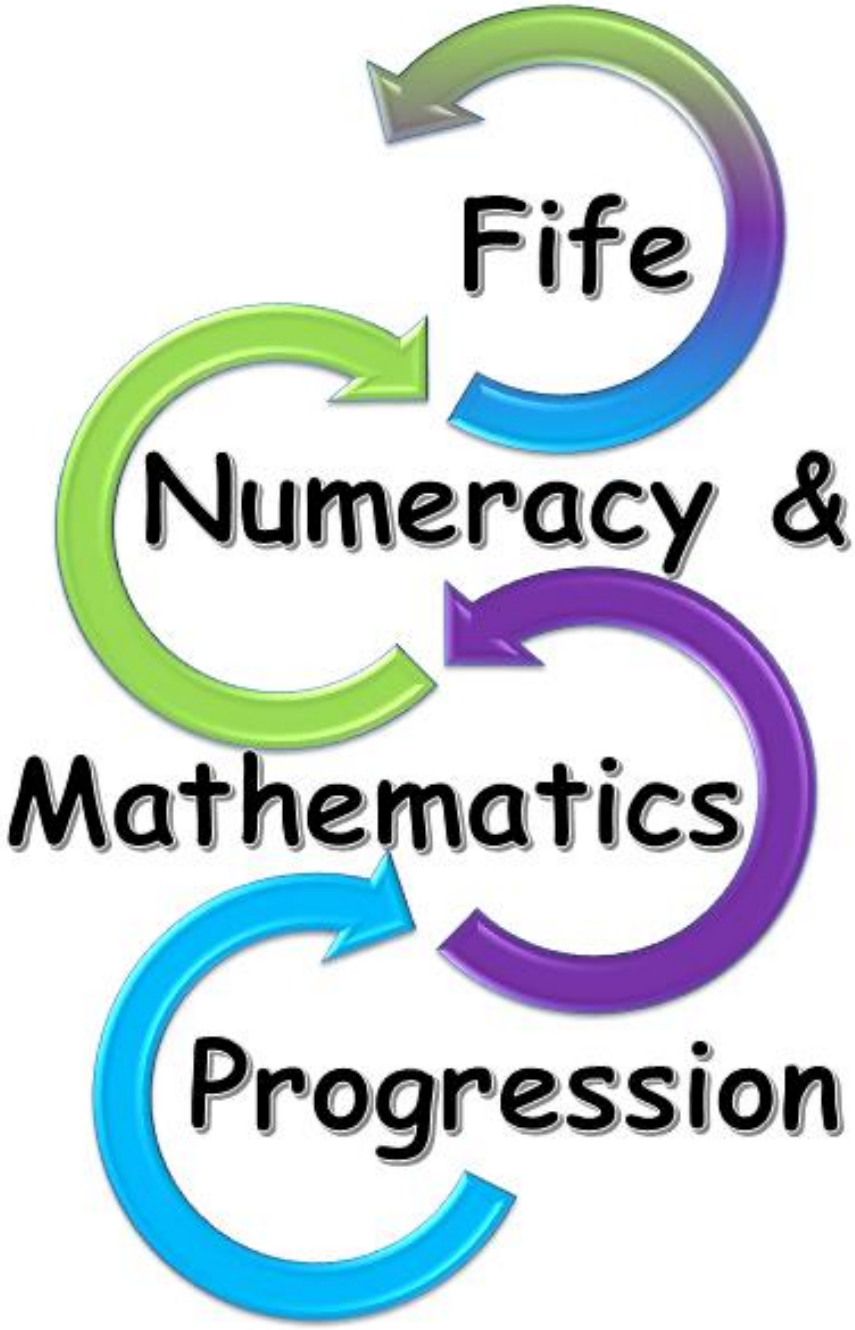

Information Handling

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Fife COUNCIL

ACKNOWLEDGEMENT

This programme is extensively based on proven approaches and strategies defined within the First Steps in Mathematics resources, Maths Recovery and New Zealand programmes.

Unlike many resources that present mathematical concepts that have been logically ordered and prioritized by mathematicians or educators, First Steps in Mathematics follows a sequence derived from the mathematical development of real children. It is based on five years of research by a team of teachers from the Western Australia Department of Education and Training, and tertiary consultants led by Professor Sue Willis at Murdoch University. The First Steps in Mathematics project team conducted an extensive review of international research literature, which revealed gaps in the field of knowledge about students' learning in mathematics. Using tasks designed to replicate those in the research literature, team members interviewed hundreds of elementary school children in diverse locations. Analysis of the data obtained from these interviews identified characteristic phases in the development of students' thinking about mathematical concepts.

Maths Recovery, founded on years of research by Dr Robert Wright, Professor in Maths Education within Southern Cross University in Australia and colleagues, is now internationally renowned in responding to problems of children's failure in early numeracy and primary mathematics and has been used extensively by many nations, including New Zealand, to develop their own standards and teaching approaches in mathematics.

We are also very grateful to the work done by both Angus and Highland Council. Their input has been key in the development of this progression.

Fife COUNCIL

GUIDANCE

The Fife Numeracy and Mathematics Progression (Information Handling) sets out a clear set of learning experiences and outcomes from the following Curriculum for Excellence numeracy/mathematics strands:

Data and Analysis

Ideas of Chance and Uncertainty

The purpose of this document is to provide a continuum of learning both within a level and through the Early, First, Second and Third levels. The developmental stages of learning in numeracy and mathematics are clearly documented and this will support teachers when identifying starting points for learners. The progression is intended to assist teachers as they plan their numeracy and mathematics curriculum.

The 'Points to Consider' and 'Suggested Written Recording' sections will be built up as feedback is received on this document.

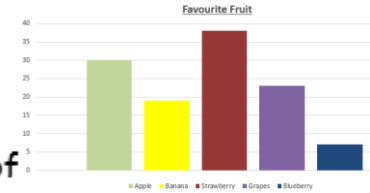
Each strand is shown as a pyramid to show how learning and teaching progress within this. The skills at the base of the pyramids are required to be understood for further learning to be built upon and are not aligned to any particular year group (at First Level, statements in blue do *not* equate to Primary 2, for example). Pupils will progress through the pyramids as and when they are ready and able to do so.

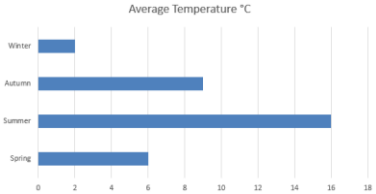
The Fife Numeracy and Mathematics Progression focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, logical reasoning, analytical thought and problem solving skills which can be applied in unfamiliar situations.

BACKGROUND NOTES

Bar Graphs

A common graph type that uses the lengths of columns or rows to represent frequencies or measurements of categories or groups. A wide range of data can be represented, with either axis being used for categories or groups, and the other axis calibrated as a scale to show a count, a percentage or a measurement. The lengths of the bars should be proportional to each other and where the data is about discrete categories, the columns or rows (bars) must be separated. Different sources of the same kind of data can be compared by putting two or more bars side by side and providing a key to show the meaning of adjacent bars. Also see Histograms.

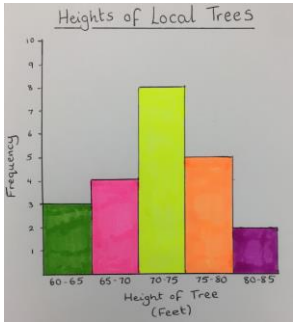


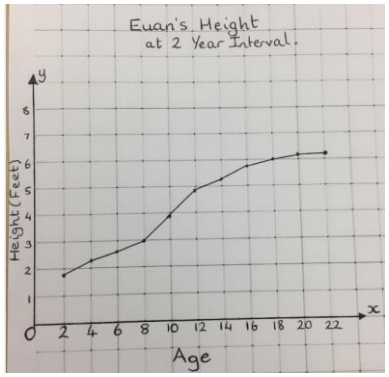


Block Graphs

Similar to a line plot in that each piece of data is displayed in columns or rows of squares above or beside a baseline. Because each square counts as one, a second axis is not required, similarly to a Line Plot.

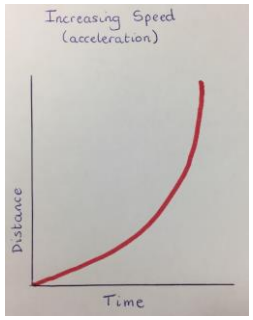
Histograms A variation of a bar graph used for continuous quantities, or categories that can be thought of as naturally ordered in time or quantity. Bars are generally vertical, with the columns touching to represent the continuity between the groups of data. If different intervals of data are used, the bars may be different widths, so that the area of the bars is proportional, as well as the length.

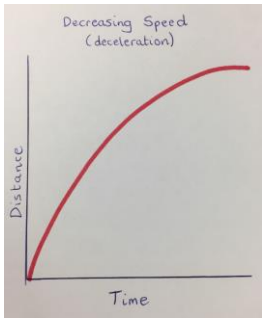




Line Graphs

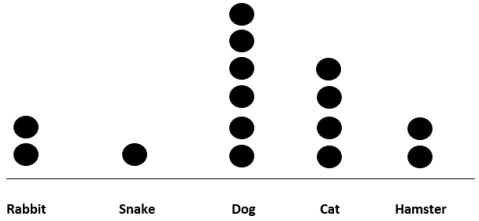
Used when it is meaningful to think of the frequency or measurement varying, usually over time. Points are plotted at intervals and the points joined to represent how the quantity changes between the data points. The base axis must be calibrated as a measurement scale so that every point on the line has meaning.





Dot Plots

Used to record or display frequency data. Dots, crosses or other equal-sized marks are used to represent each piece of data. They are placed above a baseline that has been labelled for each category or number. A second axis is not needed because each 'dot' represents one piece of data.



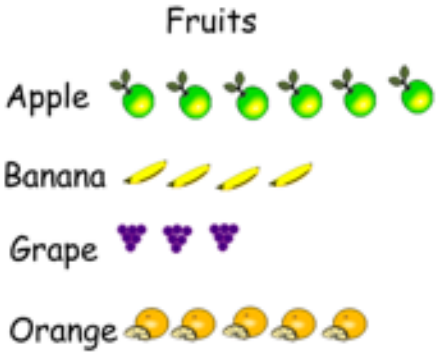
Travel to School	Number of Children
Car	6
Bus	11
Walk	9
Bike	3
Scooter	2

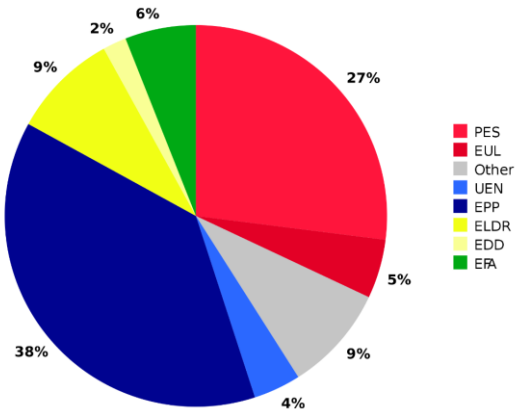
Frequency Tables or One Way Tables

Sets out related information in adjacent lists. Only the columns in one-way tables are labelled. The list of names or information in the first column links in rows to other information across the page.

Pictograms

Small pictures or icons that relate to different categories of data are placed equidistant from each other in rows or columns. Each icon may represent one or more pieces of data. A key will indicate if an icon means a quantity of data, in which case in between quantities are represented by parts of icons.





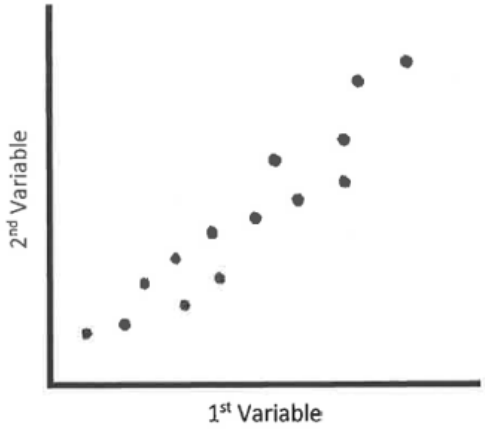
Pie Charts

Circular graph in which the area of the slices relate proportionally to the quantities in the categories. Its use only makes sense when each piece of data belongs in exactly one category of a clearly defined whole set of data. The quantities are normally shown as percentages.

Scatter Diagrams

Demonstrates visually how two different types of data are related.

Two different measures for the same person or thing are paired and plotted on a two-axis grid. Each axis relates to one type of measure, and a mark shows where the two measures intersect. A 'line of best fit' is sometimes used to emphasise strong relationships between the data. A broken scale is shown when values do not start at zero.



Stemplot of Data Set

0	4 6
1	2 4 8
2	
3	3 4 4 5 5 7 8
4	2 2 5
5	0 1 8
6	8
7	2

Key: 1|0 = 10

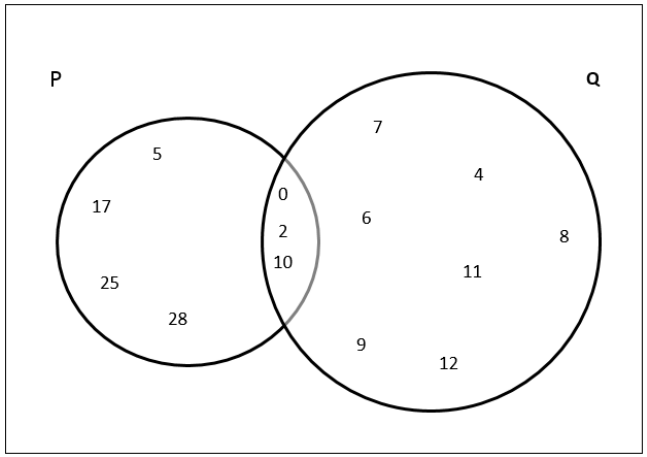
Stem Plots (also called Stem and Leaf Plots)

Used to display numerical data that range from zero into the hundreds. The tens are listed in a column, with the units of each piece of data listed in order in rows to the right and/or to the left of the respective tens number. It enables the full data set to be visible, while creating a graph of the data grouped in tens. This form of display makes it easy to see the mode/s and to work out the median.

Carroll Diagrams and Two-Way Diagrams

Information is shown in two or more categories in columns and rows, which may or may not need to be totalled. It is useful for showing how different types of frequency data might be related, for example, the different ways that boys and girls travel to school.

Criteria	Even Numbers	Not Even Numbers
Multiples of 3	6 12 18	15 21 39
Not multiples of 3	8 20 40	5 29 35



Venn Diagrams

Used to visually represent data that have overlapping categories. The number in each category is shown within an oval, and the number that is in more than one category is shown in the relevant overlapping sections.

Early Level Experiences and Outcomes ~ Information Handling

** The numeracy learner statements that are the responsibility of all are shown in italics.*

I can collect objects and ask questions to gather information, organising and displaying my findings in different ways.
MNU 0-20a Pg's 8 & 9

I can match objects and sort using my own and others' criteria, sharing my ideas with others.
MNU 0-20b Pg's 8 & 9

I can use the signs and charts around me for information, helping me plan and make choices and decisions in my daily life.
MNU 0-20c Pg's 8 & 9

Despite having no Experience and Outcome for Early Level, everyday language for chance and uncertainty need to be explored in order for this to be built upon at First Level.

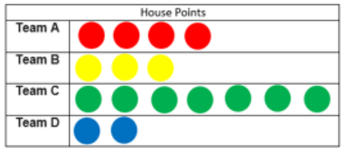
DATA AND ANALYSIS AIM: Organise information or items by classification using own criteria, justifying choices. Use counting skills to ask questions to inform data collection, contribute to simple displays and draw conclusions from data. Interpret simple charts and signs to support planning choices and inform decision making. **Note: This pyramid appears across two pages.**

MNU 0-20a, MNU 0-20b & MNU 0-20c

Organise data by classifying items in categories using own or others' criteria.

e.g. sorts coins out based upon denomination or colour.

Use symbols and charts to support decision making.



e.g. Everyday symbols, house point charts.

Make simple inferences from data gathered.

e.g. More children wanted to eat pizza rather than curry because most children do not like spicy food.

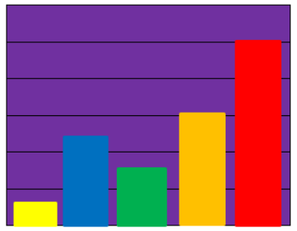
Describe how their graph shows the results of their data collection

e.g. *We spun the spinner ten times. These three squares on our graph show the three times we got yellow, these (pointing) show we got red six times and green once. Blue didn't come up.*

Write a few sentences to describe the results of their data collection using vocabulary such as most, more than, less than.

e.g. We found that pizza was the most-liked food.

Make simple inferences about data displays.



e.g. The red bar must be the number of children who want to play football because most children wanted that.

Read frequencies from a block graph (with each unit on the frequency axis marked) and hence describe the data

e.g. *The graph shows that 11 of the people asked said they preferred frozen yoghurt.*

Comment on information in displays of data produced by themselves and peers.

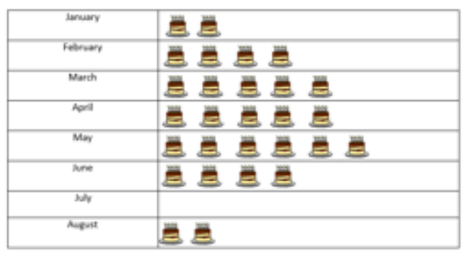
e.g. *By looking at all the graphs we can see that some groups rolled mostly four but others rolled mostly three.*

Explain their own data displays, talking about the features represented.

e.g. My tally shows that most of our class have school dinner on Monday..

Days	Tally	Total
Monday	𝍸 𝍸 𝍸	
Tuesday	𝍸 III	
Wednesday	𝍸 𝍸	
Thursday	𝍸 I	
Friday	𝍸 𝍸 II	

Read and compare frequencies from lists and simple one-way tables



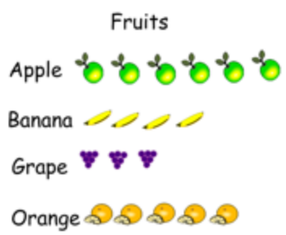
e..g. This shows that six children have a May birthday.

Collect and organise objects for a specific purpose.

Find simple information from charts and displays.

e.g. birthday charts.

Make pictograms using one-to one correspondence between 'real' data and a representation.



Interpret block graphs produced by others.

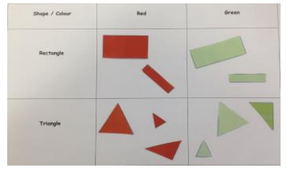
e.g. Their graph shows that there were less orange star sweets than any other.

Report the frequency information provided in a tally produced by a classmate.

e.g. *Joe found that most people would like to have a pet dog.*

In answer to the question 'How could we find out?' suggest collecting objects or information and offer suggestions about what data to collect.

Classify things using one or two familiar criteria



e.g. shape by type or shape by type and colour.

Pose questions suggested by collected data,

e.g. having collected class lunch choice data might ask if teachers mostly have packed lunches.

Make block graphs using 'real' data

e.g. pupils make block graphs from photographs of pupils.

Suggest ways of efficiently counting how many there are in each of several categories
e.g. use coloured buttons to represent students' snack preferences and arrange buttons in one-to-one

Summarise information from a chart by counting
e.g. count how many children have wellies.

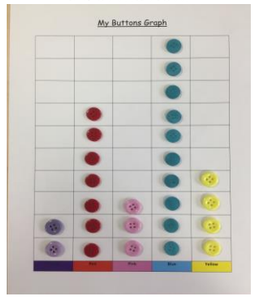
Make predictions related to familiar things.

e.g. We think that dogs are the most common pet.

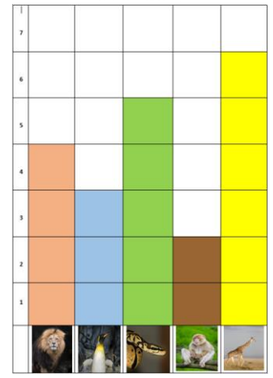
Sort and label objects

Suggest how to answer questions about collections.
e.g. If I line up the red and green shapes, I will be able to see if there are more green.

Display in one-to-one correspondence, pictures or objects that represent information.



Compare heights (or lengths) of the columns in a block graph to place categories in order.



e.g. This shows giraffes were most popular, then snakes, lions, penguins and monkeys.

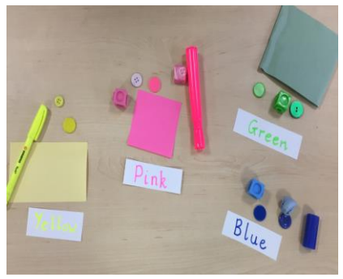
Give information about themselves using a variety of methods such as show of hands, yes/no answers.

Use real life objects or people to create living display.

e.g. stand in rows to show who has blue or brown eyes.

Ask yes/no questions to gather information.

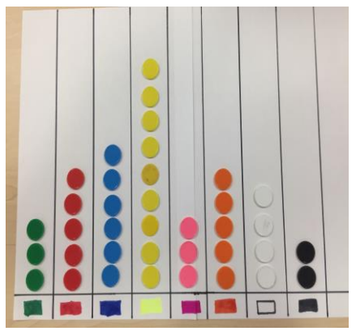
Matching using one criteria.



Place objects into sequences,

e.g. order sticks according to criteria such as length.

Display classified objects in order to compare collections.



Pose questions.

e.g. What is your favourite colour?

Use simple labels and signs in everyday life.

Describe a likeness between several things.

e.g. Some of these blocks are Lego and some are not.

Draw a picture as a record of their results.

e.g. draw a picture of the 'graph' they made with actual sweets.

Data gathering and analysis is an everyday skill. Opportunities across the curriculum and in real life situations should be maximised to give relevancy to the need to gather information and to interpret information. Data and Analysis skills will increase in sophistication as children develop. The Data and Analysis Pyramid statements should be revisited with increasing complexity as children's mathematical thinking develops.

Technology should be used to support data display and analysis where appropriate.

CHANCE AND UNCERTAINTY AIM: Use appropriate vocabulary to make predictions of outcomes based on previous experiences.

Understand that choices can be made.

e.g. Choose which t-shirt to wear, recognising that there was more than one option.

Respond appropriately to, and use 'possible' and 'impossible' for describing familiar events and actions.

e.g. It is impossible for me to fly like a bird.

Identify possible outcomes for daily events

e.g. After Dad picks me up from school, we might go to the park.

Talk about choices and justify them.

E.g. I chose blue paint because it is my favourite colour.

Talk about events recognising the nature of chance.

E.g. It might rain today.

Talk about decisions and justify them.

E.g. I decided to stay in because it was raining.

Respond appropriately to everyday language associated with uncertainty.

e.g. will, won't might, can, can't, not sure, sure

Choose between simple options such as what to have at snack time, who to play with.

Use language such as, 'always', 'never', sometimes'.

e.g. Sometimes I go to Grandma's after nursery. I always get a drink before bed. I never go to Billy's house.

Early Level Overview **The numeracy learner statements that are the responsibility of all are shown in italics.*

Key Aspect	Experiences and Outcomes	National Benchmarks
Data and Analysis Pg's 8 & 9	***I can collect objects and ask questions to gather information, organising and displaying my findings in different ways.*** ***MNU 0-20a*** ***I can match objects and sort using my own and others' criteria, sharing my ideas with others.*** ***MNU 0-20b*** ***I can use the signs and charts around me for information, helping me plan and make choices and decisions in my daily life.*** ***MNU 0-20c***	• ***Asks simple questions to collect data for a specific purpose.*** • ***Collects and organises objects for a specific purpose.*** • ***Applies counting skills to ask and answer questions, make relevant choices and decisions based on the data.*** • ***Contributes to concrete or pictorial displays where one object or drawing represents one data value, using digital technologies as appropriate.*** • ***Uses knowledge of colour, shape, size and other properties to match and sort items in a variety of different ways.*** • ***Interprets simple graphs, charts and signs and demonstrates how they support planning, choices and decision.***
Ideas of Chance and Uncertainty Pg 10	Despite having no Experience and Outcome for Early Level, everyday language for chance and uncertainty need to be explored in order for this to be built upon at First Level.	

First Level Experiences and Outcomes ~ Information Handling

** The numeracy learner statements that are the responsibility of all are shown in italics.*

I have explored a variety of ways in which data is presented and can ask and answer questions about the information it contains.

MNU 1-20a Pg's 13 & 14

I have used a range of ways to collect information and can sort it in a logical, organised and imaginative way using my own and others' criteria.

MNU 1-20b Pg's 13 & 14

Using technology and other methods, I can display data simply, clearly and accurately by creating tables, charts and diagrams, using simple labelling and scale.

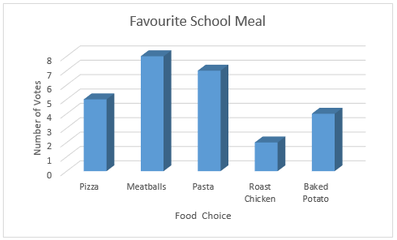
MTH 1-21a Pg's 13 & 14

I can use appropriate vocabulary to describe the likelihood of events occurring, using the knowledge and experiences of myself and others to guide me.

MNU 1-22a Pg 15

DATA AND ANALYSIS AIM: Ask and answer questions to extract key information, organise, create and interpret data from a variety of charts, diagrams and tables. MNU 1-20a, MNU 1-20b & MTH 1-21a Note: This pyramid appears across two pages.

Label bar graphs with title, both axes labelled and appropriate scale which may be where one unit represents more than one data value.

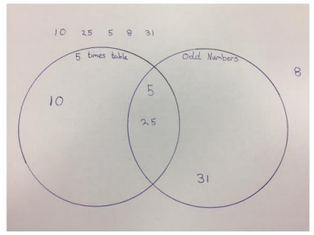


Interpret pictograms produced by others where each picture represents more than one unit.
e.g. *Each picture represents two*

cherry pie	6
chicken	4
ice cream	8
pizza	5
turkey	1

Key: Each stands for 2 people

Use a variety of different methods to explore, display and interpret relationships between data. *e.g. Venn & Carroll diagrams.*

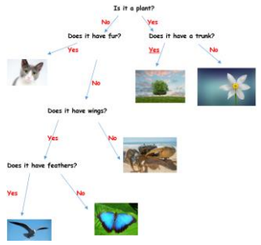


	Shapes with curved lines	Shapes with straight lines
Red Shapes		
Blue Shapes		

This shows that 10, 5 and 25 are in the 5x table and 5 and 25 are also odd numbers.

Understand why organisation of data is necessary.

Describe information from diagrams that use arrows.



Display data in pictograms where each symbol represents more than one unit, such as one picture for every 4 children.

Hobby Club	6
Writers Club	5
Hockey Club	2
Football Club	4
Basketball Club	3
Homework Club	3
Art Club	1
Drama Club	1

Key: Each stands for 4 members

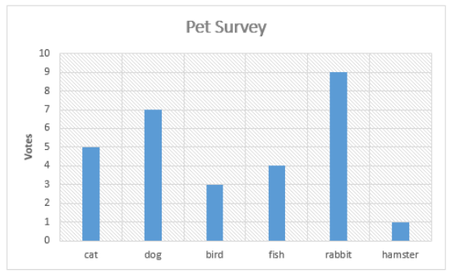
Comment on their predictions in light of the results of their own data collection.

e.g. We thought that blue Smarties would come out least and we were right.

Read frequencies from a bar graph with non unitary scales and describe the data.

e.g. *Their graph shows that dolphins can hold their breath for 12 minutes.*

Display frequency data in (vertical and horizontal) bar graphs where one axis shows the whole numbers (0, 1, 2, 3, …)



Explain their own data displays to their peers, talking about the features represented.

e.g. *My tally shows that the highest score was 10 and the lowest score was 6.*

Make quickly produced 'working' graphs to explore data.

Use lengths to represent other measures such as time or mass,

e.g. mark paper strips with the 24 hours of the day, shade the time between going to bed and getting up, cut shaded parts and make a graph of the times in bed.

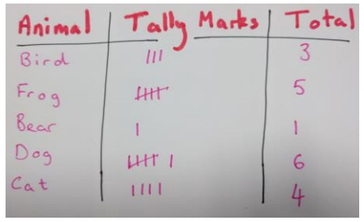
Interpret straightforward tables.

	Game 1	Game 2	Game 3	Game 4	Game 5	Frequency
Greg	1	0	0	2	3	6
Alison	0	2	1	0	0	3
Lucy	1	0	1	1	0	3
Euan	2	0	2	1	2	7
Ross	3	1	1	0	1	6
Caroline	0	1	3	1	0	5

Place direct measurement data using a baseline.

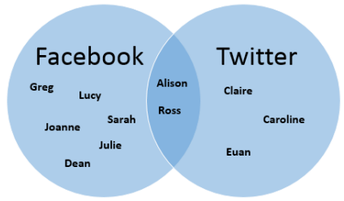
e.g. having measured by lying down, cut string and make a bar (column) graph by lining up the bottom strip.

Summarise data based on tallying.



e.g. use a conventional tally method to record information.

Summarise data in diagrams.



e.g. the names of children recorded in a Venn diagram are replaced by the count of how many were in that category.

Summarise data in diagrams and tables that show frequencies for different categories.

e.g. the category may be type of food, and frequency the number of students who chose that type; names of children recorded in a Venn diagram are replaced by the count of how many were in that category.

Record frequency data carefully using simple formats based on tallies or organised lists, and take care with their measurements.

Revise a survey question so it can be answered by 'yes/no' or a simple multiple choice.
e.g. begin with 'Which of these colours do you like?' and, after trialling, revise to 'Which pair of colours would you like best for our team strip?'

Use mathematical language related to data such as most popular, least popular.

Give information about themselves using a variety of methods such as completing surveys including those using technology.

Plan and collect information in a variety of ways such as surveys and practical investigations.

e.g. science experiments.

Improve their descriptions of categories to clarify what the category includes or excludes.
e.g. when classifying drawings of 'animals that scare me' into "pets' and 'not pets, deciding where 'snakes' belong.

Understand the need for a baseline and space blocks regularly (in provided grids) to allow comparisons to be made.

Offer suggestions about how to classify objects or information.

e.g. having asked class members what pets they have, suggest ways to classify the animals to test their prediction that the most common type will be dogs.

Apply unambiguous and familiar criteria to sequence data consistently. *e.g. order the children in their age group from oldest to youngest*

Suggest information to collect to answer particular questions.
e.g. How can we find out what cookies to bake for the class picnic? Suggest asking class about favourite flavours.

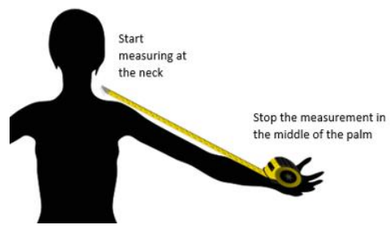
Suggest a suitable way to classify data to answer straightforward questions.

e.g. suggest sorting their 'coming to school' sketches into groups by transport type (car, bus, bike or on foot).

Clarify questions to decide what data to collect.

e.g. *We want to know what are the most popular pets in the class, and we mean best liked, not what most children have.*

Specify how frequencies or measurements are to be made.



e.g. specify that arm length is from neck to middle of palm.

Data gathering and analysis is an everyday skill. Opportunities across the curriculum and in real life situations should be maximised to give relevancy to the need to gather information and to interpret information. Data and Analysis skills will increase in sophistication as children develop. The Data and Analysis Pyramid statements should be revisited with increasing complexity as children's mathematical thinking develops.

Technology should be used to support data display and analysis where appropriate.

CHANCE AND UNCERTAINTY AIM: Use previous experiences to describe the likelihood of everyday events occurring using appropriate vocabulary. Interpret the data which is gathered.

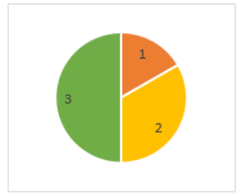
MNU 1-22a

Use data to consider events, describing them as being more or less likely.

e.g. It is less likely that we will play rugby at break because most people want to play football.

Predict the likelihood of an outcome justifying reasonableness. *e.g. is it probable, certain/uncertain*

Identify possible results of an action or event by collecting data.



e.g. Using an uneven spinner.

Compare events within their experience, describing them as being more or less likely.

e.g. It is more likely that we will have an indoor break if it is raining..

Identify situations where there is an element of luck.

e.g. When the raffle tickets are drawn at the Christmas Fayre.

Identify possible and impossible results of a familiar simple action by thinking about the situation.

e.g. You might get a red or a green or a pink sweet because they are the colours we put in the bowl. You couldn't get a black one because we didn't put any in.

Describe familiar events as being more or less likely to happen.

e.g. We are more likely to go to Grandpa's house in the car than the bus.

Distinguish impossible from unlikely events using appropriate vocabulary.

e.g. We never go to the park after school but it isn't impossible – it could happen.

Identify situations which would not be fair.

e.g. If Danny's name is not on a lollipop stick the teacher can't choose him. It would be impossible to pull out his name.

Respond appropriately to, and use 'possible' and 'impossible' for describing familiar events and actions.

e.g. it is impossible for my dad to be younger than me.

Talk about events recognising the nature of chance.

E.g. The new baby might be a girl or might be a boy.

Respond appropriately to everyday language associated with uncertainty.

e.g. will, won't might, could, couldn't, lucky, unlucky, fair, unfair, lucky, unlucky

Identify possible outcomes for daily events. *e.g. After Dad picks me up from school, we go to the shops, go straight home or go to Gran's.*

Use language such as 'won't happen', 'will happen' or 'might happen', 'always', 'never', sometimes'.

Recognise and take into account the possibility of different results for repetitions of the same simple action.

First Level Overview **The numeracy learner statements that are the responsibility of all are shown in italics.*

Key Aspect	Experiences and Outcomes	National Benchmarks
Data and Analysis Pg's 13 & 14	***I have explored a variety of ways in which data is presented and can ask and answer questions about the information it contains.*** ***MNU 1-20a*** ***I have used a range of ways to collect information and can sort it in a logical, organised and imaginative way using my own and others' criteria.*** ***MNU 1-20b*** Using technology and other methods, I can display data simply, clearly and accurately by creating tables, charts and diagrams, using simple labelling and scale. **MTH 1-21a**	• ***Asks and answers questions to extract key information from a variety of data sets including charts, diagrams, bar graphs and tables.*** • ***Selects and uses the most appropriate way to gather and sort data for a given purpose, for example, a survey, questionnaire or group tallies.*** • Uses a variety of different methods, including the use of digital technologies, to display data, for example, as block graphs, bar graphs, tables, Carroll diagrams and Venn diagrams. • Includes a suitable title, simple labelling on both axes and an appropriate scale where one unit represents more than one data value in graphs.
Idea of Chance and Uncertainty Pg 15	***I can use appropriate vocabulary to describe the likelihood of events occurring, using the knowledge and experiences of myself and others to guide me.*** ***MNU 1-22a***	• ***Uses mathematical vocabulary appropriately to describe the likelihood of events occurring in everyday situations, including, probable, likely/unlikely, certain/uncertain, possible/impossible, fair/unfair.*** • ***Interprets data gathered through everyday experiences to make reasonable predictions of the likelihood of an event occurring.***

Second Level Experiences and Outcomes ~ Information Handling

** The numeracy learner statements that are the responsibility of all are shown in italics.*

Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading.

MNU 2-20a Pg's 18 & 19

I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way.

MNU 2-20b Pg's 18 & 19

I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology.

MTH 2-21a/MTH 3-21a Pg's 18 & 19

I can conduct simple experiments involving chance and communicate my predictions and findings using the vocabulary of probability.

MNU 2-22a Pg 20

DATA AND ANALYSIS AIM: Collects, organises and displays data with others in a variety of ways including through digital technology. Analyses, interprets and draws conclusions from data and communicates findings. Note: This pyramid appears across two pages.

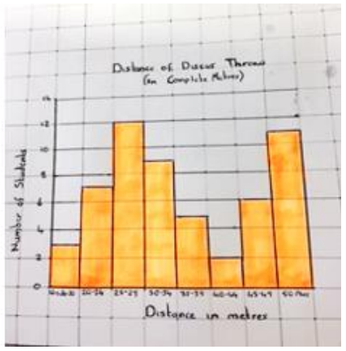
MNU 2-20a, MNU 2-20b & MTH 2-21a

Interpret pictograms where one unit represents more than one data value.

Alan	● ● ◔
Bob	● ●
Chris	● ◔
Dave	◔

● = 4 points

Interpret histograms for grouped data, including where the scales on the axes must be 'read' between calibrations.



Comment sensibly on how well their own collected data answers their original questions.

e.g. We thought asking people what food they liked would help plan the camp, but we didn't ask it very well and so we couldn't classify it. Next time we would …

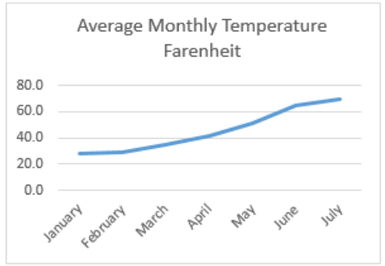
Interpret and report on information provided in line graphs, informally describing trends in the data.

e.g. This shows that the bath lasted for 8 minutes.

Use fractions and decimals to summarise data.

e.g. the thumb tack fell on its side about two-thirds of the time.

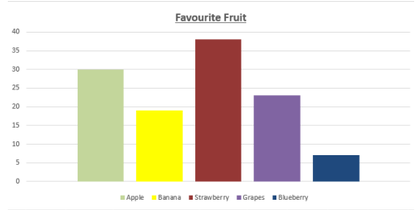
Explore misleading statistics in real life contexts and comment.



e.g. To show an increase in global warming the graph only displays data for the first six months of the year which is misleading.

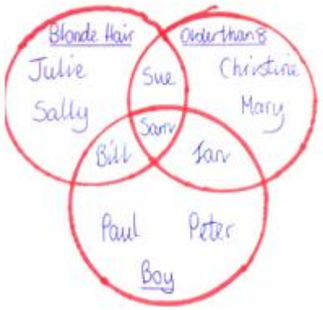
Select the most suitable way of collecting data for a given task.

Create, interpret and report on information provided in tables and bar graphs where data are grouped into simple intervals.

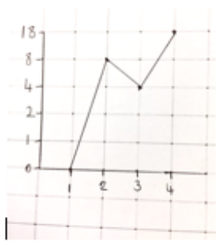


Explore the difference in appearance by changing the scale and intervals of graphs.

Interpret and report on information provided in Venn diagrams that have more than two circles.



Explore the effect of incorrect use of scale



e.g. the graph appears to show a steep increase but due to incorrect scale this is misleading.

Explore the effect of poor sampling

Girls Only!

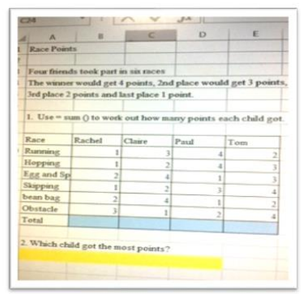
e.g. to discover the most desirable lunchtime activity 40 pupils were sampled. However they were all girls.

Display measurements in tables with provided class intervals

Height (in cm)	Number of Students
146-150	1
151-155	0
156-160	6
161-165	3
166-170	8
171-175	1
176-180	1

e.g. find the height of pupils and group.

Create simple spreadsheets.



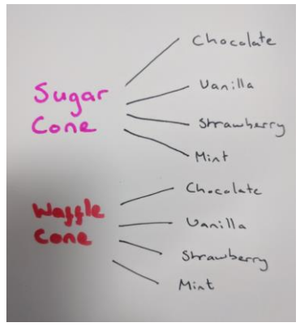
Represent data in diagrams and tables that may include simple pie charts, Venn diagrams and Carroll diagrams.

8 22 18 49 100

	Even Numbers	Odd Numbers
Numbers in the 7 times table		
Numbers not in the 7 times table		

Comment sensibly on how well their questions are answered by data provided by, or collected from, others, and how the data might be improved.
e.g.
We wanted to know whether people preferred books that had pictures in them, but the data doesn't classify books that way so it wasn't very helpful. We needed to know …

Interpret and report on information provided in simple tree diagrams.



Enter data in a simple spreadsheet.

	A	B
1	**Fruit**	**Number**
2	Apple	8
3	Orange	4
4	Banana	3
5	Grapes	5
6	Peach	3
7	Pear	1

Enter data in databases with fields already defined.

e.g. enter information on the books each class member reads in preparation for a Book Week display

Explore the ways that information can be gathered about people.
e.g. investigate the Office for National Statistics Census

Suggest what data to collect to help estimate numbers or quantities.

e.g. to estimate how many raisins one could expect 'on average', collect data from a number of small packs of raisins.

Read the information provided on axes of bar and line graphs, including where all calibrations on the scale may not be labelled.

Collect data using surveys and investigations in collaboration with others.

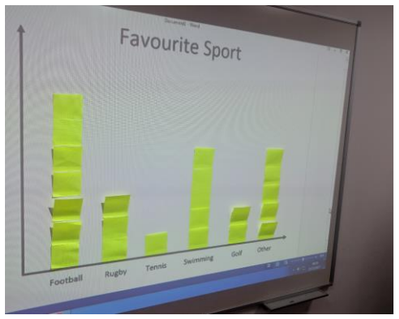
Realise that it is sometimes helpful to group data involving whole numbers into class intervals.

e.g. having estimated the number of sweets in a jar, organise the estimates in intervals such as 41-45, 46-50, 51-55, 56-60, to compare estimates with.the true amount.

Ensure that data is displayed in a way that can be clearly accessed and interpreted including bar graphs, line graphs, tables and simple pie charts.

Realise that different classifications may tell different things and suggest an alternative classification to answer new questions.

Make quickly produced 'working' graphs to explore data,



e.g. use sticky paper notes with food choices written on them to make quick block graphs based on different ways of classifying foods.

Suggest ways to improve a classification to better answer a question.

e.g. Having asked the question ' Which genre of book is most popular?' and classified answers into fiction and nonfiction then suggests classification of poetry, horror etc

Revise a survey question so it can be answered by a simple multiple choice,

e.g. begin with 'Which country will get most medals?' and after trialling, revise to 'From these European countries, which do you think will get most medals?'

Construct and use their own categories to answer specific questions.

e.g. for 'How animals move', they classify animals by 'walk', 'fly', 'wriggle', and 'swim'

Data gathering and analysis is an everyday skill. Opportunities across the curriculum and in real life situations should be maximised to give relevancy to the need to gather information and to interpret information. Data and Analysis skills will increase in sophistication as children develop. The Data and Analysis Pyramid statements should be revisited with increasing complexity as children's mathematical thinking develops.

Technology should be used to support data display and analysis where appropriate.

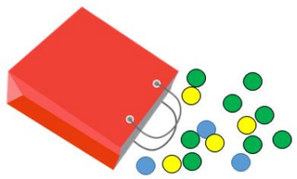
CHANCE AND UNCERTAINTY AIM: Construct experiments of chance and report using appropriate language of probability.

MNU 2-22a

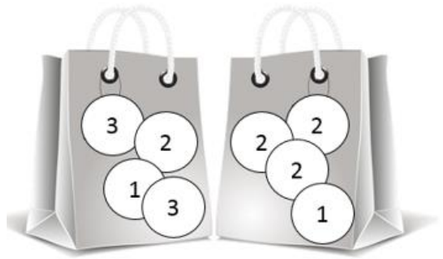
Analyse and explain results of simple experiments involving chance.

e.g. When creating a tombola what are the chances that the customer will win a prize?

Plans and carries out repeated simple experiments of chance and record findings to determine which outcome is likely.



Use probability to explain fairness in mathematical terms.



e.g. If the goal is to pull out a 2 then the person with bag 1 has an advantage because 3 out of 4 of their tokens are a 2.

Design a probability device such as a die, spinner or a bag of coloured beads to produce a specified order of probability.

e.g. colour a spinner so it is most likely to stop on red, least likely to stop on green or yellow

List all possible outcomes for straightforward situations.

e.g. If I can choose two scoops of ice cream for my cone what are my options?

Use language of probability to describe the likelihood of a simple event.

e.g. equal chance, fifty fifty, one in three chance,

Use data to predict the likelihood of the outcome of a simple experiment, justifying reasonableness.

Order outcomes for a single random action from least to most likely by thinking about (i.e. analysing) the situation,

e.g. for a die with the faces 1, 1, 2, 2, 2, 3, state that a 2 is most likely, 1 is next and 3 is least likely

Use a simple probability scale to record likelihood.

Understand that certainty relates to events that must happen and events that cannot happen.

Use available data to order things from most likely to least likely.

e.g. using rainfall data to order Scottish cities from least likely to have rain in July to most likely.

Order probability devices from the one most likely to the one least likely to produce an outcome.

e.g. order three spinners with different proportions shaded yellow from the one most likely to the one least likely to produce a yellow result

Describe outcomes as having an equal chance or equally likely.

Order events from least likely to most likely.

e.g. Tomorrow will be Monday.

There will be salad at lunch tomorrow.

Justify choice of more or less likely.

e.g. We have salad choices every day so it is most likely that we will have that tomorrow. But today is Friday so it is really, really unlikely that it will be Monday.

Recognise that the chance of an event happening can be influenced.

e.g. I am more likely to get to go swimming with my friend if I walk the dog for Mum.

Use language of chance.

e.g. impossible, probably, unlikely, always

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Second Level Overview **The numeracy learner statements that are the responsibility of all are shown in bold and italics.*

Key Aspect	Experiences and Outcomes	National Benchmarks
Data and Analysis Pg's 18 & 19	***Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading.*** ***MNU 2-20a*** ***I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way.*** ***MNU 2-20b*** I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. **MTH 2-21a/MTH 3-21a**	• ***Devises ways of collecting data in the most suitable way for the given task.*** • ***Collects, organises and displays data accurately in a variety of ways including through the use of digital technologies, for example, creating surveys, tables, bar graphs, line graphs, frequency tables, simple pie charts and spreadsheets.*** • ***Analyses, interprets and draws conclusions from a variety of data.*** • ***Draws conclusions about the reliability of data taking into account, for example, the author, the audience, the scale and sample size used.*** • Displays data appropriately making effective use of technology and chooses a suitable scale when creating graphs.

Key Aspect	Experiences and Outcomes	National Benchmarks
Idea of Chance and Uncertainty Pg 20	***I can conduct simple experiments involving chance and communicate my predictions and findings using the vocabulary of probability.*** ***MNU 2-22a***	• ***Uses the language of probability accurately to describe the likelihood of simple events occurring, for example, equal chance; fifty-fifty; one in two, two in three; percentage chance and 1:6.*** • ***Plans and carries out simple experiments involving chance with repeated trials, for example, what is the probability of throwing a double six if you throw two dice fifty times?*** • ***Uses data to predict the outcome of a simple experiment and explains reasons for the prediction.***

Third Level Experiences and Outcomes ~ Information Handling

** The numeracy learner statements that are the responsibility of all are shown in italics.*

I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.

MNU 3-20a Pg's 24 & 25

When analysing information or collecting data of my own, I can use my understanding of how bias may arise and how sample size can affect precision, to ensure that the data allows for fair conclusions to be drawn.

MTH 3-20b Pg's 24 & 25

I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology.

MTH 2-21a/MTH 3-21a Pg's 24 & 25

I can find the probability of a simple event happening and explain why the consequences of the event, as well as its probability, should be considered when making choices.

MNU 3-22a Pg 26

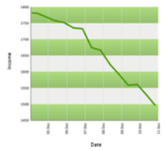
DATA AND ANALYSIS AIM: Source, interpret and analyse information taking reliability into account. Display data appropriately. Make effective use of technology to support information handling. Note: This pyramid appears across two pages.

MNU 3-20a MNU 3-20b & MTH 3-21a

Explore the benefits of different types of graphs.

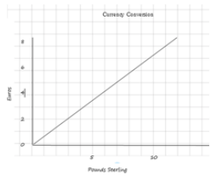
e.g. A pictogram is easy to read but difficult to quantify partial icons.

Identify trends in data using appropriate vocabulary. *e.g increasing/decreasing trend*



Recognise that statistics provide an interpretation and summary of data.

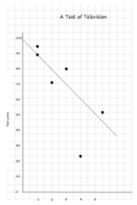
Display, interpret and draw conclusions from information provided in conversion graphs.



e.g. currency conversion graphs.

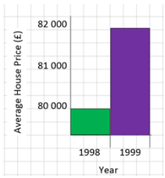
Explore the ways that information can be gathered about people.
e.g. investigate the way search histories can be used to target adverts on the internet.

Represent two-variable data in scatter diagrams and make informal statements about relationships.



e.g. between time spent watching TV each week and a test score.

Identify information that is vague, robust or misleading.



e.g. This graph appears to show a great increase in house price. However as the scale does not start at zero, and does not indicate a broken scale, it is misleading.

Explore opportunities to use primary and secondary data and discuss limitations of using either.

Primary Data	Secondary Data
Surveys	Newspapers
Samplings	Journals
Interviews	Demographic Data
Focus Groups	Market Research Report

Interpret and draw conclusions from information provided in databases.

Interpret and draw conclusions from information provided in spreadsheets.

	A	B	C	D	E	F
1	Item	Selling Price		Cost Price		Profit
2	Mars Bar	£0.30		£0.25		£0.05
3	Twix	£0.30		£0.25		£0.05
4	Snickers	£0.28		£0.23		£0.05
5	Bounty	£0.27		£0.21		£0.06
6	Crisps	£0.25		£0.20		£0.05
7	Coke	£0.50		£0.40		£0.10
8	Irn Bru	£0.50		£0.40		£0.10
9	Lemonade	£0.40		£0.25		£0.15

Check accuracy of their data before interpreting it.

e.g. *We plotted the surface areas of the cubes against the volume of the cubes, and found that we could draw a smooth curve through all the points except one, so we checked and found we'd made a mistake.*

Create, interpret and draw conclusions from information provided in a variety of forms *e.g compound bar and line graphs and pie charts.*

Carry out investigations which show understanding of sample size and bias.

e.g. When asking questions about the food choice at the canteen be aware that those that do not use the canteen may have a valid opinion.

Interpret and draw conclusions from information provided in tables and charts.

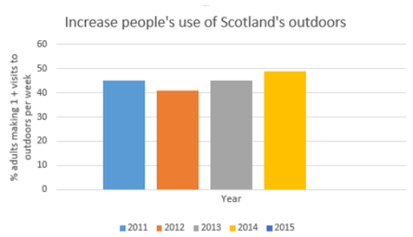
Write or present an accurate summary of the information displayed in a range of tables and graphs.

e.g. *what is shown by their line plot of ages of the caregivers of class members.*

Use fractions or percentages to compare data.

e.g. *Before, I got 26 balls from 50 tries, that's 52%. This time I got 24 from 40 tries, or 60%. They are close, but I may be improving a bit.*

Comment sensibly on how well their questions are answered by data provided by, or collected from, others, and how the data might be improved.

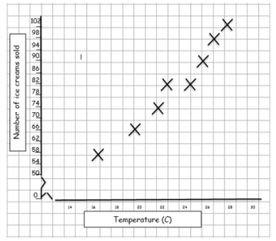


e.g. *We wanted to know whether teenagers visited the outdoors but the data wasn't organised that way so it wasn't very helpful. We needed to know …*

Comment sensibly on how well their own collected data answers their original questions.

e.g. *We thought asking people what career they were interested in would help us plan our talk, but we didn't ask it very well and so we couldn't classify it. Next time we would …*

Begin to interpret relationships and reach conclusions from scatter diagrams.



e.g. *It looks like people bought ice creams because it got hotter but we can't say that one causes the other.*

Collaborate in making and refining data collection sheets involving lists or tables or scales.

e.g. decide which categories to use in investigating animal behaviour for a science project.

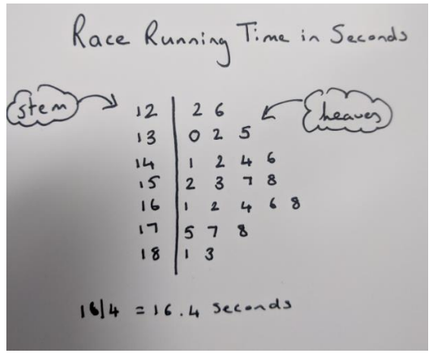
Collaborate in developing and trialling two or three questions involving 'yes/no' answers, simple multiple choice responses, or categories.

e.g. 'Do you think teenagers should have to help around the home for pocket money?' (yes/no)

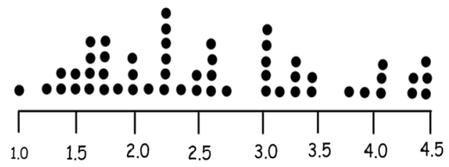
Collaborate to clarify terms to help ensure that data are collected consistently.

e.g. in considering 'Do students do more homework as the year goes on?', decide what they mean by 'doing homework' and if 'how much homework' means time spent or some other measure.

Use stem plots (or stem and leaf graphs) to group and display one-variable data.



Display one-variable data in dot frequencies with various scales, including multiple and decimal fractions.



e.g. the mass of the cabbages has been rounded to the nearest tenth.

Improve the collection of measurements to make them more consistent.

e.g. decide where to place the tape so that each measurement is done the same way.

Enter data in databases with fields already defined.

e.g. enter information on minibeasts to help identify common British insects.

Carry out data collection consistently and accurately.

e.g. ask the planned question in the same way each time; measure between the same body parts; round in the same way.

Plan data collection sheets for the collection of two-variable data.

	TV	Reading
Ailsa		
Beth		
Catriona		

e.g. the amount of time spent watching TV and reading for each student surveyed.

Data gathering and analysis is an everyday skill. Opportunities across the curriculum and in real life situations should be maximised to give relevancy to the need to gather information and to interpret information. Data and Analysis skills will increase in sophistication as children develop. The Data and Analysis Pyramid statements should be revisited with increasing complexity as children's mathematical thinking develops.

Technology should be used to support data display and analysis where appropriate.

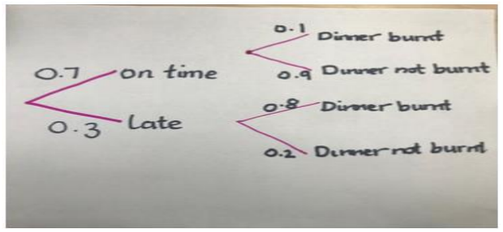
CHANCE AND UNCERTAINTY AIM: Calculate the probability of a simple event happening and express it numerically.

MNU 3-22a

Know the difference between theoretical and experimental probability.

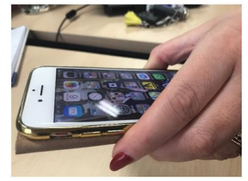
e..g. Dropping a coin 20 times and recording that it lands on the head 4 in 5 times will give an experimental probability. However a theoretical probability would state that there is a 1 in 2 probability of being a head.

Discuss probability in mathematical terms for everyday situations.



Show an awareness of the concept of risk, and how this affects real life.

e.g. mobile phone insurance.



Understand sample size and its relationship to reliability and validity.

Make choices and decisions based upon chance and uncertainty.

e.g. Decide to enter a draw to win concert tickets because the odds are favourable.

Design a device to fit specified probabilities.

e.g. colour a spinner so the probability of it stopping on red is 0.5, on green is 0.1 and on blue is 0.4

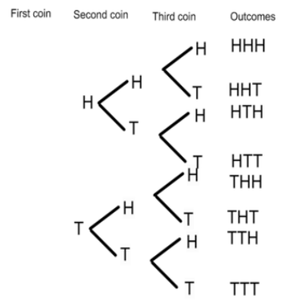
Demonstrate awareness of how influencing the possible outcomes can affect the probability of the desired outcome.

e.g. With a box of 40 chocolates of half orange half strawberry creams I have a 1 in 2 chance of taking an orange cream. However each time I take a sweet the odds change.

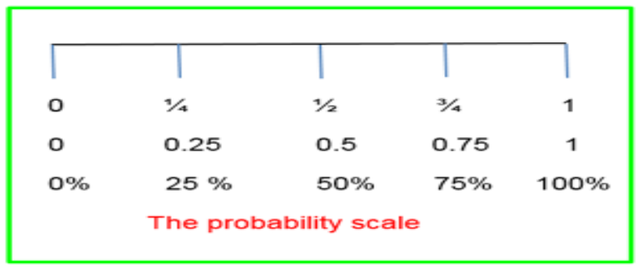
Use a given probability to calculate an expected outcome.

e.g. the probability of rain in June is 0.25 so how many days do we expect it to rain?

Use methods such as tree diagrams to record possibilities to allow for calculation.



Record probability on a probability scale.



Know how to construct a numerical representation of probability in fraction, decimal and percentage form.

Interpret expressions of probability in general usage.

e.g. The probability of rain tomorrow is 30% There's a 50-50 chance of the baby being a boy.

Predict the likelihood of an outcome justifying reasonableness.

Understand that events which cannot happen are certain as having a probability of 0, events that will happen are certain as having a probability of 1, and events which may happen as having a probability between 0 and 1.

List equally likely outcomes for a 'one-step' action in order to assign probabilities.

e.g. each of 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are equally as likely to appear as the last digit of a telephone number (but not as the first digit), so the probability that the last digit is 7 is 0.1

Use fractions to assign probabilities.

e.g. 14 girls' and 16 boys' names are put in a bag; the probability of drawing a boy's name is 16 out of 30

Use the frequency of the results of a simple experiment to predict the results in a repetition of it.

e.g. use results of tossing a coin 50 times to predict what would happen in a later experiment of 100 tosses

Third Level Overview ** The numeracy learner statements that are the responsibility of all are shown in bold and italics.*

Key Aspect	Experiences and Outcomes	National Benchmarks
Data and Analysis Pg's 24 & 25	***I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.*** ***MNU 3-20a*** When analysing information or collecting data of my own, I can use my understanding of how bias may arise and how sample size can affect precision, to ensure that the data allows for fair conclusions to be drawn. **MTH 3-20b** I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. **MTH 2-21a/MTH 3-21a**	• ***Sources information or collects data making use of technology where appropriate.*** • ***Interprets data sourced or given.*** • ***Describes trends in data using appropriate language, for example, increasing trend.*** • ***Determines if information is robust, vague or misleading by considering, for example, the validity of the source, scale used, sample size, method of presentation and appropriateness of how the sample was selected.*** • Collects data by choosing a representative sample to avoid bias. • Organises and displays data appropriately in a variety of forms, for example, compound bar and line graphs, and pie charts, making effective use of technology as appropriate.

Key Aspect	Experiences and Outcomes	National Benchmarks
Idea of Chance and Uncertainty Pg 26	***I can find the probability of a simple event happening and explain why the consequences of the event, as well as its probability, should be considered when making choices.*** ***MNU 3-22a***	• ***Uses the probability scale of 0 to 1 showing probability as a fraction, decimal fraction or percentage.*** • ***Demonstrates understanding of the relationship between the frequency of an event happening and the probability of it happening.*** • ***Calculates the probability of a simple event happening, for example, the probability of selecting a face card from a standard deck of cards.*** • ***Identifies all of the mutually exclusive outcomes of a single event and calculates the probability of each*** • ***Investigates real-life situations which involve making decisions on the likelihood of events occurring and the consequences involved.***

Fourth Level Experiences and Outcomes

**** The numeracy learner statements that are the responsibility of all are shown in bold italics.***

I can evaluate and interpret raw and graphical data using a variety of methods, comment on relationships I observe within the data and communicate my findings to others.

MNU 4-20a Pg's 30 & 31

In order to compare numerical information in real-life contexts, I can find the mean, median, mode and range of sets of numbers, decide which type of average is most appropriate to use and discuss how using an alternative type of average could be misleading.

MTH 4-20b *Pg's 30 & 31*

I can select appropriately from a wide range of tables, charts, diagrams and graphs when displaying discrete, continuous or grouped data, clearly communicating the significant features of the data.

MTH 4-21a *Pg's 30 & 31*

By applying my understanding of probability, I can determine how many times I expect an event to occur, and use this information to make predictions, risk assessment, informed choices and decisions.

MNU 4-22a Pg 32

DATA & ANALYSIS AIM: Note: This pyramid appears across two pages

Display and interpret data using appropriate statistical diagram. Calculate the mean, median, mode and range of a data set.

MNU 4-20a, MTH 4-20b, MTH 4-21a

National 5 Link ~ Compare data sets using statistics.

- Semi-interquartile range
- Standard deviation

National 5 Link ~ Determine the equation of a best-fitting straight line on a scattergraph and use it to estimate/calculate *y* given *x* (or vice-versa).

Make a valid comparison between two or more sets of data and comment appropriately on the information displayed.

Interpret charts to find the mean, median, mode and range.

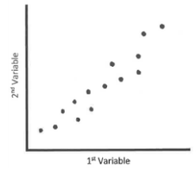
Numbers of Sports Played	Frequency	Number of Sports x Frequency	
0	20	0 x 20	= 0
1	17	1 x 17	= 17
2	15	2 x 15	= 30
3	10	3 x 10	= 30
4	9	4 x 9	= 36
5	3	5 x 3	= 15
6	2	6 x 2	= 12
TOTAL	76		140

Mean = 140 ÷ 76 = 2 sports (to the nearest whole)

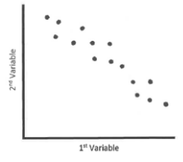
Interprets raw and graphical data.

Uses different types of charts to display discrete, continuous and grouped data appropriately.

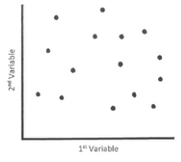
Use the terms positive/direct correlation and negative/indirect correlation.



Positive/direct correlation



Negative/indirect correlation



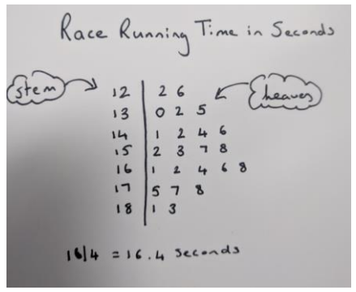
No correlation

Discuss and explain how using an alternative type of average could be misleading.

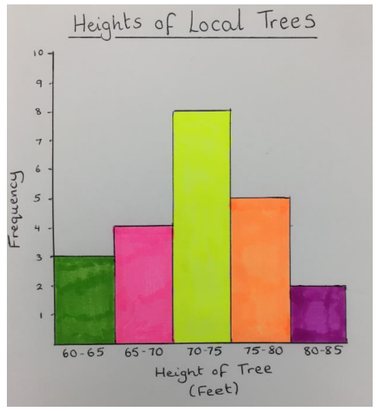
Justifies the most appropriate statistical diagram to display a given data set.

Calculates the mean, median, mode and range of a data set.

Selects the most appropriate statistical diagram to display a given data set, for example, stem and leaf.

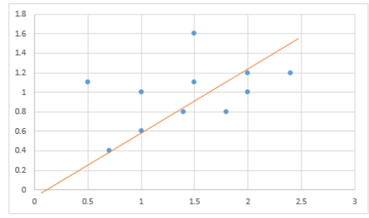


Create complex scales (including class intervals, fractions and percentages) on axes, to produce a wide range of graphs.

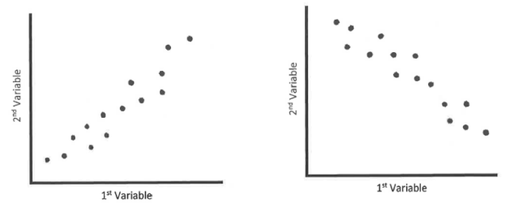


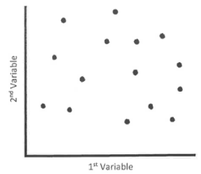
Uses statistical language, for example, correlations, to describe identified relationships.

Draw lines of best fit onto scatter graphs to investigate correlations between variables.



Investigate how scatter graphs can be used to show correlation between variables.





Understand that the average represents all the values within the data set.

Understand that an average must always be located between the extreme values.

Use Stem and leaf diagrams, frequency tables, line graphs, bar graphs, pie charts, box plots and scatter diagrams to display data.

Continue to explore the advantages and disadvantages of different statistical diagrams.

Continue to investigate ways of collecting and displaying data sets.

Explores the differences between different types of data (discrete and continuous).

Explore and discuss examples of graphs representing real-life scenarios between two variables.
e.g. water being poured into different shaped beakers.

Discuss statements regarding two variables and explain whether or not they are connected.
e.g. The air temperature and the number of ice-creams sold.

Explore spreads within data sets and discuss their meaning.

Explore averages and their meaning in different contexts.

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Technology should be used to support data display and analysis where appropriate.

IDEAS OF CHANCE & UNCERTAINTY AIM: Calculate probability of events, using these to make informed predictions about the expected occurrence of the event.

MNU 4-22a

Uses two-way tables to calculate probabilities of events.

	Blue Eyes	Not Blue Eyes
Fair Hair	32	3
Not Fair Hair	67	93

A person with fair hair is chosen at random. What is the probability that they do not have blue eyes?

Applies knowledge of skills in calculating probability to make predictions.

e.g.

Chocolate Cream Pies	1
Blackberry Pies	1
Apple Pies	1
Coconut Cream Pies	6
Pumpkin Pies	3

Regan's Pie Shop recorded how many pies they recently sold in each flavour.
Considering the data, how many of the next 14 pies sold would you expect to be coconut cream pies?

Calculates the probability and determines the expected occurrence of an event.

e.g. If you rolled a fair die 45 times on how many occasions would expect to roll a 3 or 4?

Calculates the probability of independent and dependent events.

e.g. A bag contains 4 red balls, 5 blue balls and 5 yellow balls.
(a) Find the probability of pulling out a blue ball at random.
(b) A blue ball is pulled from the bag and not replaced. What is the probability of pulling out a yellow ball next?

Can identify and knows the difference between independent and dependent events.

Independent - The probability of one event happening isn't influenced by the outcome of another. E.g. pulling coloured balls from a bag and replacing afterwards. Probability of getting a blue ball next time has not changed from first time.

Dependent - Is the opposite. If the outcome of one event influences the probability of the other they aren't independent. E.g. pulling coloured balls from a bag and not replacing afterwards. Probability of pulling a certain colour

Calculate and use the probabilities of opposite, mutually exclusive and overlapping events while displaying an understanding of the meaning of the numerical value of these probabilities.

e.g. The probability of rolling a 2 on a dice is 1/6. What is the probability of not throwing a 2?

Calculate and use probability of simple events while displaying an understanding of the meaning of the numerical value of the probability.

Calculates both theoretical and experimental probability and can explain why there may be a difference between these.

Explore, compare and discuss the differences between theoretical and experimental probabilities by carrying out practical experiments.

Fourth Level Overview * *The numeracy learner statements that are the responsibility of all are shown in bold and italics.*

Key Aspect	Experiences and Outcomes	National Benchmarks
Data and Analysis Pg's 30 & 31	***I can evaluate and interpret raw and graphical data using a variety of methods, comment on relationships I observe within the data and communicate my findings to others.*** *MNU 4-20a* In order to compare numerical information in real-life contexts, I can find the mean, median, mode and range of sets of numbers, decide which type of average is most appropriate to use and discuss how using an alternative type of average could be misleading. MTH 4-20b	• ***Interprets raw and graphical data.*** • ***Uses statistical language, for example, correlations, to describe identified relationships.*** • Calculates the mean, median, mode and range of a data set. • Selects the most appropriate statistical diagram to display a given data set, for example, stem and leaf. • Justifies the most appropriate statistical diagram to display a given data set. • Uses different types of charts to display discrete, continuous and grouped data appropriately.

Key Aspect	Experiences and Outcomes	National Benchmarks
	I can select appropriately from a wide range of tables, charts, diagrams and graphs when displaying discrete, continuous or grouped data, clearly communicating the significant features of the data. **MTH 4-21a**	
Ideas of Chance and Uncertainty Pg 32	***By applying my understanding of probability, I can determine how many times I expect an event to occur, and use this information to make predictions, risk assessment, informed choices and decisions.*** ***MNU 4-22a***	• ***Calculates the probability and determines the expected occurrence of an event.*** • ***Applies knowledge and skills in calculating probability to make predictions.***

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