KS3 Progression Map: Geometry and Measures

This progression map expands upon the statements of subject content in the DfE document *Mathematics programmes of study: Key Stage 3* 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.

Year 7	Year 8	Year 9
Measuring and calculating		
draw and measure line segments and angles in geometric figures; calculate lengths represented by line segments in scale drawings given scale factors as ratios in the form 1 : n, and understand that the lengths are approximate	draw and measure line segments and angles in geometric figures; calculate lengths represented by line segments in scale drawings given scale factors as ratios in any form, and understand implications of the accuracy of the measurements for the accuracy of the calculated lengths	draw and measure line segments and angles in geometric figures, including interpreting scale drawings
derive and apply formulae to undertake calculations and solve problems involving perimeter and area of rectangles	derive and apply formulae to undertake calculations and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)	undertake calculations and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes
		use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles
Drawing and constructing		
describe, sketch and draw: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons that are reflectively and rotationally symmetric; use conventional terms and notations, such as using 'dashes' to indicate equal lengths and (multiple) arrows to indicate parallel lines	describe, sketch and draw: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons that are reflectively and rotationally symmetric; use conventional terms and notations, such as *complementary* to describe angles with a sum of 90˚ and *supplementary* to describe angles with a sum of	describe, sketch and draw: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons that are reflectively and rotationally symmetric; use conventional terms and notations, such as *definition*, *derived property* and *convention*

	180˚	
	derive and use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); recognise and use the perpendicular distance from a point to a line as the shortest distance to the line	use construction methods to: investigate what happens (for example to the angle bisectors, or perpendicular bisectors of sides, of triangles) in changing situations; explore derived shapes, such as circumcircles and inscribed circles of triangles, and other polygons (where possible)
use the standard conventions for labelling the sides and angles of triangle ABC		know and use the criteria for congruence of triangles
Properties and relationships		
derive and illustrate properties [for example, equal lengths and angles] of triangles, quadrilaterals, and other plane figures using appropriate language and technologies	classify quadrilaterals by their geometric properties, and provide convincing arguments to support classification decisions	derive and illustrate properties of circles
apply translations, rotations and reflections to given figures, and identify examples of translations, rotations and reflections (for example, be able to pick out from a group of shapes those that are translations, rotations or reflections of a given shape)	know that translations, rotations and reflections map shapes onto congruent shapes; understand that the relation 'is congruent to' implies that there exists a translation, rotation or reflection that takes one shape to another	identify properties of, and describe the results of, translations, rotations and reflections applied to given figures; know that any reasoning using these transformations could be replaced by reasoning using congruence criteria, and be familiar with some examples
	construct similar shapes by enlargement, with and without coordinate grids	identify and construct congruent triangles, with and without coordinate grids
apply the properties of angles at a point, angles at a point on a straight line, vertically opposite	understand and use the relationship between parallel lines and alternate and corresponding	

angles	angles	
	derive and use the sum of angles in a triangle	use the sum of angles in a triangle to deduce the angle sum in any polygon, and to derive properties of regular polygons
		apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem, and use known results to obtain simple proofs
	use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms and cylinders to solve problems in 3-D	use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres to solve problems in 3-D
interpret mathematical relationships both algebraically and geometrically		