kg — a hair
- 100kg — an articulated truck
- 10kg — sack of cement
- 1kg — bag of sugar
- 0.1kg — an elephant
- 0.01kg — one of the bells in Big Ben
- 0.001kg — a feather
- 0.0001kg — packet of spice

Use of the bar model to solve problems

300g of sweets cost 36p

- What is the cost of 100g?
- What is the cost of 1 kilogram?
- What is the cost of 3 kilograms?
- What is the cost of 25g?
- If 10 sweets weigh 50g, estimate the cost of each sweet.

Think about these rectangles:
a 4 cm by 6 cm rectangle
a 12 cm by 2 cm rectangle
a 3 cm by 8 cm rectangle.
What's the same?
What's different?

Ben has 5 coins in his pocket, how much money could he have?

Complete this:
1/2kg = ___g
1/4kg = ___g

Which has the greater mass?
1/5kg or 1/10kg
Explain why

Order from smallest to biggest:
Half of 3L
Quarter of 2L
300ml

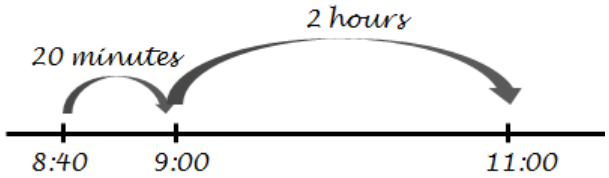
Rachel says 'my apple weighs 25cm'. Is she correct? Explain how you know.

True or false?
1.5kg + 600g = 2.1kg + 300g
32cm + 1.05m = 150cm – 0.13m
3/4ℓ + 0.05ℓ = half of 1.6ℓ

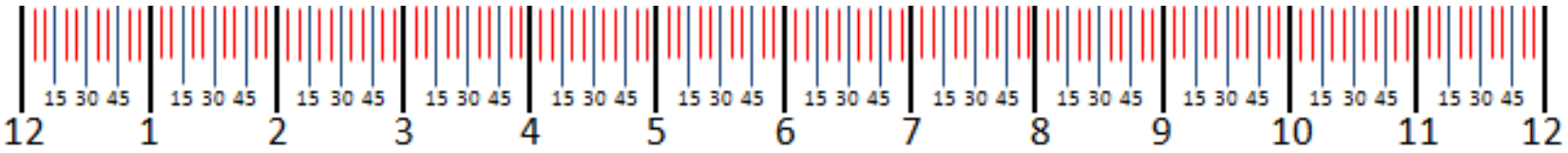
Explain your reasoning

- Emily has 5 times as much money as Luke. If they have £1578 altogether, how much more money does Emily have than Luke?
- Nancy, Marcus and Ken shared £364 among themselves. Marcus received 4 times as much money as Ken. Nancy received twice as much money as Marcus. How much money did Marcus receive?
- A sandwich and a cup of coffee cost £11. The coffee is £3 cheaper than the sandwich. How much is the sandwich?
- The cost of 3 shirts and 2 bags is £155. Each bag costs £10 more than each shirt. How much does each shirt cost?
- Every month, Sam spends 65% of his salary on rent and 15% on food. He saves the rest. He saves £130 more than what he spends on food. What is his monthly salary?

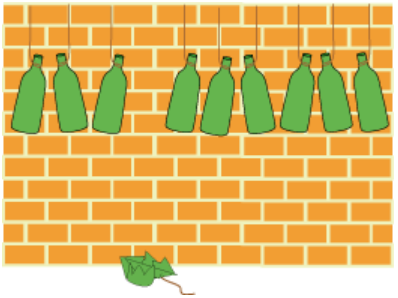
Time



Since time is not represented using the decimal system, it is much better to show time intervals along a number line.



Say it, show it, prove it



Ten green bottles hanging on a wall
Ten green bottles hanging on a wall
If *one green bottle should* accidentally fall
There'd be *nine green bottles hanging* on the wall
Nine green bottles .....

If the first bottle fell at *ten past five in* the morning (5.10 a.m.) and the others fell down at 7 minute intervals, what would the time be when the last bottle fell down? What time did the 8th bottle fall down?