Tables and Probability

Year 8

#MathsEveryoneCan

White Rose Maths

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Autumn	**Proportional Reasoning**						**Representations**					
	Ratio and scale		Multiplicative change		Multiplying and dividing fractions		Working in the Cartesian plane			Representing data		Tables & Probability
Spring	**Algebraic techniques**						**Developing Number**					
	Brackets, equations and inequalities				Sequences	Indices	Fractions and percentages		Standard index form		Number sense	
Summer	**Developing Geometry**						**Reasoning with Data**					
	Angles in parallel lines and polygons		Area of trapezia and circles		Line symmetry and reflection		The data handling cycle				Measures of location	

Autumn 2: Representations

Weeks 1 to 3: Working in the Cartesian Plane

Building on their knowledge of coordinates from KS2, students will look formally at algebraic rules for straight lines, starting with lines parallel to the axes and moving on to the more general form. They can explore the notions of gradient and intercepts, but the focus at this stage is using the equations to produce lines rather than interpretation of m and c from a given equation; this will be covered in Year 9. Use of technology to illustrate graphs should be embedded. Appreciating the similarities and differences between sequences, lists of coordinates and lines is another key point. Students following the higher strand may also explore non-linear graphs and mid-points of line segments.
National curriculum content covered:

- move freely between different numerical, algebraic, graphical and diagrammatic representations
- develop algebraic and graphical fluency, including understanding linear (and simple quadratic) functions
- make connections between number relationships, and their algebraic and graphical representations
- substitute numerical values into formulae and expressions
- recognise, sketch and produce graphs of linear functions of one variable with appropriate scaling, using equations in x and y and the Cartesian plane

Weeks 4 and 5: Representing Data

Students are introduced formally to bivariate data and the idea of linear correlation. They extend their knowledge of graphs and charts from Key Stage 2 to deal with both discrete and continuous data.

National curriculum content covered:
describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, continuous and grouped data

- construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data
- describe simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts and illustrate using scatter graphs
- use language and properties precisely to analyse probability and statistics

Week 6: Tables and Probability

Building on from the Year 7 unit, this short block reminds students of the ideas of probability, in particular looking at sample spaces and the use of tables to represent these.
National curriculum content covered:

- record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale
- generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities
- use language and properties precisely to analyse probability and statistics

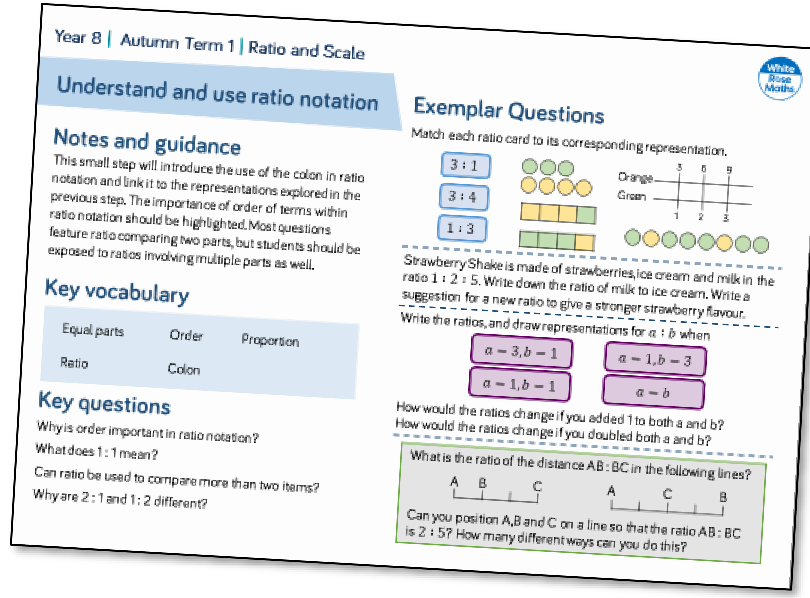
Why Small Steps?

We know that breaking the curriculum down into small manageable steps should help students to understand concepts better. Too often, we have noticed that teachers will try and cover too many concepts at once and this can lead to cognitive overload. We believe it is better to follow a "small steps" approach.

As a result, for each block of content in the scheme of learning we will provide a "small step" breakdown. ***It is not the intention that each small step should last a lesson – some will be a short step within a lesson, some will take longer than a lesson.*** We would encourage teachers to spend the appropriate amount of time on each step for their group, and to teach some of the steps alongside each other if necessary.

What We Provide

- Some ***brief guidance*** notes to help identify key teaching and learning points
- A list of ***key vocabulary*** that we would expect teachers to draw to students' attention when teaching the small step,
- A series of ***key questions*** to incorporate in lessons to aid mathematical thinking.
- A set of questions to help ***exemplify*** the small step concept that needs to be focussed on.



Year 8 | Autumn Term 1 | Ratio and Scale

Understand and use ratio notation

Notes and guidance

This small step will introduce the use of the colon in ratio notation and link it to the representations explored in the previous step. The importance of order of terms within ratio notation should be highlighted. Most questions feature ratio comparing two parts, but students should be exposed to ratios involving multiple parts as well.

Key vocabulary

Equal parts, Order, Proportion, Ratio, Colon

Key questions

Why is order important in ratio notation?
What does 1 : 1 mean?
Can ratio be used to compare more than two items?
Why are 2 : 1 and 1 : 2 different?

Exemplar Questions

Match each ratio card to its corresponding representation.

3 : 1
3 : 4
1 : 3

Strawberry Shake is made of strawberries, ice cream and milk in the ratio 1 : 2 : 5. Write down the ratio of milk to ice cream. Write a suggestion for a new ratio to give a stronger strawberry flavour.

Write the ratios, and draw representations for $a : b$ when

$a = 3, b = 1$
$a = 1, b = 3$
$a = 1, b = 1$
$a = b$

How would the ratios change if you added 1 to both a and b?
How would the ratios change if you doubled both a and b?

What is the ratio of the distance AB : BC in the following lines?

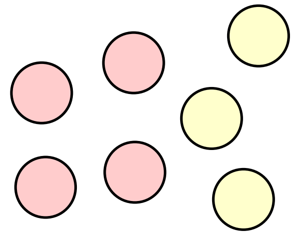
Can you position A, B and C on a line so that the ratio AB : BC is 2 : 5? How many different ways can you do this?

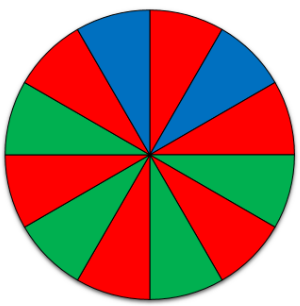
- These include reasoning and problem-solving questions that are fully integrated into the scheme of learning. Depending on the attainment of your students, you many wish to use some or all of these exemplars, which are in approximate order of difficulty. Particularly challenging questions are indicated with the symbol .
- For each block, we also provide ideas for key representations that will be useful for all students.

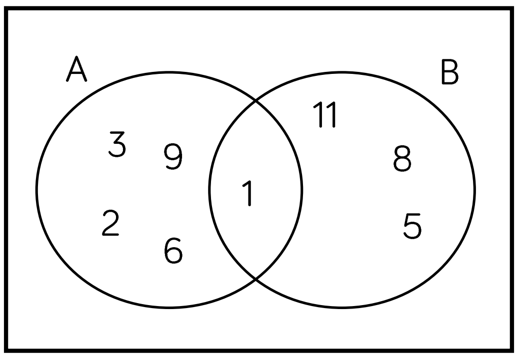
In many of the blocks of material, some of the small steps are in **bold**. These are content aimed at higher attaining students, but we would encourage teachers to use these with as many students as possible – if you feel your class can access any particular small step, then please include it in your planning.

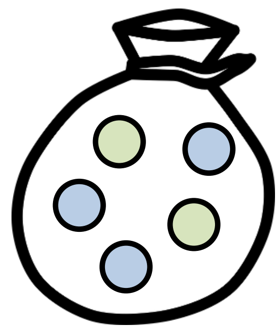
Key Representations

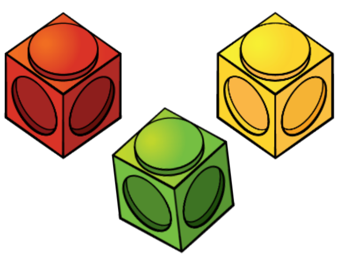
	Boys	Girls	Total
Year 8			
Year 9			
Total			

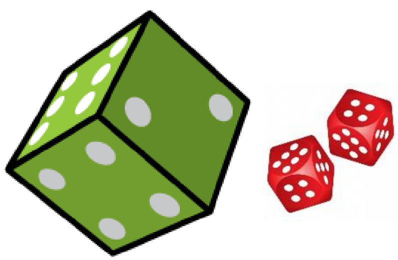












	H	T
H	HH	HT
T	TH	TT

Concrete, pictorial and abstract representations are an important part of developing students' conceptual understanding.

Here are a few examples of both concrete manipulatives and pictorial representations you may use to aid understanding with students in your classroom.

Manipulatives such as cubes, counters and spinners can be used to demonstrate events, outcomes and associated probabilities.

Pictorial representations including two-way tables and venn diagrams are key in modelling how to organise information to ensure that all possible outcomes are listed.

Tables and Probability

Small Steps

- Construct sample spaces for 1 or more events
- Find probabilities from a sample space
- Find probabilities from two-way tables
- Find probabilities from Venn diagrams
- **Use the product rule for finding the total number of possible outcomes** H

H denotes higher strand and not necessarily content for Higher Tier GCSE

Constructing sample spaces

Notes and guidance

In Year 7 students were introduced to the concept of an experiment, event and outcome. Building on this knowledge, students now consider sample spaces, listing all possible outcomes in an experiment. Sample spaces are usually denoted by the letter S and can be written using set notation, { }. Emphasis should be placed on a systematic approach to listing all possible outcomes.

Key vocabulary

Outcomes	Sample space	Set
Probability	Systematic	Chance

Key questions

What is a sample space and how can you ensure you have listed all possible outcomes in your sample space?

Why is being systematic important when listing outcomes?

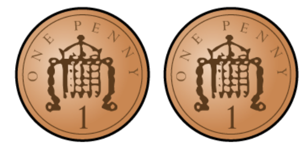
How can you determine what method or type of sample space diagram to use?

Exemplar Questions

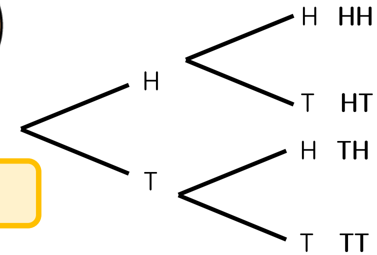
Two coins are flipped at the same time. Compare and contrast what is the same and what is different about the representations below?

	H	T
H	HH	HT
T	TH	TT

$S = \{TT, TH, HT, HH\}$

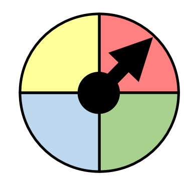


HH, HT, TH, TT



A spinner is spun and a fair die is rolled at the same time. Complete the table listing all the possible outcomes.

	1	2	3	4	5	6
R	1R					
G		2G				
B						
Y						6Y



Eva is working out all the possible combinations she can have for her lunch. Continue listing all her combinations.

Meal Deal £2
Drink: *Water or Juice*
Sandwich: *Tuna, Cheese or Ham*
Fruit: *Apple or Banana*

Drink	Sandwich	Fruit
W	T	A

Probability from sample space

Notes and guidance

Students build on their understanding of creating sample spaces by working out probabilities of events. There is introduction of the notation P(event), articulated as the probability of an event happening. It is important to emphasis the different ways probabilities can be represented and to consider when events are and are not equally likely.

Key vocabulary

Sample space	Probability	Event
Equally likely	Unbiased	P(event)

Key questions

What does P(event) mean?
Is it possible to write a probability as 'out of' or as a ratio? Why not?
What are the equivalent different ways of writing a probability?
Can probabilities be simplified? Why/Why not?

Exemplar Questions

Two dice are thrown. Mo thinks that the probability of getting 2 sixes must be $\frac{2}{12}$

Mo is wrong.
Explain why.

Continue completing the table for rolling two regular dice and adding the numbers together.

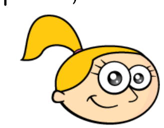
+	1	2	3	4	5	6
1	2	3				7
2						
3						
4						
5						
6						

Work out,
- P(total is even)
- P(6 or 7)
- P(Number>4)
- P(0)
- P(prime number)
- P(square number)

These probabilities should be out of 36 as that's the total.

Eva has worked out all the possible outcomes when flipping two coins. Check her sample space, is she correct? Why/Why not?

$S = \{TT, TH, HH\}$



Why Eva is incorrect? Justify your answer.

Probability from two-way tables

Notes and guidance

This step focuses on using data in two-way tables to find probabilities.

Students should be given guidance on which total to use when answering questions including discussion around how probabilities can be represented e.g. whether it is appropriate to simplify fractions.

Key vocabulary

Two-way table	Probability
Sample	Denominator

Key questions

How can a two-way table be used to calculate a probability?

How do you decide which row or column to look at?

How do you design a two-way table?

Exemplar Questions

Dora

The probability a Year 8 student has a school dinner is $\frac{18}{49}$

Whitney

No! The probability a Year 8 student has a school dinner is $\frac{18}{100}$

Complete the table and decide whether you agree with Whitney or Dora.

What is the probability that a year 9 student has a packed lunch?

	Year 8	Year 9	Total
School Dinner		26	44
Packed Lunch	31		56
Total		51	

The following table shows how 200 children travelled to school.

	Car	Bus	Walk	Total
Boys	36	46	21	103
Girls	44	29	24	97
Total	80	75	45	200

Work out the probability that a child travels to school by car.
Calculate the probability that a girl walks to school.

- Females are more likely to own a cat than males.
- The probability that a person has a dog or a cat is $\frac{1}{2}$

Construct your own two way table to represent this information.

Probability from Venn diagrams

Notes and guidance

Students build on the link between interpreting Venn diagrams and finding probabilities. They should be familiar with drawing and interpreting Venn diagrams from Year 7 but may need reminding. They should be encouraged to consider which region or regions are included in the event described and which regions are not included.

Key vocabulary

Set	Intersection	Event
And/Or	Union	Region

Key questions

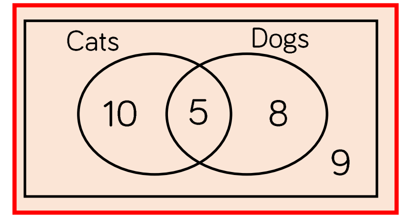
How do the words 'and/or' relate to set notation and regions on a Venn diagram?

Why do we start with the intersection of sets when adding information to a Venn diagram?

Exemplar Questions

The Venn diagram shows how many students in a class own cats, dogs or both. A student is picked at random from the class. Find:

- P(They own a cat but not a dog)
- P(They own a cat)
- P(They own a dog)
- P(They do not own a dog)
- P(They own both a cat and a dog)
- P(They own neither a cat nor a dog)



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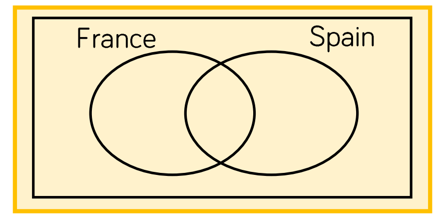
100 people were surveyed about countries they had visited.
30 had visited France, 25 had visited Spain and 12 had visited both France and Spain. Use a Venn diagram to show this information. One person is chosen from the survey to win a prize.
Find the probability the winner had visited neither France nor Spain.



In a group of 45 people, 15 belong to a cricket club, 18 belong to a tennis club and 9 belong to both a cricket and a tennis club.
Draw a Venn diagram to represent this information.
A person is chosen at random from this group.
Find the probability that this person:

- belongs to a cricket and a tennis club
- belongs to a cricket or tennis club
- does not belong to a cricket club
- does not belong to either a cricket or a tennis club
- belongs to a tennis club but not a cricket club.

Product rule & total outcomes H

Notes and guidance

Students are introduced to the product rule to find total arrangements. Students start by considering how many choices they have for each place in their list. They need to consider situations where repeats are or are not allowed. Students could also experience opportunities of designing lists given the number of possible arrangements.

Key vocabulary

Total	Possibilities	Outcomes
Product	Table	Order

Key questions

How can you find the total number of arrangements without listing each one?

Is commutativity important when working out the total number of arrangements? Why/Why not?

How can factors help when finding lists that have a specified number of arrangements?

Exemplar Questions

Eva is trying to work out all the different arrangements you can have when buying her meal deal. Comment on her calculation.

Meal Deal £2
Drink: *Water or Juice*
Sandwich: *Tuna, Cheese or Ham*
Fruit: *Apple or Banana*

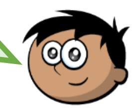
$2 \times 3 \times 2 =$
12 Possibilities

In how many different ways can you order the letters C, D, E and F? List all the possible orders.

Dora

$4 \times 4 = 16$
There are 16 possibilities

$4 \times 3 \times 2 \times 1 = 24$
There are 24 possibilities



Amir

Who is right, Dora or Amir? Why?

Here is a set of 5 cards. How many different arrangements are there which include all 5 cards? What strategy did you use to work this out?

A	B	C	1	2

Alex is opening a café. She wants to give her customers 20 possibilities when buying a meal deal.
Write down a meal deal menu that she could use.
Compare you answers as a class.
What's the same and what's different about your menus?