

**KS3 Progression Map: Ratio, proportion and rates of change**

This progression map expands upon the statements of subject content in the DfE document [*Mathematics programmes of study: Key Stage 3*](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/239058/SECONDARY_national_curriculum_-_Mathematics.pdf)published September 2013. Suggested allocation of material to Years 7, 8 and 9 is given as starting points for writing schemes of work, but the implicit chronology is not intended to be prescriptive or restrictive; indeed, the programme of study is explicit that “Decisions about progression should be based on the security of pupils’ understanding and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content in preparation for key stage 4. Those who are not sufficiently fluent should consolidate their understanding, including through additional practice, before moving on”. The NCETM fully endorses these principles, and will be developing further this progression map to help teachers achieve them.

Furthermore, although the map is organised by content, this is only for ease of reference and use. In the classroom, links between topics on the map, and between different maps, should be looked for and explored at every opportunity, so that “by the end of Key Stage 3, pupils … know, apply and understand the matters, skills and processes specified”. Throughout Y7-9 pupils should have regular and opportunity and developmental feedback that helps them to **develop fluency**, to

* consolidate their numerical and mathematical capability from Key Stage 2 and extend their understanding of the number system and place value to include decimals, fractions, powers and roots
* select and use appropriate calculation strategies to solve increasingly complex problems
* move freely between different numerical, algebraic, graphical and diagrammatic representations [for example, equivalent fractions, fractions and decimals, and equations and graphs]
* use language and properties precisely to analyse numbers, algebraic expressions, 2-D and 3-D shapes, probability and statistics;

to **reason mathematically**, to

* extend their understanding of the number system; make connections between number relationships, and their algebraic and graphical representations
* extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and in formulating proportional relations algebraically
* make and test conjectures about patterns and relationships; look for proofs or counter-examples
* begin to reason deductively in geometry, number and algebra, including using geometrical constructions
* interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning
* explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally;

and to **solve problems**, to

* develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems
* develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics
* begin to model situations mathematically and express the results using a range of formal mathematical representations
* select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.

The NCETM will be developing further resources to support the development and embedding of these skills.

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| **Year 7** | **Year 8** | **Year 9** |
| **Multiplicative relationships** |
| change freely between related standard units, for example: time (4 hours = 4 × 360 seconds), length (7 mm = 7 × 0.1 cm), area (9 m2 = 9 × 10000 cm2), volume/capacity (3 mm3 = 3 x 0.001 cm3) , mass (5 kg = 5 × 1000 g)  | change freely between related standard units, for example speed (m per sec to km per hour and vice-versa)  | change freely between related standard units, for example acceleration |
| express one quantity as a whole-number multiple of another, and by reversing the expression of the same relationship express one quantity as a unit fraction of another  | express one quantity as a fraction of another, where the fraction is less than 1 and where it is greater than 1 | given the expression of quantity A as a non-unit fraction of quantity B know immediately how to express quantity B as a fraction of quantity A |
| **Ratio notation and number multipliers** |
| understand that a multiplicative relationship between two quantities that can be expressed as a ratio of the form 1 : n where n is an integer can also be expressed as the unit fraction 1/n  | understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction | understand that a multiplicative relationship between two quantities can be expressed as a ratio, fraction or decimal  |
| use ratio notation, including reduction to simplest form | use ratio notation, including deriving the fraction A / (A + B) from the ratio A : B in appropriate contexts | use ratio notation to express relationships between side-lengths of right-angled triangles |
| use scale factors of scale diagrams and maps in everyday contexts | use scale factors when constructing similar shapes by enlargement | use scale factors when solving problems involving similar shapes |
| relate the language of ratios and the associated calculations to the arithmetic of fractions | relate the language of ratios and the associated calculations to gradients | relate the language of ratios and the associated calculations to linear functions |
| relate dividing a given quantity into two parts in a given part:whole ratio to finding a fraction of a quantity; relate part:part ratios of quantities to the corresponding part:whole ratios  | divide a given quantity into two parts in a given part:part or part:whole ratio; express the division of a quantity into two parts as a ratio | distinguish between contexts involving comparisons expressed using a : b notation in which the idea of ‘part’ is a helpful model and contexts in which the idea of ‘part’ is not a helpful model  |
| **Percentage change** |
|  | solve problems involving percentage change, including: percentage increase, decrease and original value problems | solve problems involving simple interest in financial mathematics  |
| **Direct and inverse proportion** |
|  | solve problems involving direct proportion, including graphical and algebraic representations | solve problems involving direct and inverse proportion, including graphical and algebraic representations |
| **Compound units** |
| use the idea of compound units (A ‘per’ B), as in unit pricing, to solve problems | use familiar compound units, such as speed, to solve problems | use compound units, such as density, to solve problems |