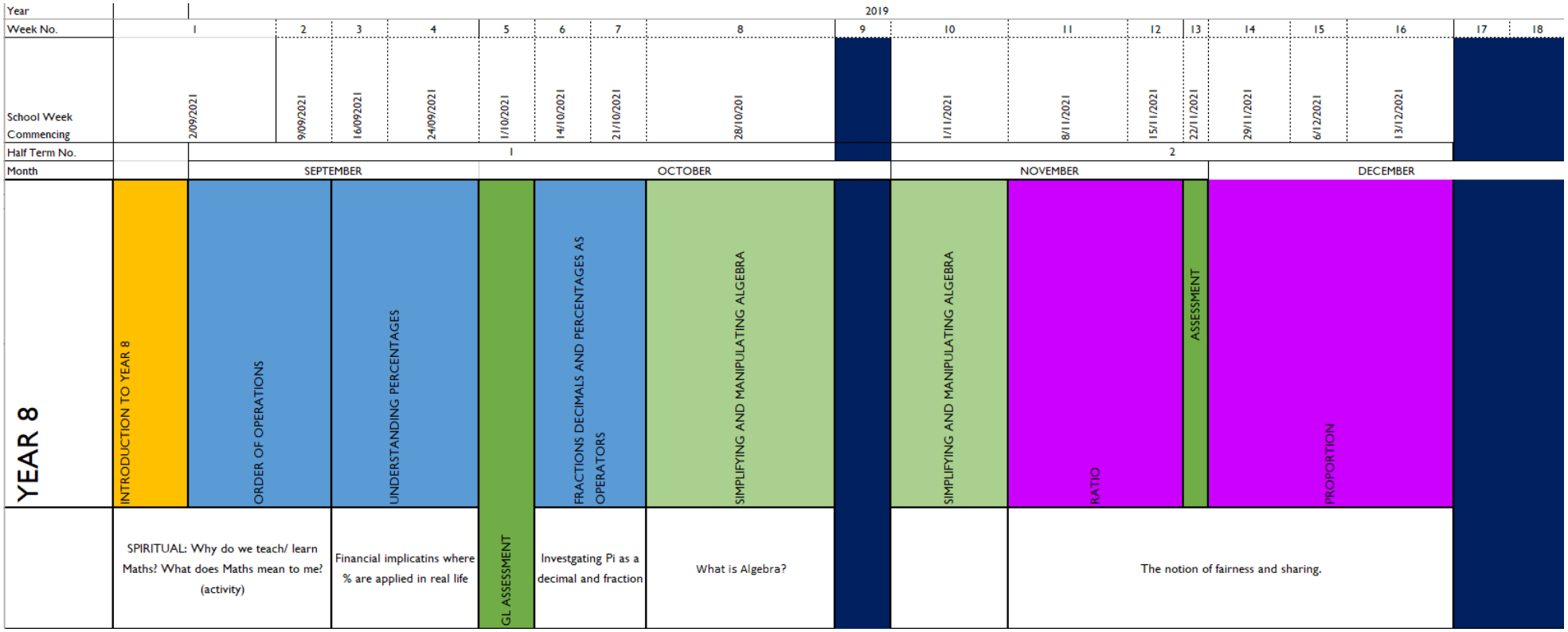
D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Year 8 Handbook 2021-2022

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Autumn Term



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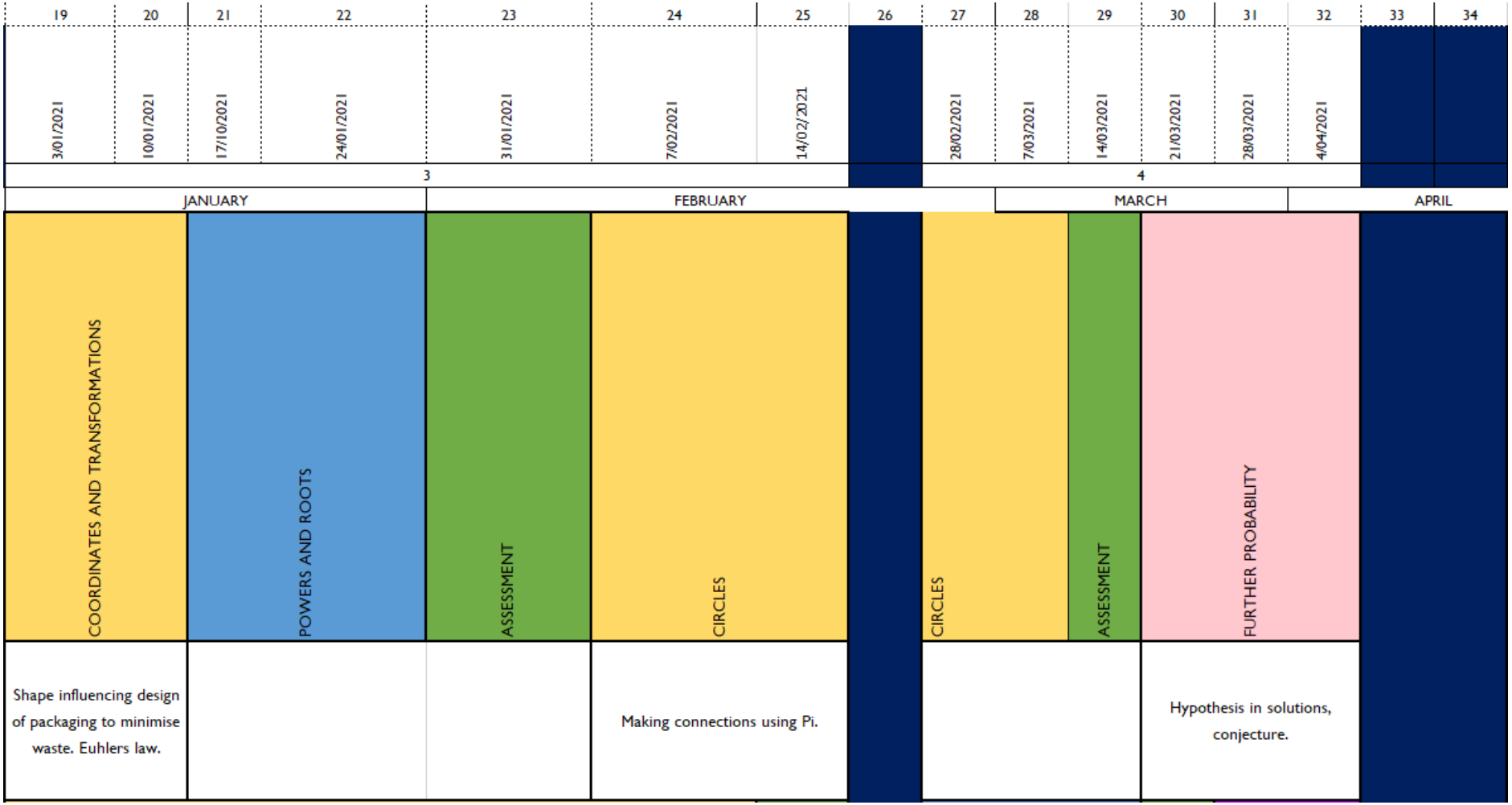
Spring Term



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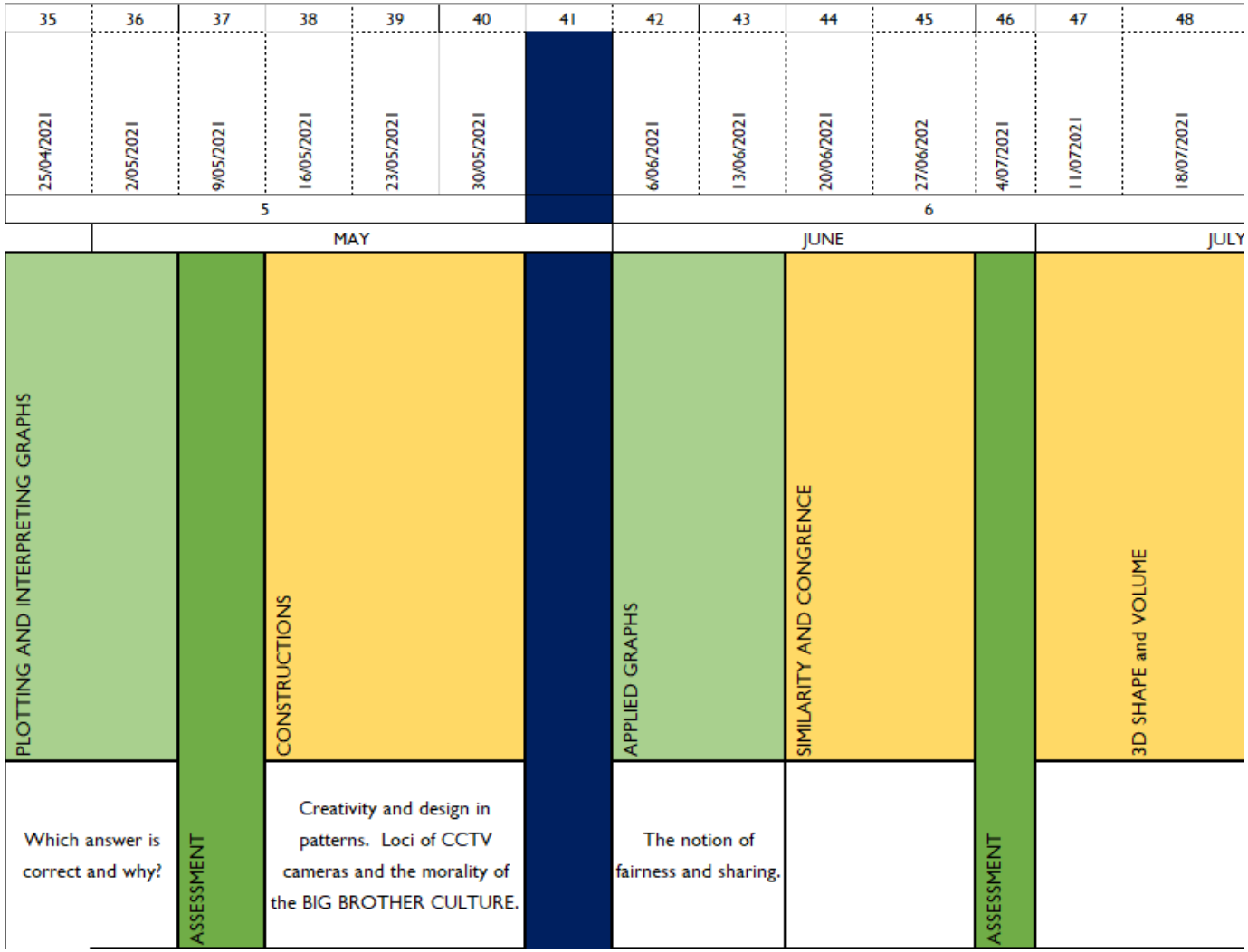
Summer Term

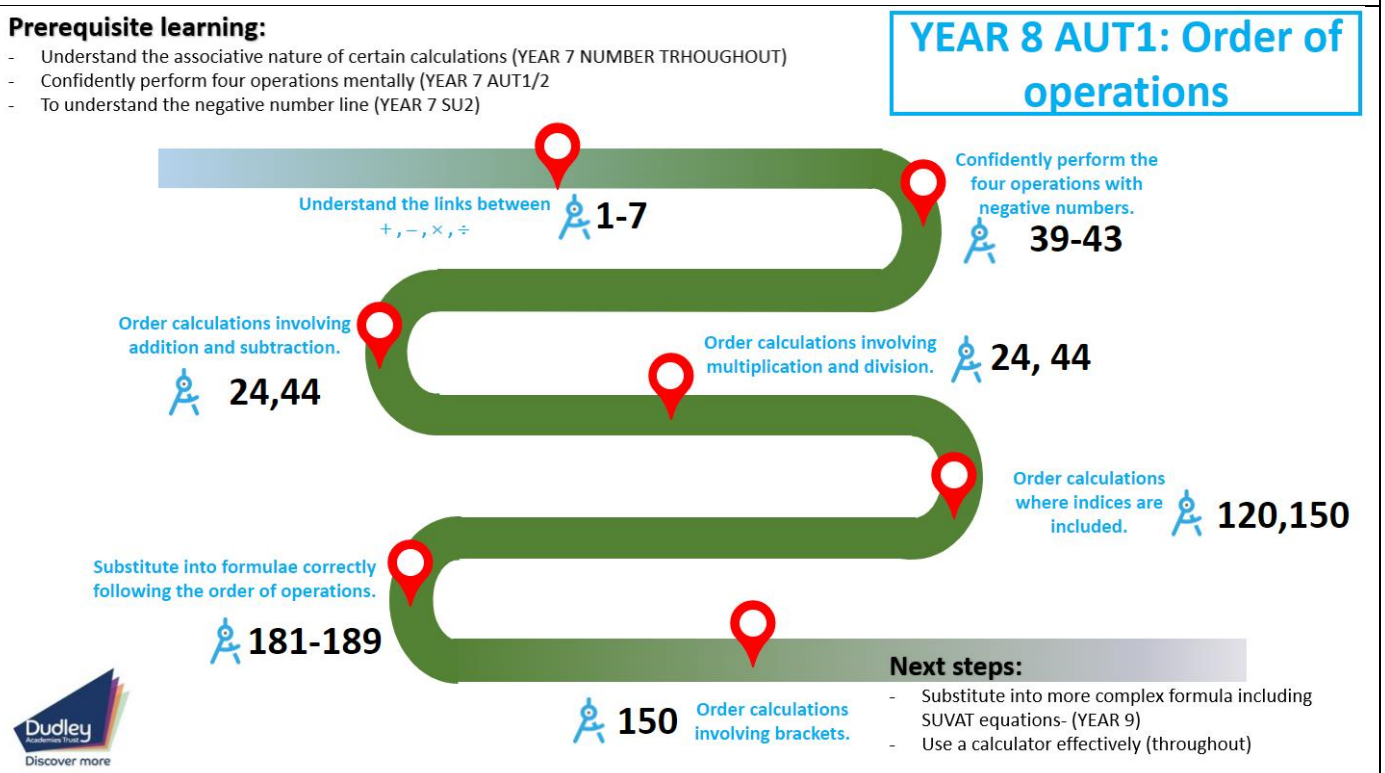


D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.1 Order of Operations (Unit 5)

Objectives

5a	Understand the links between the four operations, +, -, ×, ÷. Know that addition and multiplication are commutative (D)
5b	Confidently perform the four operations with negative numbers (D,P)
5c	Order calculations involving add and subtract only (D,P)
5d	Order calculations involving multiply and divide only (D,P)
5e	Order calculations involving all four operations (D,P)
5f	Order calculations when indices are included (D,P)
5g	Order calculations involving brackets (D,P)
5h	Can add brackets to a calculation in order the change the outcome (D,P)
5i	Substitute into a given formula correctly following the order of operations (D,P)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Order, negative, operation, substitute, indices, formulae
Commutative

PREQUISITE KNOWLEDGE

- Multiplication up to 12 x 12 without a calculator.
- Square numbers from 1 to 12 without a calculator, up to 15 with a calculator.
- Negative number line.
- Perform four operations mentally.

GREATER DEPTH EXEMPLIFICATION

- Identifying where brackets must go to make a sum correct.
- Identifying the correct answer and reasoning from two options, using BIDMAS.
- Substituting into more complex formulae, including SUVAT equations.

COMMON MISCONCEPTIONS:

- Learners think there are certain 'BIDMAS' questions rather than that the order of operations needs to be correctly applied in all calculations.
- Writing or saying subtraction statements in reverse such as 150 – 210 = 60
- Confusion around half remembered rules "minus and a minus makes a plus" or used in incorrect context.
- Misconceptions around blanket use of the word minus. Use of subtract and negative instead can help.
- Learners instinctively read calculations from left to right.
- Addition and subtraction – learners think as A is first in BIDMAS, addition must come first. Stress commutativity, same level operations and in these cases we read LEFT TO RIGHT.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Tim says, if a is 5 then 3+4×a would be 35. Is Tim correct? If not what mistake has he made and can you correct it?
- Graeme and John are working out the value of 3y2 if y=3. Graeme says its 81

MASTERY PEDAGOGY

- Incrementally more difficult questions building up the levels of 'BIDMAS' required
- Include operations on fractions, decimals, negatives and zero
- Include teaching of non-examples i.e where order of operations is left to right

RESOURCES TO SUPPORT LEARNING:

- Laminated multiplication grid.
- Double sided counters for operations resulting in negative answers.

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

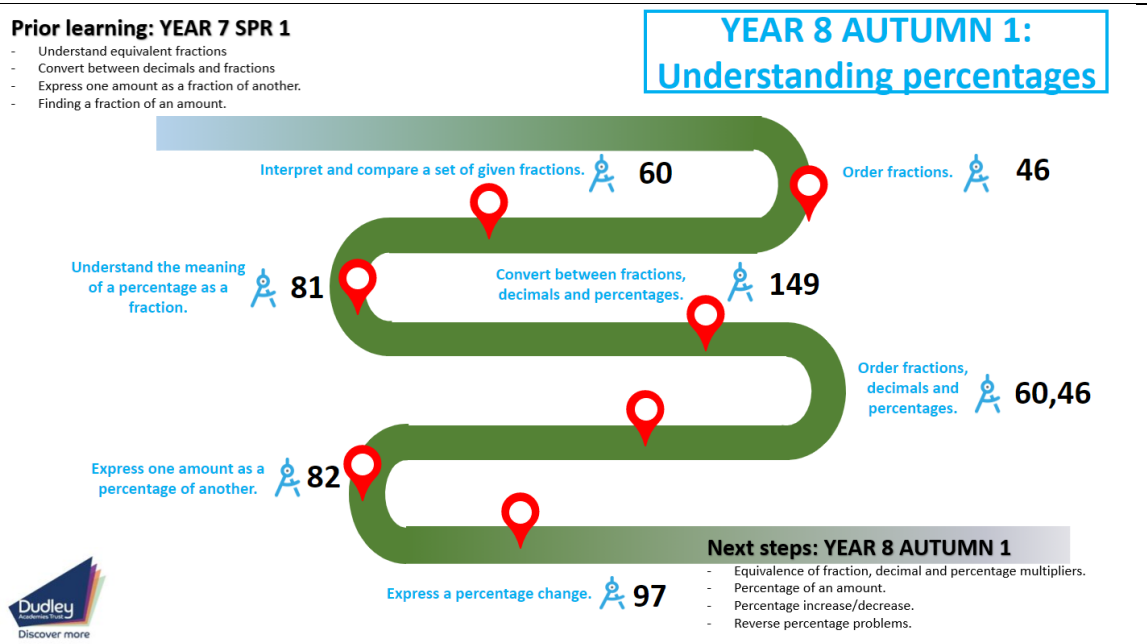
and John says its 27. Who is correct and why? ▪ Where could you put the brackets to make the answer correct: 4 + 2 2 × 2 = 72 ▪ Jade and Carl were substituting into the formula: $x^2 - \frac{y}{z}$ With the values x=-4, y=5.1 and z=7.25. Jade gets -16.7 (1dp) and Carl gets 15.3 (1dp). Who do you think is correct? Find the mistake that has been made by the other person.	▪ Frayer Model – examples and non-examples **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** ▪ Substitution into formulae (page 4 of Maths in Science Factsheet)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.2 Understanding Percentages (Unit 1)

Objectives

1a	Interpret and compare a set of given fractions. Can use $<$, $\leq$, $>$, $\geq$, $=$ and $\neq$ (D,P)
1b	Interpret and order a list of fractions and decimals. Confidently convert between the two (D,P)
1c	Understand the meaning of a percentage as a fraction out of 100 (D,P)
1d	Convert between fractions decimals and percentages (D,P,C)
1e	Order a mixed list of fractions, decimals and percentages by converting (D,P,C)
1f	Express a decimal > 1 as a Percentage (D,P,C)
1g	Express one amount as a percentage of another (D,P,C)
1h	Express a change as a percentage (D,P,C)



Essential Language

Equivalent, order, fraction, decimal, percentage, convert

Inequality, comparative

PREQUISITE KNOWLEDGE	COMMON MISCONCEPTIONS:
	▪ Stress the importance of knowing multiplication tables to aid fluency

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

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- Understand equivalent fractions.
- Decimal/fraction conversion.
- Express one amount as a fraction of another.
- Finding a fraction of an amount.

GREATER DEPTH EXEMPLIFICATION

- Equivalence of fraction, decimal and percentage multipliers.
- Percentage increase and decrease.
- Reverse percentages.

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- Incorrect links between fractions and decimals, such as thinking that $\frac{1}{5}$ = 0.15, 5% = 0.5, 4% = 0.4 0.2 = ½, etc.
- Understanding of relative place value when converting decimals eg 0.02 =20%
- Learners think it is not possible to have a percentage greater than 100%.
- Emphasise that to find an amount after an increase by 30%, we should NOT multiply by 0.7 as the original amount was NOT 70%. Original amount is always 100%, so an increase of 30% results in 130%.

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OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- "An amount is increased by 30% to give x. Tom says that to find the original amount, we should multiply x by 0.7. Is Tom correct? Explain your answer."
- 30% of what amount would give you 24.
- What percentage of 20 is 4?
- A sailing club has 200 members. 58% are male and 50% of the female members are children. How many adults were male, how many were female. How many children were there children?
- Heather says that if she increases £40 by 20% then by 10%, this would be different to increasing £40 by 10% then by 20%.
- The price of a jumper is reduced by 10% in a sale so that its new price is £54. What was its original price?

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MASTERY PEDAGOGY

- Frayer Model – examples and non-examples.
- 100 grid, percentage meaning per cent, per 100.
- Bar Modelling to find percentage as a fraction of 100

RESOURCES TO SUPPORT LEARNING:

- Laminated multiplication grid.
- 100 grid to support LA learners with decrease questions (i.e. if we decrease by 30%, what are we left with?)
- Use of manipulatives to represent FDP
- Grids/Pie charts to shade

TRANSFERABLE SKILLS- Content in other context
SCIENCE

- Percentage change – concentration of solutions (page 5, maths in science factsheet)
- Rounding, link to Maths in Science Rounding Document

GEOGRAPHY

- Converting between FDP (Page 33-36 of Maths in Geography document.)
- Rounding, link to Maths in Geography Document, (pages 52 to 54)

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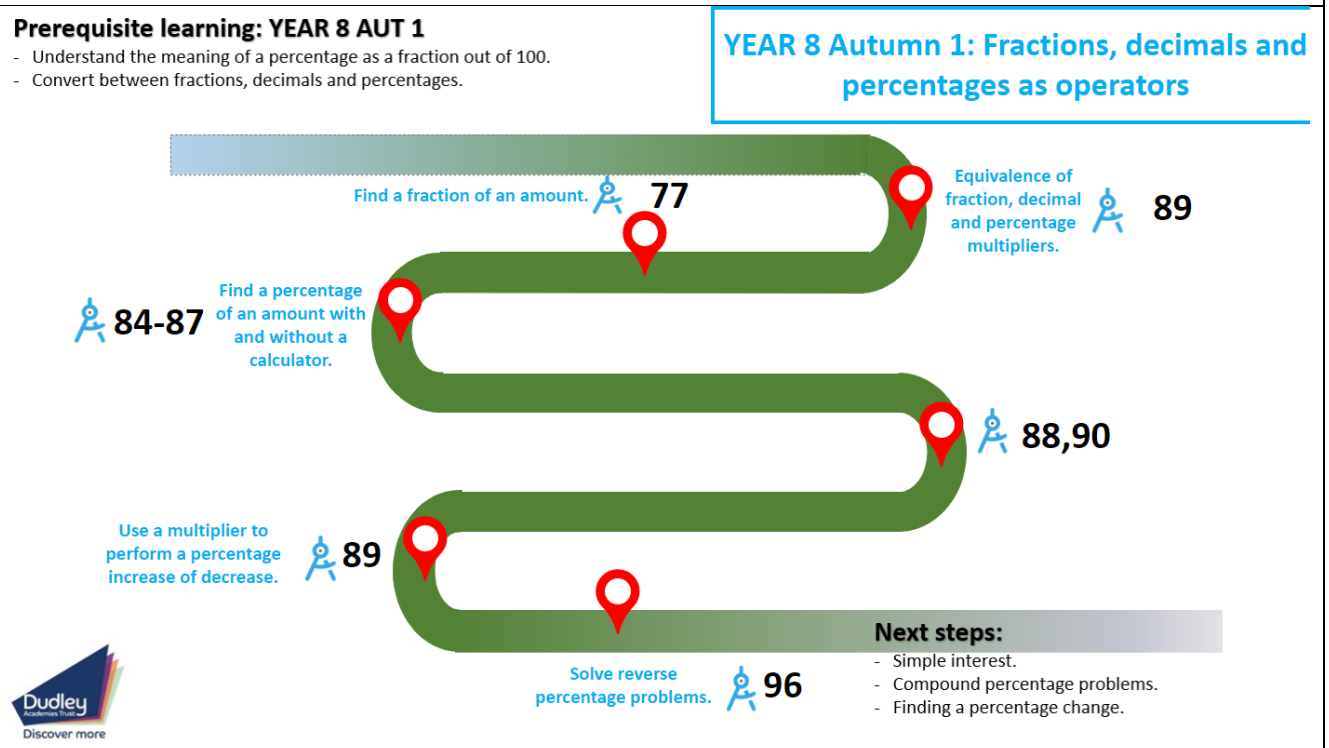
D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Fractions and Percentages as Operators (Unit 2)

Objectives

2a	Find a fraction of an amount (D,P,C)
2b	Equivalence of Fraction, Decimal and Percentage multipliers (D,P)
2c	Find a percentage of an amount without a calculator (D,P,C)
2d	Find a percentage of an amount with a calculator (D,P,C)
2e	Calculate a percentage increase and decrease by adding or subtracting (D,P,C)
2f	Use a single multiplier to perform a percentage increase or decrease (D,P,C)
2g	Solve reverse percentage problems (D,P,C)



Essential Language

Amount, fraction, decimal, percentage, change, multiplier

Reverse, compound, interest

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

PREQUISITE KNOWLEDGE ▪ FDP conversion. ▪ Percentage as a fraction out of 100 **GREATER DEPTH EXEMPLIFICATION** ▪ Simple interest. ▪ Compound Interest. ▪ Finding a percentage change.	**COMMON MISCONCEPTIONS:** ▪ Stress the importance of knowing multiplication tables to aid fluency ▪ Incorrect links between fractions and decimals, such as thinking that $\frac{1}{5}$ = 0.15, 5% = 0.5, 4% = 0.4 0.2 = ½, etc. ▪ Understanding of relative place value when converting decimals eg 0.02 =20% ▪ Learners think it is not possible to have a percentage greater than 100%. ▪ Emphasise that to find an amount after an increase by 30%, we should NOT multiply by 0.7 as the original amount was NOT 70%. Original amount is always 100%, so an increase of 30% results in 130%.
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: ▪ Find the size of each category from a pie chart using fractions. ▪ How many different ways can you find of working out 68% of 340. ▪ 2/3 of a number is 30 what is the number? ▪ 30% of what amount would give you 24. ▪ What percentage of 20 is 4? ▪ A sailing club has 200 members. 58% are male and 50% of the female members are children. How many adults were male, how many were female. How many children were there children? ▪ Heather says that if she increases £40 by 20% then by 10%, this would be different to increasing £40 by 10% then by 20%.	**MASTERY PEDAGOGY** ▪ Frayer Model – examples and non-examples. ▪ 100 grid, percentage meaning per cent, per 100. **RESOURCES TO SUPPORT LEARNING:** ▪ Laminated multiplication grid. ▪ 100 grid to support LA learners with decrease questions (i.e. if we decrease by 30%, what are we left with?) ▪ Frayer Model – examples and non-examples, potential to use when studying percentage increases and decreases. ▪ **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** ▪ Percentage change – concentration of solutions (page 5, maths in science factsheet) ▪ Rounding, link to Maths in Science Rounding Document **GEOGRAPHY** ▪ Converting between FDP (Page 33-36 of Maths in Geography document.)

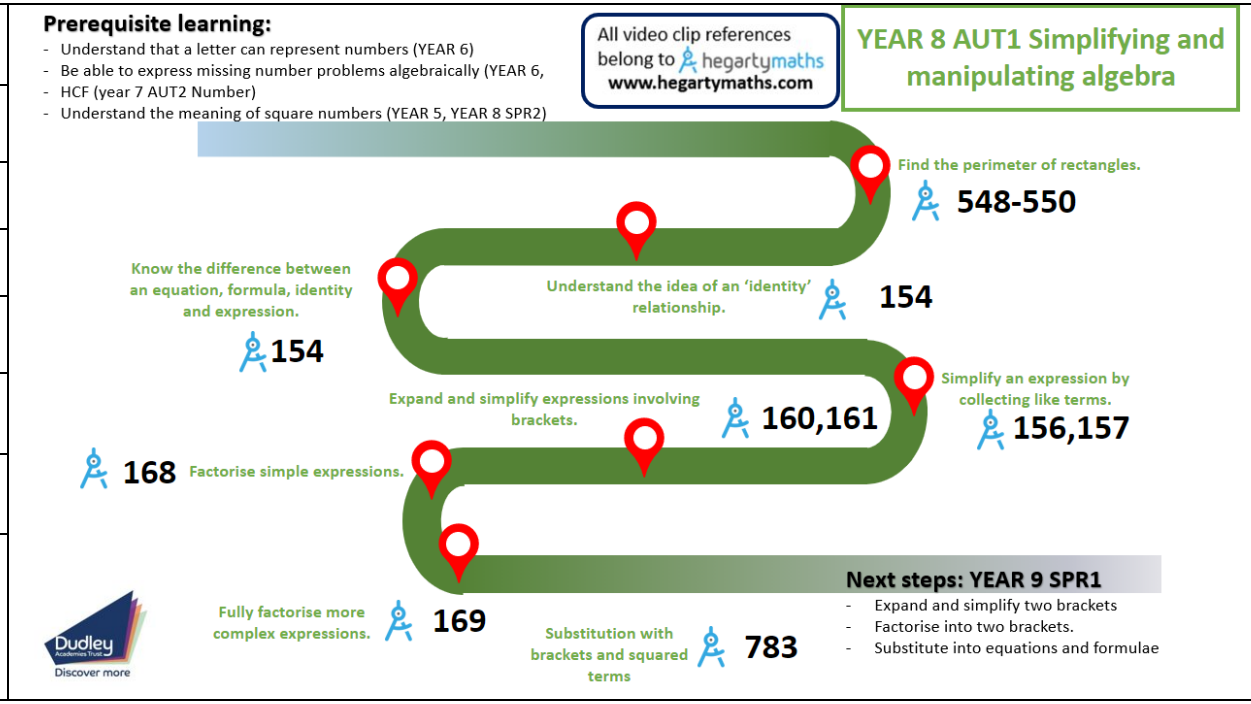
D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

▪ The price of a jumper is reduced by 10% in a sale so that its new price is £54. What was its original price?	▪ Rounding, link to Maths in Geography Document, (pages 52 to 54)

8.4 Simplifying and Manipulating Algebra (Unit 6)

Objectives

6a	Find the perimeter of a given rectangle in different ways (D,P)
6b	Understand the idea of an 'Identity' relationship. (D)
6c	Identify an equation, formula, identity or expression and understand the differences (D)
6d	Simplify an expression by collecting like terms (D,P)
6e	Expand and simplify expressions involving brackets (D,P)
6f	Factorise simple expressions into single brackets (D,P)
6g	Fully factorise a more complex expressions into a single bracket (D,P)
6h	Substitution in expressions with brackets and squared terms (D,P)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Expression, term, simplify, factorise, substitute, expand

PREQUISITE KNOWLEDGE

- A letter can represent a number.
- Multiplication tables, including square numbers.
- Be able to express missing number problems algebraically.
- HCF for factorising.

GREATER DEPTH EXEMPLIFICATION

- Factorising with powers.
- Factorise/expand quadratics.
- Forming from area/perimeter shapes.
- Substitution.

COMMON MISCONCEPTIONS:

- $3(x + 4) = 3x + 4$.
- The convention of not writing a coefficient with a single value, i.e. x instead of $1x$, may cause confusion.
- Some students may think that it is always true that $a = 1$, $b = 2$, $c = 3$.
- If $a = 2$ sometimes students interpret $3a$ as 32.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- An expression has simplified to $4x + 3y$, what could the expression have been? Can you find any solutions with negatives in?
- A pentagon has side $3x - y$, find an expression for the perimeter of the pentagon.
- A rectangle has width $2x$ and length $5x + 4$. Find expressions for its perimeter and area.
- A square has area $4y^2$, what is its perimeter.

MASTERY PEDAGOGY

- Frayer Model – examples and non-examples (e.g. Teach non-examples where terms can't be collected or can't be factorised)
- Bar modelling
- Manipulatives used to support expanding and factorising
- Pictorial representations of multiplicative algebraic expressions as areas and additive expressions as perimeters
- Include operations on positives, negatives, fractions, decimals and zero.

RESOURCES TO SUPPORT LEARNING:

- Laminated multiplication grid.
- Mathsbot – Mastery Tools, manipulatives

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

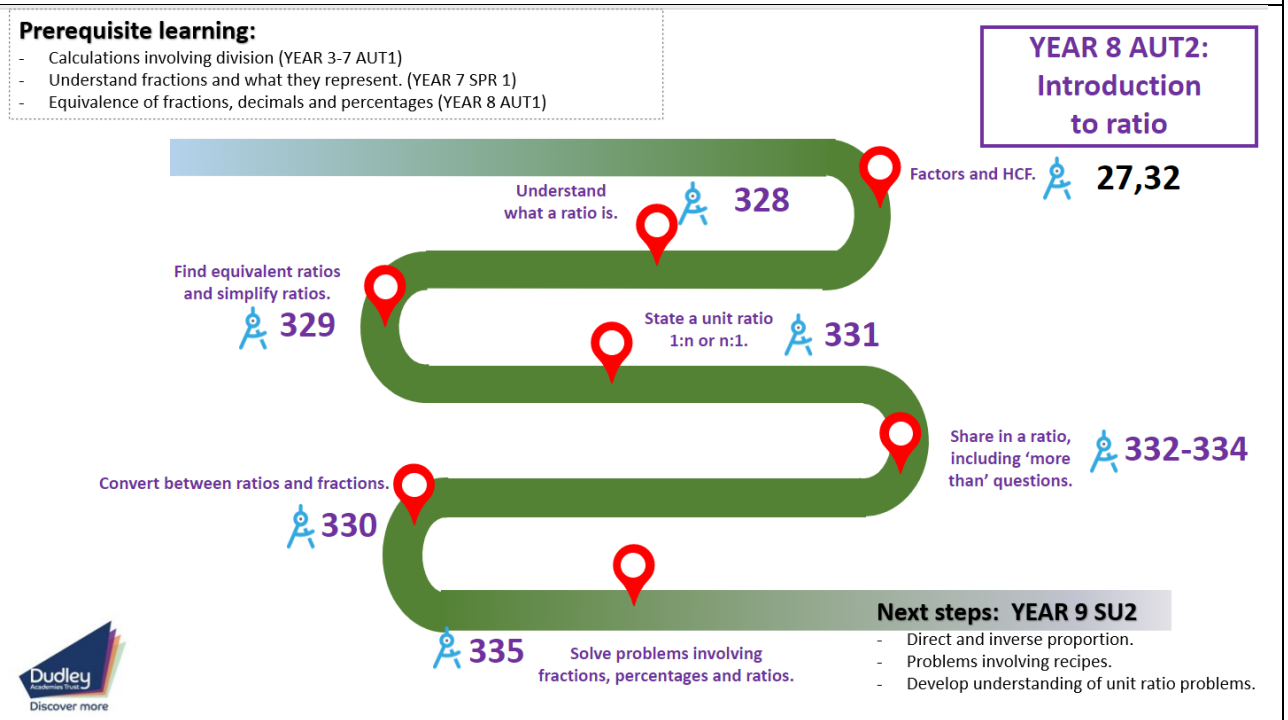
• A rectangle with dimensions 2y and 3y - 6 is cut from a larger rectangle with dimensions 4y + 1 and 3y + 2. Find an expression for the area of the shape left. • The width of a rectangle is 2x + 3. The ratio of the width to the length is 1:3. Find an expression for the perimeter of the shape. • Why is this not factorised 'fully' 8x+16 = 4(2x+4) • What is the common factor in $5x^3+20x^2$ • Jo says if you factorise $6x^2+6x$ you get 6x(x) because the 6x goes out of the bracket, is she correct?	**TRANSFERABLE SKILLS- Content in other context** **SCIENCE** ▪ Understand and use the symbols: =, <, <<, >>, >, ∝, ~ ▪ Substitute numerical values into algebraic equations using appropriate units for physical quantities (AQA Algebra in Science Document)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.5 Ratio (Unit 3)

Objectives

3a	Identify Factors of a number and the HCF of given numbers (D,P)
3b	Understand what a ratio is and express parts of a whole as a ratio (D,P)
3c	Find equivalent ratios (with two parts and with more than two parts) (D,P)
3d	Simplify a given ratio (with two parts and with multiple parts) (D,P)
3e	State a unit ratio 1:n or n:1 (D,P,C)
3f	Dividing a total in a given ratio (D,P,C)
3g	Sharing in a ratio when given one part (D,P,C)
3h	Sharing in a ratio when a difference is given (D,P,C)
3i	Can convert between ratios and fractions (D,P,C)
3j	Find parts when two linked ratios are given (D,P,C)
3k	Solve problems involving fractions percentages and ratios (D,P,C)



Essential Language

Ratio, total, share, difference, divide, fraction

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

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PREQUISITE KNOWLEDGE

- Fractions and what they represent
- Division calculations
- Fraction, decimal, percentage equivalence

GREATER DEPTH EXEMPLIFICATION

- Direct and inverse proportion.
- Calculations with recipes.
- Forming equations from ratio (e.g. if x:y is 2:3, write an equation for x in terms of y)

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COMMON MISCONCEPTIONS:

- Order for ratio is not important eg 3:2 = 2:3
- If ratio of Red to Blue is 2:3 then 2/3 are red.
- Using a ratio to find one quantity when the other is known often results in students 'sharing' the known amount.

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OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Gemma has £42, Glen has twice as much as Gemma and Rick has quarter of the amount Rick has. Write the ratio of the money they each have in its simplest form.
- The winnings from a competition are shared between 1st and 2nd place in the ratio 7:4. If the winner gets £15 more than the person who came 2nd, how much was the total prize pot and how much did they each get?
- Combining simple ratios - a:b is 5:4 and b:c is 3:1 what is the ratio a:b:c in its simplest form?
- Ann and Bob shared some money in the ratio 3 : 5. Ann gave a 50% of her share to Colin. Bob gave 1/10 of his share to Colin. Express the money Ann, Bob and Colin each received as a single ratio in its simplest form.

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MASTERY PEDAGOGY

- Concrete: counters/cubes used to introduce concept of ratio, simplifying ratios and linking ratios to fractions
- Incrementally more difficult questions on simplifying and sharing in ratio
- Bar modelling diagrams used to share in a ratio
- Combine Fractions, Decimals, Percentages and Ratio into longer problems
- Emphasise similarities

RESOURCES TO SUPPORT LEARNING:

- Laminated multiplication grid.
- Mastery resources listed above.

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Simple ratios e.g. in balancing equations, phenotype ratios (Maths in Science Factsheet)
- Rounding, link to Maths in Science Rounding Document

GEOGRAPHY

- Ratio and proportion (Page 36-38 of Maths in Geography document.)
- Rounding, link to Maths in Geography Document, (pages 52 to 54)

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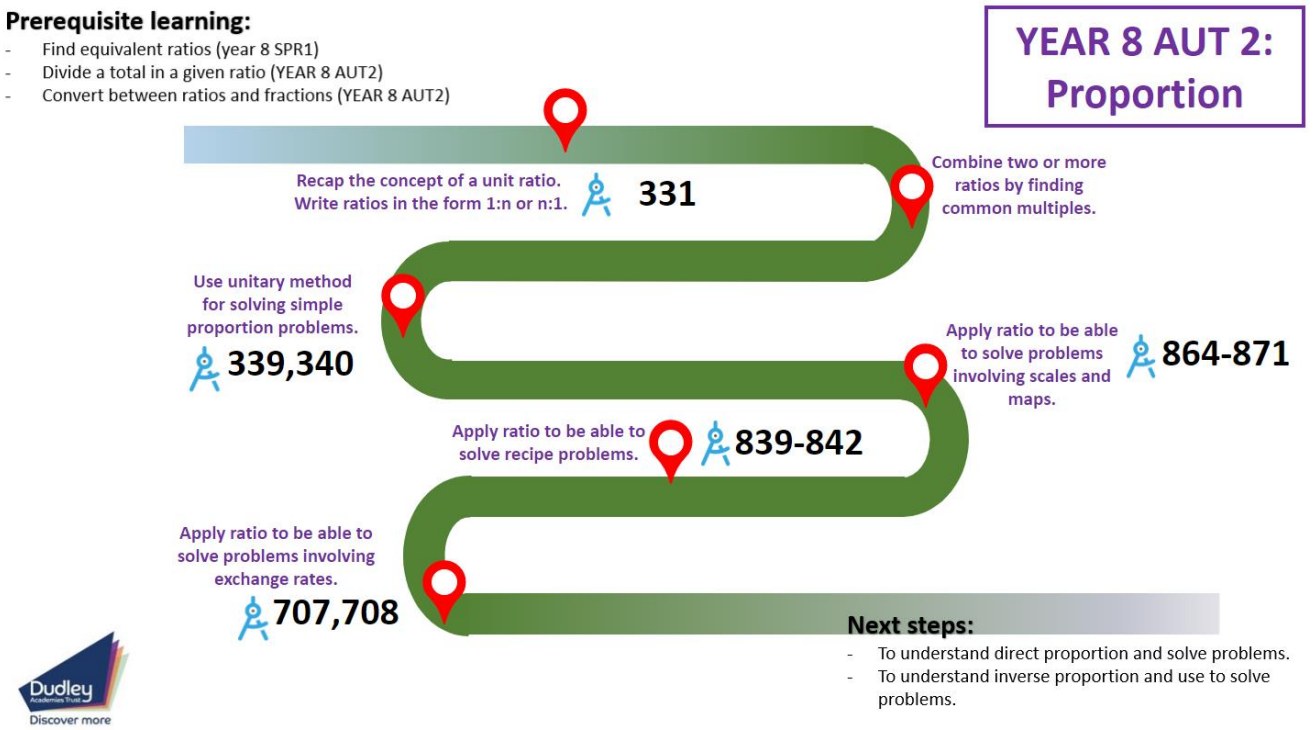
• Sharing problems where starting amount is unknown and 100% is used to give an answer as a proportion.	

8.6 Proportion (Unit 11)

Objectives

11a	Recap the concept of a unit ratio. Write ratios in the form 1:n or n:1. (D,P,C)
11b	Combine two or more ratios by finding common multiples. a:b, b:c to a:b:c (D,P,C)
11c	Use unitary method for solving simple proportion problems (D,P,C)
11d	Apply ratio to be able to solve problems involving scales and maps (D,P,C)
11e	Apply ratio to be able to solve problems involving exchange rates (D,P,C)
11f	Apply ratio to be able to solve recipe problems (D,P,C)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Ratio, exchange, rate, scale, combine, proportion

Unitary

PREQUISITE KNOWLEDGE

- Equivalent ratio
- Dividing an amount in a ratio
- Converting between ratios and fractions

GREATER DEPTH EXEMPLIFICATION

- Direct and inverse proportion

COMMON MISCONCEPTIONS:

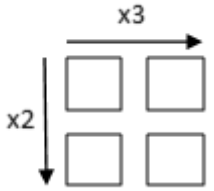
- Confusion around whether to multiply or divide in a scale or exchange rate problem e.g. some students 'always multiply to go form £s to something else' without checking that the exchange rate is £1:n.
- Address the misconception learners often make regarding value of different currencies – e.g. that £1 is roughly 100 rupees so rupees are better because 100 is bigger.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Proportion questions where 2 variables are included eg 5kg of apples and 3kg of pears costs £10, 7kg of pears costs £8. How much does 3kg of apples cost?
- A recipe for 4 pancakes says 2 eggs, 100g flour and 150ml of milk. Richard makes some pancakes, he uses 225 ml of milk. How many pancakes did he make, how much did he use of the other ingredients.
- Given a recipe and set amounts of ingredient what is the maximum number that can be made?
- Exchange rate questions involving comparison of prices in different countries or where multiple conversions are need to solve.
- Interpreting scale drawings and maps involving lengths that need to be measured (rather than given in the problem).

MASTERY PEDAGOGY

- Bar modelling support ratio and proportion problem solving



- Other diagrams to support identification and use of 'scale factor'
- Incrementally more difficult questions used to practice concepts
- Use of fractional and decimal values on questions
-

RESOURCES TO SUPPORT LEARNING:

- Laminated multiplication grid.

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Simple ratios e.g. in balancing equations, phenotype ratios (Maths in Science Factsheet)
- Rounding, link to Maths in Science Rounding Document

GEOGRAPHY

- Ratio and proportion (Page 36-38 of Maths in Geography document.)
- Rounding, link to Maths in Geography Document, (pages 52 to 54)

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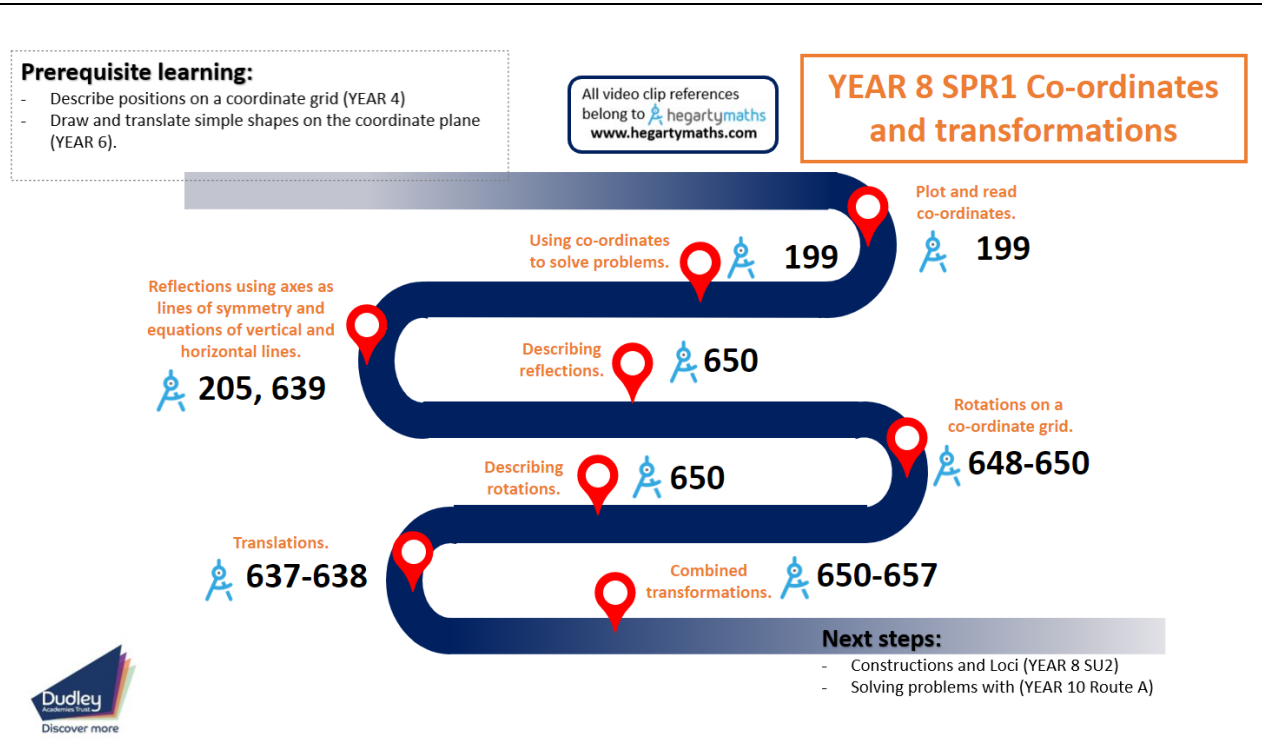
Year 8.7 Coordinates and Transformations (Unit 8)

Objectives

a	Plotting and reading coordinates (D,P)
b	Using coordinates – for example to find the missing corner of a rectangle (D,P)
c	What is a translation, rotation and reflection? (D)
d	Reflections on a co-ordinates grid –using axes as lines of symmetry (D,P)
e	Vertical and horizontal lines on a co-ordinate grid (D)
f	Reflections in vertical and horizontal lines on a co-ordinate grid (D,P)
g	Describing reflections (D,P)
h	Rotation on a co-ordinate grid using a centre of rotation (D,P)
i	Describing rotations (D,P)
j	Reflection in the line y = x and y = -x on a co-ordinate grid (D,P)
k	Translations using vectors (D,P)
l	Mixed describing transformations (D,P)
m	Combined transformations (D,P)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Reflection, rotate, translate, enlargement, scale factor, transformation

Negative, combined, describe

PREQUISITE KNOWLEDGE

- Plotting coordinates
- Equations of straight lines

GREATER DEPTH EXEMPLIFICATION

- Transformations of graphs, including linear, quadratic and cubic
- Functions of graphs

COMMON MISCONCEPTIONS:

- The directions on a column vector often get mixed up.
- Student need to understand that the 'units of movement' are those on the axes, and care needs to be taken to check the scale.
- Correct language must be used: students often use 'turn' rather than 'rotate'.
- Emphasise the need to describe the transformations fully, and if asked to describe a 'single' transformation they should not include two types.
- Students will often just count squares with translation questions. It is essential that the students check the increments on the coordinate grid when translating shapes.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Students should be given the opportunity to explore the effect of reflecting in two parallel mirror lines and combining transformations.
- True/False -Moving the centre of rotation 1 place to the left moves the image 1 place to the left also.
- Describe two different transformations that could move the first rectangle to the second.
- The coordinates of the vertices of a triangle are (4, 1), (4, 5) and (8, 1). If the triangle is translated in the vector (11), without drawing find the coordinates of the shape in its new position.
- A triangle with coordinates (1,2), (1, 5) and (4, 2) is reflected in the y-axis.
- Without drawing it, what will be the co-ordinates after the reflection?
- **https://nrich.maths.org/6544**

MASTERY PEDAGOGY

- Incrementally more difficult questions

RESOURCES TO SUPPORT LEARNING:

- Tracing paper.
- Mirrors potentially to support with reflections.
- Laminated coordinate grids.

TRANSFERABLE SKILLS- Content in other context

GEOGRAPHY

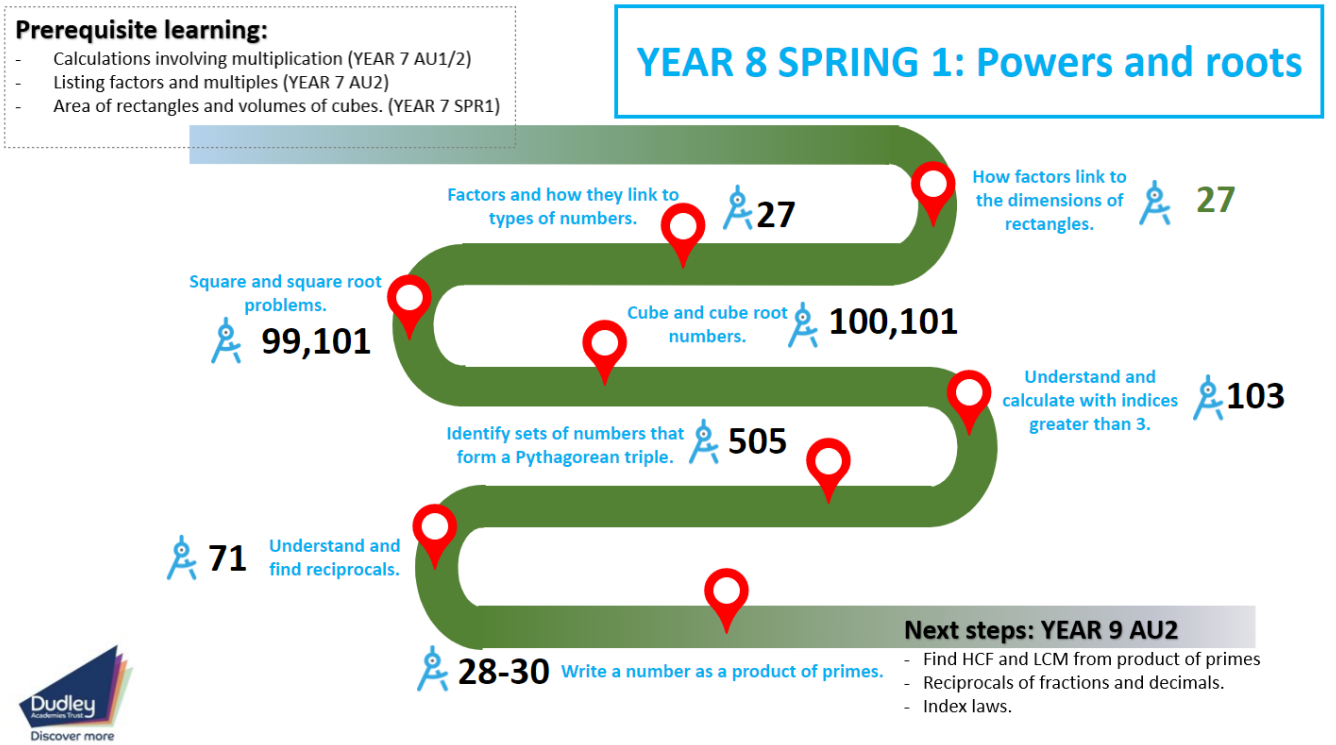
- Link enlargements to scales used in maps and map drawing.

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.8 Powers and Roots (Unit 4)

Objectives

4a	Can find the factors of a number, identify numbers with an odd number of factors (D,P)
4b	Understand the link between factors of a number and dimensions of rectangles with that area (D,P,C)
4c	Can square and square root numbers and solve problems involving squares and area. Inc decimals and fractions (D,P,C)
4d	Can cube and cube root numbers and solve problems involving cubes and link to volume. Inc decimals and fractions (D,P,C)
4e	Confidently use a calculator to square and square root, cube and cube root. (D,P)
4f	Understand and calculate with indices greater than 3 (D,P)
4g	Identify sets of numbers that form a Pythagorean triple. (D,P,C)
4h	Calculate with negative integers and understand the term reciprocal. (D,P)
4i	Can represent a given number as a product of its prime factors (D,P)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Factor, prime, multiple, power, root, index/indices

Reciprocal

PREQUISITE KNOWLEDGE

- Factors and multiples
- Area squares/rectangles
- Multiplication tables

GREATER DEPTH EXEMPLIFICATION

- HCF and LCM using prime factors – written in index form
- Reciprocals of fractions and decimals
- Index laws
- Standard form

COMMON MISCONCEPTIONS:

- $3^2 = 6$ (3×2)
- Students often find it hard to read/verbalise '3 to the power of 4' etc. Insist on correct use of language
- $7^2 = 49$ so 7 is a square number
- The order of operations is often not applied correctly when squaring negative numbers, and many calculators will reinforce this misconception.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Why does √25 have two solutions?
- Which of these numbers cannot be prime - 356, 895, 5739, 3457
- How many ways can you start a factor tree for 24? What is special about the numbers you have written?
- Ask students to reason the validity of a given statement eg: Squaring any number gives a positive value
  Any number to an even power, then cubed, gives a square number
  Any number to the power 10 will be greater than 10 to the power of that same number

MASTERY PEDAGOGY

- Use manipulative to help find factors of a number
- Links between factors, square and cubes to area and volume of rectangles, squares and cuboids
- Emphasise multiplication as repeated addition and indices as repeated multiplication
- Incrementally more difficult questions when practising including negatives, decimals and fractions.
- Multi-link cubes for square/cube numbers

RESOURCES TO SUPPORT LEARNING:

- Multiplication grid

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- For greater depth – look at index laws with standard form.
  Link to maths in science, standard form document.
- Rounding, link to Maths in Science Rounding Document

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

▪ Reasoning using Pythagorean Triples: Would a triangle with sides 4, 6, and 8cm contain a right angle?	**GEOGRAPHY** ▪ Rounding, link to Maths in Geography Document, (pages 52 to 54)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.9 Circles and Compound Area (Unit 9)

Objectives

9a	Identify all key parts of a circle (D)
9b	Know and use the formula for the circumference of a circle (D,P)
9c	Know and use the formula for the area of a parallelogram (D,P)
9d	Derive and use the formula for the area of a circle (D,P,C)
9e	Solve problems involving the area of circles (D,P,C)
9f	Work backwards from area or circumference to find radius and diameter (D,P,C)
9g	Calculate areas involving compound shapes including where circular areas have to be subtracted (D,P,C)
9h	Calculate arc length and sector area of fractions of circles (D,P,C)

Prerequisite learning:

- Area of rectangles, triangles and trapeziums (YEAR 5/6).
- Understanding of units for area (YEAR 6)
- Problem solving with area to find lengths (YEAR 7 SPR2)

All video clip references belong to hegartymaths www.hegartymaths.com

YEAR 8 SPR1 Circles compound area

Next steps:

- Find volume of prisms (YEAR 8 SPR1).
- Arc length and sector area with harder angles (YEAR 10 Route B, 11 ROUTE A).

Dudley Academies Trust Discover more

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Perimeter, circumference, radius, diameter, area, length

Arc, sector, theta

PREQUISITE KNOWLEDGE

- Area of rectangles, triangles and trapezia.
- Units for area.
- Using area to find missing lengths.

GREATER DEPTH EXEMPLIFICATION

- 3D shape volume – prisms in the first instance, moving on to spheres and pyramids.
- Arc length and sector area with more challenging angles, including surds and algebra.

COMMON MISCONCEPTIONS:

- Confusion around fundamental difference between and area and a perimeter
- Meaning of the terms circumference and perimeter
- Misremembered formula - particularly for circle area and circumference
- Use of units for length and area
- Seeing a measurement of $3mm^2$ and think that this means 3^2 in the calculation

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- A circle has area of 40cm2, what is its diameter?
- A circular cake tin has a diameter of 22.5cm. The lid is sealed with tape. The ends of the tape overlap by 1.5cm. Calculate the length of tape needed to seal the tin.
- The London eye has a diameter of 135m and takes approximately 30 minutes to complete one revolution. Passengers travel in capsules. How far does the base of a capsule travel every 5 minutes?

MASTERY PEDAGOGY

- Incrementally more difficult questions used for practising application of formulae.
- Range of different units, decimals and fractions.
- Questions used that incorporate decimals and fractions

RESOURCES TO SUPPORT LEARNING:

- Multiplication grid
- Circle/pie chart to support with angle facts.

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Link to requirement to recall and apply formula in different contexts.
- Rounding, link to Maths in Science Rounding Document

GEOGRAPHY

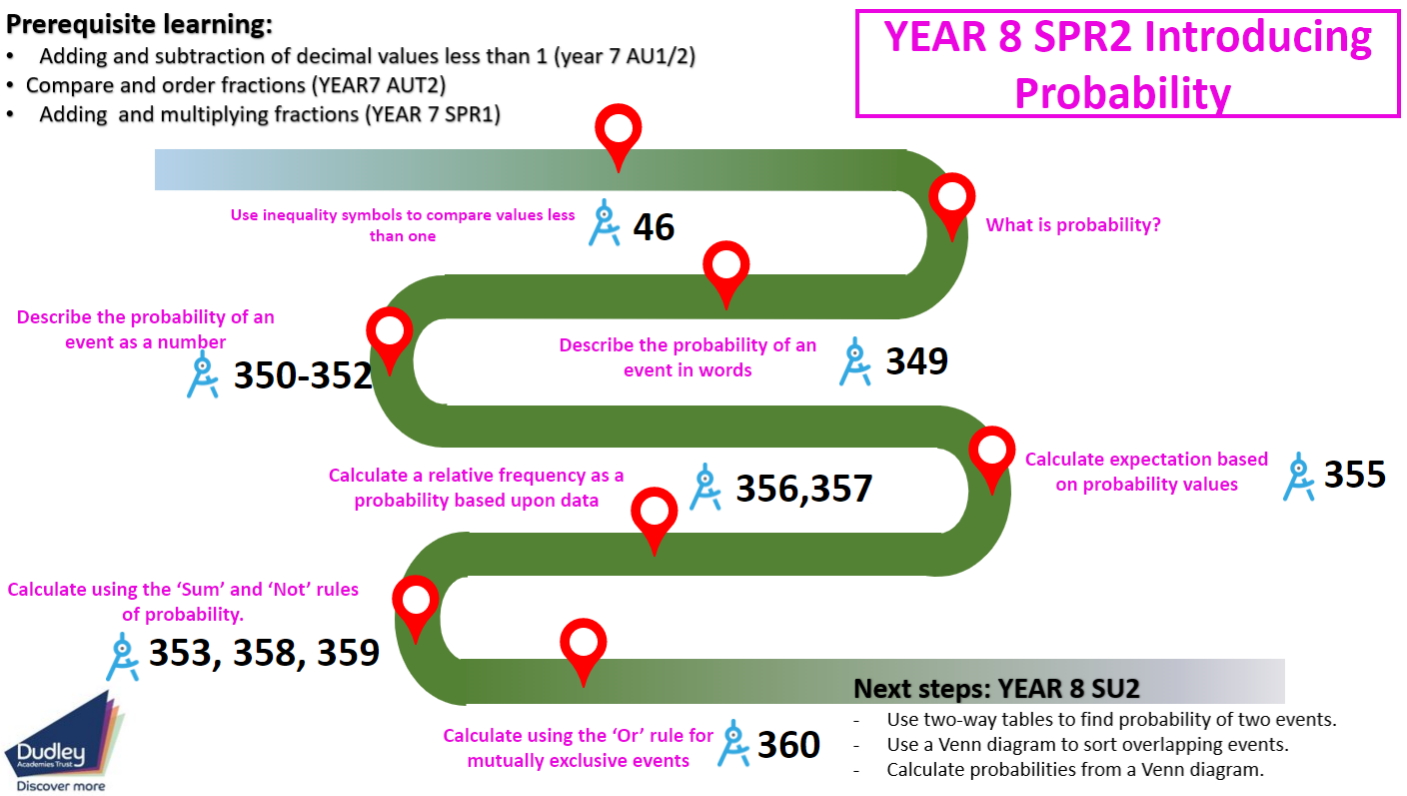
- Rounding, link to Maths in Geography Document, (pages 52 to 54)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.10 Further Probability (Unit 15)

Objectives

15a	Complete two way tables and frequency trees to calculate probabilities (D,P,C)
15b	Use a Venn diagram to sort overlapping events (not mutually exclusive) (D,P,C)
15c	Use set notation to describe regions on a Venn diagram. (D,P,C)
15d	Calculate probabilities from a Venn diagram (D,P,C)
15e	Use the 'Or' rule for two events that are not mutually exclusive. (D,P,C)



Essential Language

Probability, and, or, mutually exclusive, Venn, notation

Tree diagram, dependent, independent

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

<table>
<tr>
<td>PREQUISITE KNOWLEDGE
▪ Describe probability in words
▪ Apply numbers to probabilities
▪ Expectation based on probabilities
▪ Sum, not, and, or rules

GREATER DEPTH EXEMPLIFICATION
▪ Tree diagrams (dependent and independent)
▪ Venn diagrams with algebra</td>
<td>COMMON MISCONCEPTIONS:

▪ Students often forget to subtract the intersection from any totals given when filling a Venn diagram.
▪ Missing the values or items not in AUB ie in the outer rectangle of the Venn Diagram
▪ Always calculating probabilities out of the total amount rather than a subset. Eg Probability of choosing a girl in glasses is out of the total number of girls not everyone.</td>
</tr>
<tr>
<td>OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

▪ In a class of 30 students 19 have a brother, 15 have a sister, 4 do not have a brother or a sister. Use a Venn diagram to work out how many students have a brother and a sister
▪ 150 a-level pupils were interviewed. 85 studied maths, 70 studied English, 50 studied both. How many signed up for English and maths?
▪ We asked 500 game fanatics whether they like the classics Pacman and Space invaders. 200 gamers like both games. 100 gamers don't like either of the games and 20% of the gamers likes Pacman but not the Space Invaders. Draw a Venn diagram to show this.
▪ Use Venn Diagrams to sort types of numbers</td>
<td>MASTERY PEDAGOGY

▪ Laminated Venn diagram to complete or shade sections
▪ Incrementally more difficult questions for presenting data in Venn Diagrams, including values given as proportions (percentages and fractions)
▪ Counters, dice, other manipulatives used to allow experimentation

RESOURCES TO SUPPORT LEARNING:
▪ Laminated Venn diagrams

TRANSFERABLE SKILLS- Content in other context
SCIENCE

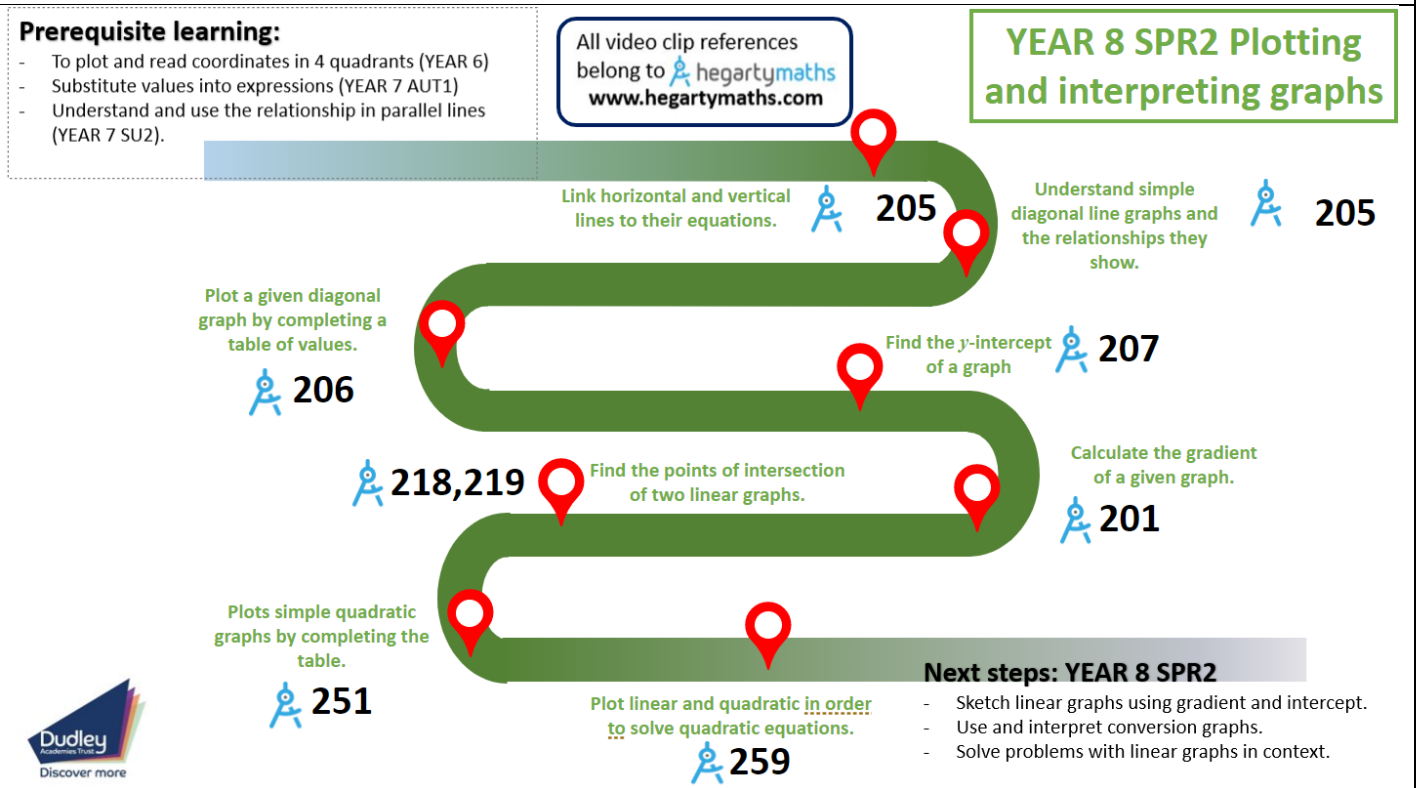
▪ Link to Maths in Science, Probability document</td>
</tr>
</table>

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.11 Plotting and Interpreting Graphs (Unit 7)

Objectives

7a	Link horizontal and vertical lines to their equations (D,P)
7b	Understand simple diagonal line graphs and the relationships they show (D,P)
7c	Plot a given diagonal graph by completing a table of values (D,P)
7d	Identify the y-intercept of a diagonal graph, linking the graph to the equation (D,P,C)
7e	Calculate the gradient of a given diagonal graph (D,P)
7f	Identify straight line relationships in the form y = mx + c, making links between the equation and the graph (D,P,C)
7g	Plot two linear graphs and use their point of intersections to solve an equation (D,P)
7h	Plot graphs of simple quadratic relationships by completing a table of values (D,P)
7i	Identify families of quadratic graphs and compare graphs and equations of different lines using intercept and gradient (D,P)
7j	Plot both linear and quadratic graphs in order to solve quadratic equations (D,P)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Gradient, intercept, linear, substitute, parallel, plot

Perpendicular, simultaneous, conversion

PREQUISITE KNOWLEDGE

- Substituting into expressions
- Plotting coordinates in 4 quadrants
- Relationship between parallel lines.

GREATER DEPTH EXEMPLIFICATION

- Sketch linear graphs using gradient and intercept.
- Conversion graphs.
- Linear graphs in context.
- Transformation of graphs.

COMMON MISCONCEPTIONS:

- Confusion around identification of x and y and therefore reading and plotting coordinates
- Not understanding that any x value can be used to generate a y value. Needing to be given x's to use explicitly

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- The lines y = 2, x = 4, y = -2 and x = -4 are plotted. Without drawing these, say what shape do they form? What would be the co-ordinates of the vertices of the shape?
- What would be the coordinate of where the lines y = 4 and y = 2x + 4 cross?
- If the line y = 0.5x was extended, would it go through the point (7, 4)? Explain you answer.
- What point do both the graphs y=x and y=2x go through?
- These points lie in a straight line (-3, 6), (0, 0) and (2, -4). Which of the following is the equation of the line? y = x + 9, x + y = 3, y + 2x = 0.
- Which of these lines are parallel: $y = 2x + 3$, $y = 5x + 3$, $y = 2x - 9$, $2y = 4x - 8$

MASTERY PEDAGOGY

- Link back to sequences work covered in Y7
- Laminated axis for students to plot graphs on
- Use equations written in all forms
- Substitute x values which are positive, negative, fractional, decimal or zero
- Use coefficients of x which are positive, negative, fractional, decimal or zero

RESOURCES TO SUPPORT LEARNING:

- Laminated axis for students to plot graphs on

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Link to maths in science, graphs document (slides 6 to 12 in particular)

GEOGRAPHY

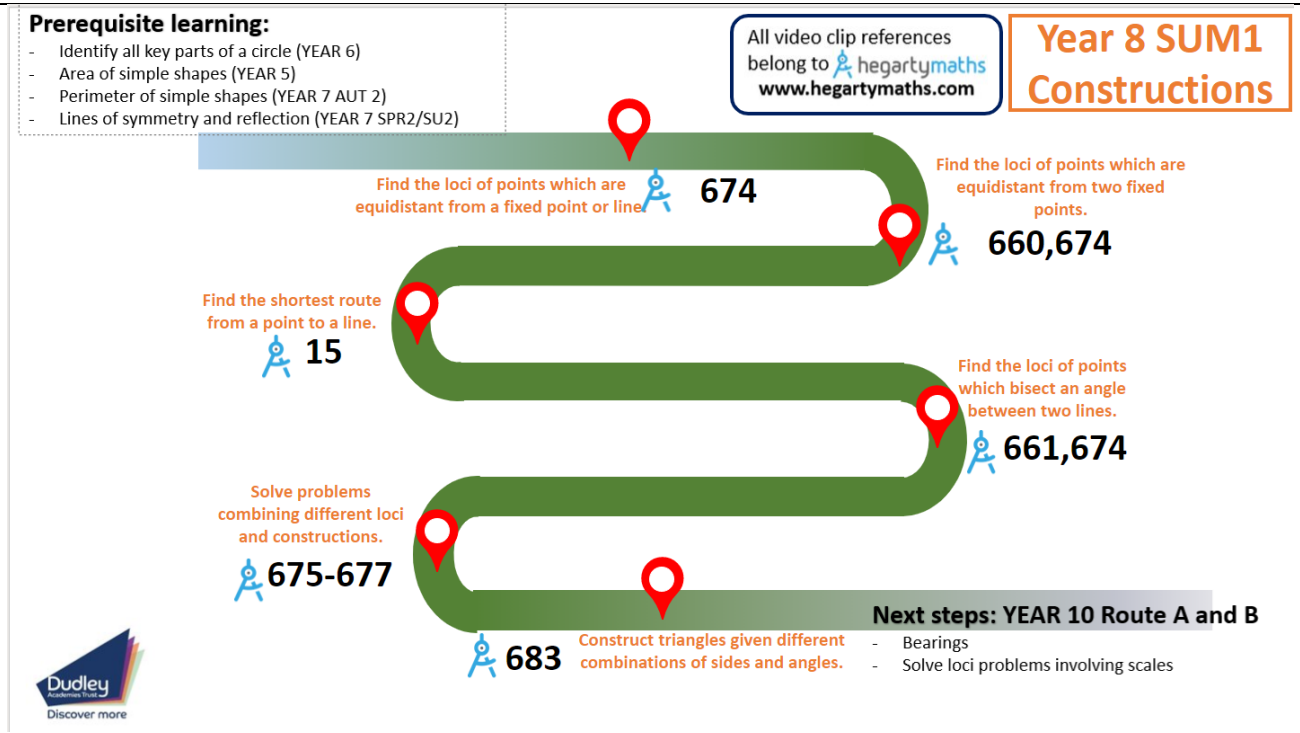
- Link to maths in geography document (pages 25 to 30 in particular)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.12 Constructions (Unit 12)

Objectives

12a	Find the loci of points which are equidistant from a fixed point or fixed line (D,P)
12b	Find the loci of points which are equidistant from two fixed points (Perpendicular bisector of a line) (D,P)
12c	Find the shortest route from appoint to a line (D,P)
12d	Find the loci of points which bisect an angle between two lines (D,P)
12e	Solve simple problems combining different loci and constructions (D,P,C)
12f	Construct triangles given different combinations of sides and angles (D,P,C)



Essential Language

Construct, loci, equidistant, bisector, triangle, perpendicular

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

<table>
<tr>
<td>PREQUISITE KNOWLEDGE
▪ Identify key parts of a circle.
▪ Area and perimeter of simple shapes.
▪ Symmetry and reflection.

GREATER DEPTH EXEMPLIFICATION
▪ Bearings.
▪ Loci problems involving scales.</td>
<td>COMMON MISCONCEPTIONS:

• Use of the wrong scale of a protractor. For example, they measure an obtuse angle as 60° rather than as 120°.
• Rubbing out construction lines to make solution look neater</td>
</tr>
<tr>
<td>OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

▪ Interpreting scale drawings and maps involving lengths that need to be measured (rather than given in the problem).

▪ Link problems with other areas of mathematics, such as bearings, the trigonometric ratios and Pythagoras' Theorem

▪ Explain what triangle with two angles of 85 degrees, with the between length of 5cm, would look like, what would the third angle be? Does the length of the line make a difference to the third angle? What would a triangle with two angles of 90 degrees look like?
▪ Which of these lines are parallel: $y = 2x + 3$, $y = 5x + 3$, $y = 2x - 9$, $2y = 4x - 8$</td>
<td>MASTERY PEDAGOGY

• Compass, Rulers and Protractors needed for all students
• Large compass, protractor and ruler to use at the board
• String and Blu-Tak can be used to model constructions on a large scale

RESOURCES TO SUPPORT LEARNING:
▪ Equipment – ruler, compass, protractor.
▪ Online demonstrations or use of Smartnotes for teacher demonstration using compass.

TRANSFERABLE SKILLS- Content in other context

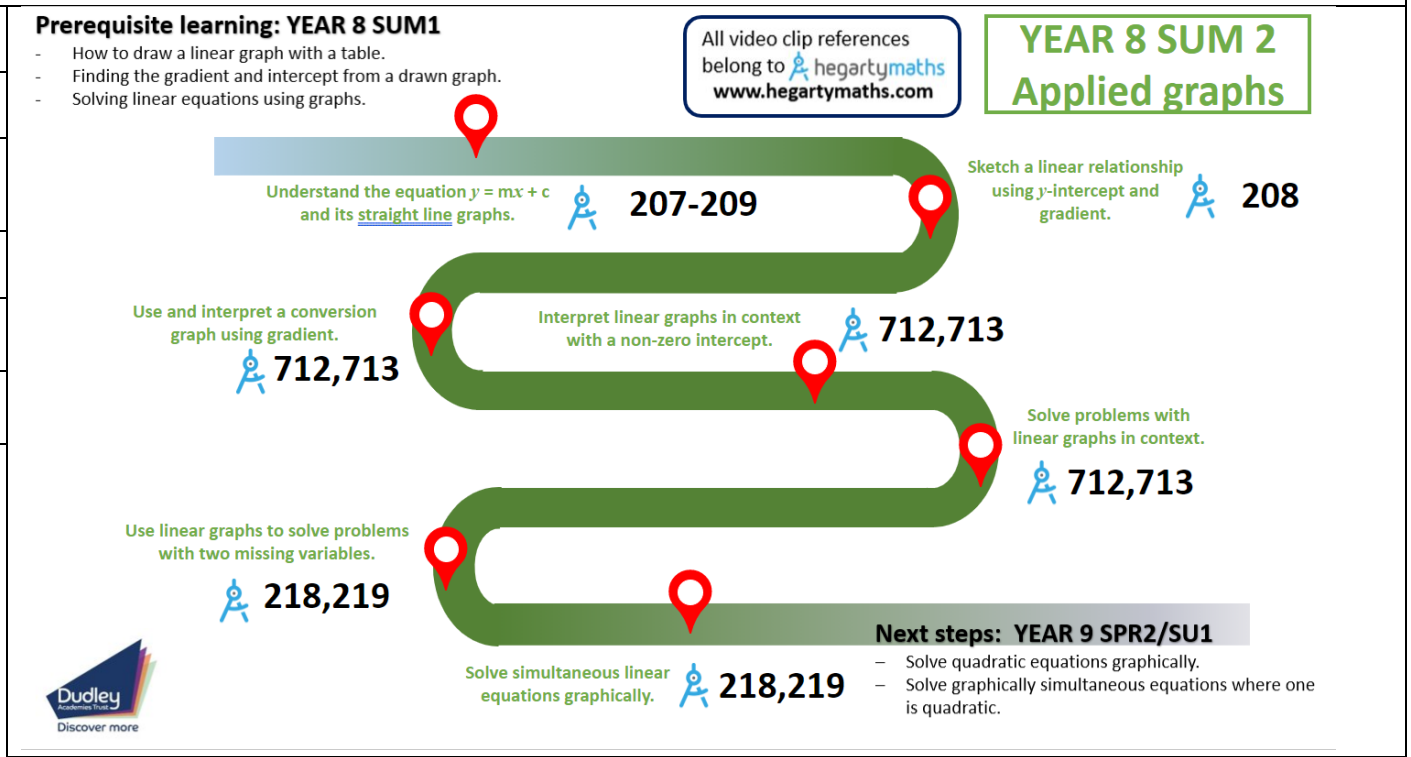
GEOGRAPHY
▪ If introducing maps and scales as greater depth, emphasise use in Geography.</td>
</tr>
</table>

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.13 Applied Graphs (Unit 14)

Objectives

14a	Understand the equation y=mx+c and its straight line graph (D,P)
14b	Sketch a linear relationship using y-intercept, gradient and x-intercept (D,P)
14c	Use and interpret a conversion graph using gradient to write a relationship (D,P,C)
14d	Interpret linear graph in context with a non-zero intercept (D,P,C)
14e	Solving problems with linear graphs in context (D,P,C)
14f	Use linear graphs to solve problems with two missing variables (D,P,C)
14g	Solve simultaneous linear equations graphically (D,P,C)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Substitute, gradient, linear, y-intercept, conversion, variable

Simultaneous, quadratic

PREQUISITE KNOWLEDGE

- Plotting linear graph with a table.
- Finding gradient and intercept from a graph.
- Solve linear equations using graphs.

GREATER DEPTH EXEMPLIFICATION

- Solve quadratic equations graphically.
- Solve simultaneous equations graphically, including quadratics.

COMMON MISCONCEPTIONS:

- Confusion around identification of x and y and therefore reading and plotting coordinates
- Not understanding that any x value can be used to generate a y value. Needing to be given x's to use explicitly
- Accuracy of plotting and use of a ruler is very important
- Not seeing that a conversion graph can be used to convert

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Given two pricing structures (graphically, algebraically, in words) decide which is the best value for money. Understand that a point of intersection relates to same price and therefore before and after this point different options are the best value
- Ask for verbal or written descriptions about what a graph shows in the context of the situation
- Ask to convert values that are not shown on the graph by scaling up something smaller

MASTERY PEDAGOGY

- Laminated axis for plotting of graphs
- Link to proportional contexts covered in previous units, exchange rates, scales on maps
- Include fractional and decimal values to substitute or read from a graph
- Use conversion graphs as part of extended problems involving fraction, percentages and ratio

RESOURCES TO SUPPORT LEARNING:

- Equipment – ruler, pencil, graph paper.
- Teacher demonstration plotting points.

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Link to maths in science, graphs document (slides 6 to 12 in particular)

GEOGRAPHY

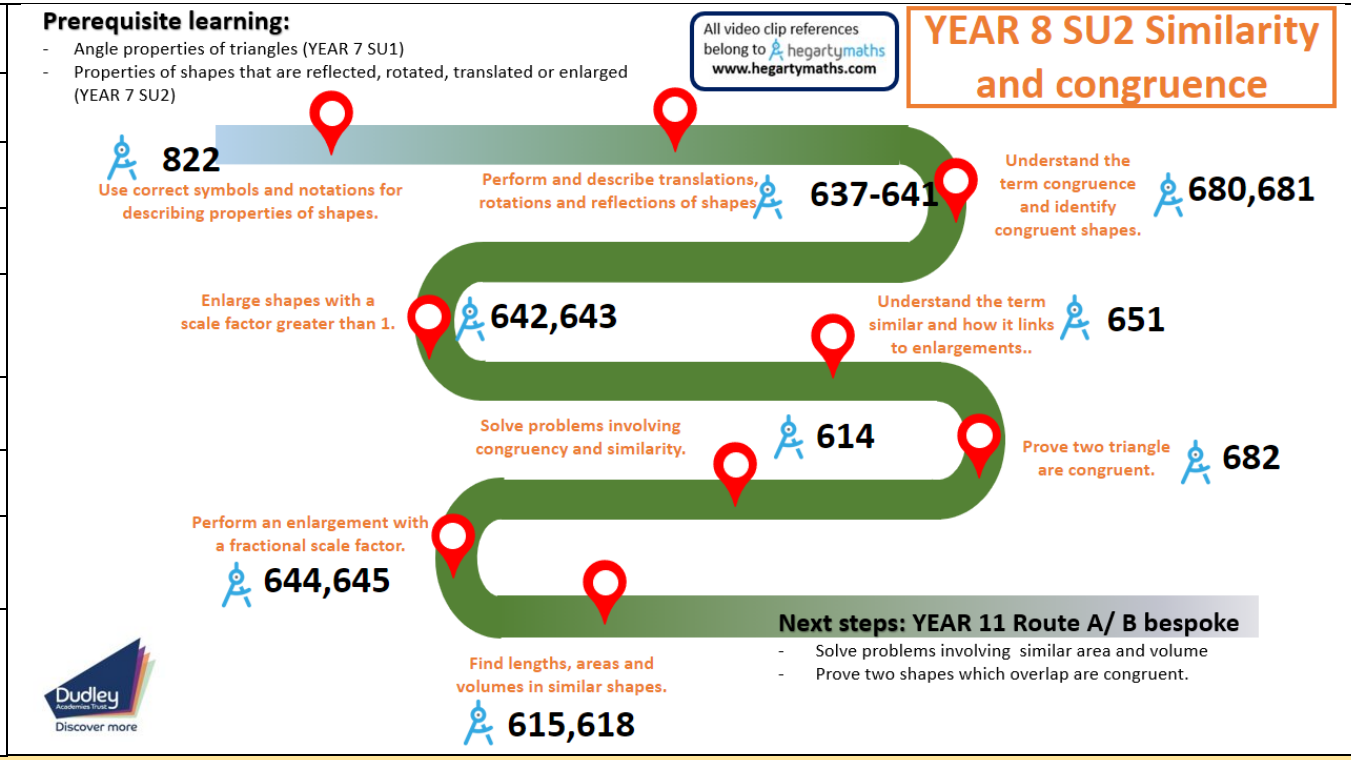
- Link to maths in geography document (pages 25 to 30 in particular)

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.14 Similarity and Congruence (Unit 13)

Objectives

13a	Use correct symbols and notations for describing properties of shapes (D)
13b	Perform and describe translations, rotations and reflections of shapes (D,P)
13c	Understand the term congruence and identify congruent shapes (D,P)
13d	Enlarge a shape with a scale factor greater than 1 (D,P)
13e	Understand the term similar, identify a scale factor for similar shapes and describe a given enlargement (D,P,C)
13f	Solve problems involving congruency and similarity (D,P,C)
13g	Perform an enlargement with a fractional scale factor (D,P)
13h	Calculate lengths, areas and volumes in similar shapes understanding the link between scale factors (D,P,C)
13i	Prove that two triangles are congruent (D,P,C)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Similar, congruent, scale, factor, enlarge, ratio

Proof, prove

PREQUISITE KNOWLEDGE

- Angle properties of triangles
- Properties of shapes when reflected, rotated, enlarged or translated.

GREATER DEPTH EXEMPLIFICATION

- Solve problems including area and volume.
- Prove that two overlapping shapes are congruent.

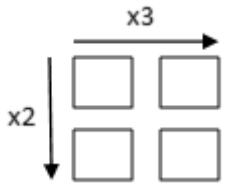
COMMON MISCONCEPTIONS:

- Confusions around mixing up the four transformations
- Ignoring centres of rotations and enlargement, not realising that he position of the image is important
- Confusing column vectors and coordinates and misunderstanding their meanings.
- Difficulty in choosing whether a scale factor should be multiplied or divided by to find missing sides in similar shapes

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- There are two shapes. They have the same number of sides and the same angles. Sam says they must be congruent. Is he correct? Explain your answer.
- Two rectangles measure: 1cm by 2cm and 2cm by 3cm. Jane says that the second rectangle is an enlargement of the first. Is she correct? Explain your reasoning.
- The coordinates of the vertices of a triangle are (2, 4), (5, 4) and (5, 1). If the triangle is translated in the vector followed by a reflection in the x-axis. Find without drawing the new coordinates.
- Use overlapping or rotated shapes in similarity problems to increase the difficulty.
- https://nrich.maths.org/6544

MASTERY PEDAGOGY

- 

Proportion diagrams used to support identification and use of 'scale factor'
- Include shapes with fractional or decimal lengths and various units
- Link back to previous units on ratio and proportion
- With similar shapes present smaller shape on both left and right of pair, present shapes in different orientations or where shapes overlap

RESOURCES TO SUPPORT LEARNING:

- Laminated axis used for quick practice of transformations

TRANSFERABLE SKILLS- Content in other context

GEOGRAPHY

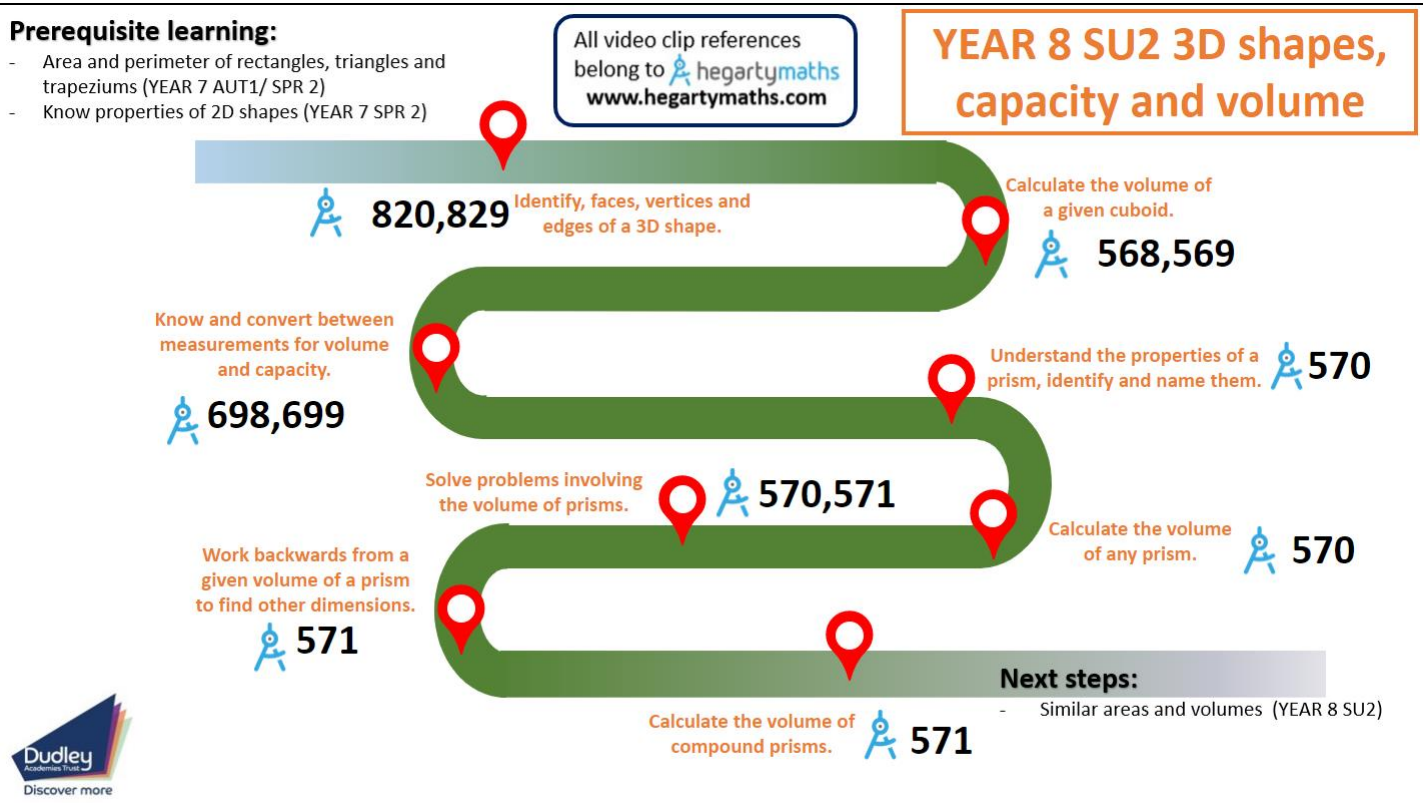
- Link enlargements to scales used in maps and map drawing.

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8.15 3D Shapes and Volume (Unit 10)

Objectives

13a	Identify faces, vertices and edges of a 3D shape (D)
13b	Calculate the volume of a given cuboid (D,P,C)
13c	Know and convert between measurements for volume and capacity (D,P)
13d	Understand the properties of a prism, identify and name them. (D)
13e	Calculate the volume of any prism (D,P,C)
13f	Solve problems involving the volume of prisms (D,P,C)
13g	Work backwards from a given volume of a prism to find other dimensions (D,P,C)
13h	Calculate the volume of compound prisms including where volumes are subtracting (D,P,C)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language

Volume, prism, pyramid, capacity, convert, measure

PREQUISITE KNOWLEDGE

- Area and perimeter of rectangles, triangles and trapezia.
- Properties of 2D shapes.

GREATER DEPTH EXEMPLIFICATION

- Converting between measures of volume.
- Similar areas and volume (link to previous unit)

COMMON MISCONCEPTIONS:

- Confusion around fundamental differences between area and perimeter and between volume and surface area – often manifests in incorrect units
- Use of units for length, area and volume
- Seeing a measurement of $3mm^2$ and think that this means 3^2 in the calculation
- Converting with squared or cubed units is the same scale factor as linear units.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:

- Two cubes of length 5cm are joined together face to face. What shape do they make? What is the volume and surface area?
- A cuboid has volume $432m^3$, if its base is a rectangle with length 9m and width 8m, what is its height?
- Twelve small boxes of matches are to be packed tightly into a carton. Each box of matches has length 5cm, width 3.5cm and height 1.5cm. What is the volume of the carton? What are the possible dimentions of the carton? Is there more than one solution? What considerations do you have to make?

MASTERY PEDAGOGY

- Incrementally more difficult questions used for practising application of formulas
- Questions used involving a range of different units
- Questions used that incorporate decimals and fractions
- Questions that require answers to be given as a proportion of the total or two answers given as a ratio

RESOURCES TO SUPPORT LEARNING:

- Physical shapes for learners to discuss features.
-

TRANSFERABLE SKILLS- Content in other context

SCIENCE

- Rounding, link to Maths in Science Rounding Document

GEOGRAPHY

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

▪ A 25mm square hole is cut right through the centre of a cuboid. Find the volume of the remaining cuboid. ▪ The volume of a prism is 90cm^3. Find three different shapes of prism with this volume. Give the dimensions of each one.	▪ Representations of 3D Shapes, link to Maths in Geography Document (pages 41 to 46) ▪ Converting between units of measures, link to Maths in Geography Document (pages 47 to 51) ▪ Rounding, link to Maths in Geography Document, (pages 52 to 54)