4. 3. 2 Measures, Shape and Space Dimension (Key Stage 3)

Unit	Learning objectives	Suggested time ratio
Measures in 2-D and 3-D Figures		
Estimation in Measurement	• recognize the approximate nature of measurement and choose an appropriate measuring tool and technique for a particular purpose • choose an appropriate unit and the degree of accuracy for a particular purpose • develop estimation strategies in measurement • handle and reduce errors in measurement • estimate, measure and calculate lengths, areas, capacities, volumes, weights, rates, etc.	6
Simple Idea of Areas and Volumes	• find areas of simple polygons • explore the formula for the area of a circle • calculate circumferences and areas of circles • understand and use the formulas for surface areas and volumes of cubes, cuboids, prisms and cylinders • appreciate the application of formulas, besides measurement, in finding measures and be aware of the accumulated errors arisen • **explore the maximum area of figures for a given perimeter • **design a container by cutting squares from the 4 corners of a sheet of A4 paper to maximize the capacity of the container	15
More about Areas and Volumes	• calculate arc lengths and areas of sectors • understand and use the formulas for volumes of pyramids, circular cones and spheres • understand and use the formulas for surface areas of right circular cones and spheres • understand and use the relationships between sides, surface areas and volumes of similar figures • distinguish between formulas for length, area, volume by considering dimensions	18

Note: The objectives with asterisk (**) are exemplars of **enrichment topics**.
The objectives <u>underlined</u> are considered as **non-foundation** part of the syllabus.

Unit	Learning objectives	Suggested time ratio
Learning Geometry through an Intuitive Approach		
Introduction to Geometry	• recognize the common terms and notations in geometry such as line segments, angles, regular polygons, cubes and regular polyhedra (Platonic solids) etc. • identify types of angles and polygons • construct 3-D solids and explore their properties, such as Euler's formula • sketch the 2-D representation of simple solids • sketch the cross-sections of the solids • overview tools of geometry and explore ways of using them to construct polygons, circles, parallel and perpendicular lines • **recognize some semi-regular polyhedra (Archimedean Solids)	10
Transformation and Symmetry	• recognize reflectional and rotational symmetries in 2-dimensional (2-D) shapes • recognize the effect on 2-D shapes after the transformation including reflection, rotation, translation, dilation/contraction etc. • appreciate the symmetrical shapes around and transformations on shapes used in daily-life • **construct and design tile patterns	6
Congruence and Similarity	• recognize the properties for congruent and similar triangles • extend the ideas of transformation and symmetry to explore the conditions for congruent and similar triangles • recognize the minimal conditions in fixing a triangle • identify whether 2 triangles are congruent/similar with simple reasons • <u>explore and justify the methods to construct angle bisectors, perpendicular bisectors and special angles by compasses and straight edges</u> • <u>appreciate the construction of lines and angles with minimal tools at hand</u> • ** discuss the possibility of trisecting an angle by compasses and straight edges • **explore some shapes in fractal geometry	14

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The objectives <u>underlined</u> are considered as **non-foundation** part of the syllabus.

Unit	Learning objectives	Suggested time ratio
Angles related with Lines and Rectilinear Figures	• recognize different types of angles • explore and use the angle properties associated with intersecting lines and parallel lines • explore and use the properties of lines and angles of triangles • explore and use the formulas for the angle sum of the interior angles and exterior angles of polygons • explore regular polygons that tessellate • <u>appreciate the past attempts in constructing some special regular polygons with minimal tools at hand</u> • <u>construct some special regular polygons using straight edges and compasses</u> • **discuss past attempts in constructing some special regular polygons such as 17-sided regular polygons	18
More about 3-D Figures	• extend the idea of symmetry in 2-D figures to recognize and appreciate the reflectional and rotational symmetries in cubes and tetrahedron • explore and identify the net of a given solid • imagine and sketch the 3-D objects from given 2-D representations from various views • recognize the limitation of 2-D representations in identifying the solid • explore the properties of simple 3-D object, such as identifying ◆ the projection of an edge on one plane ◆ the angle between a line and a plane ◆ the angle between 2 planes • **investigate the reflectional and rotational symmetries in other regular polyhedra • **assemble a set of Soma Cube into a larger cube • **explore the number of regular polyhedra	8

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Unit	Learning objectives	Suggested time ratio
Learning Geometry through a Deductive Approach		
Simple Introduction to Deductive Geometry	• develop a deductive approach to study geometric properties through studying the story of Euclid and his book - *Elements* • develop an intuitive idea of deductive reasoning by presenting proofs of geometric problems relating with angles and lines • understand and use the conditions for congruent and similar triangles to perform simple proofs • identify lines in a triangle such as medians, perpendicular bisectors etc. • explore and recognize the relations between the lines of triangles such as the triangle inequality, concurrence of intersecting points of medians etc. • explore and justify the methods of constructing centres of a triangle such as in-centre, circumcentre, orthocentre, centroids etc. • **prove some properties of the centres of the triangle	27
Pythagoras' Theorem	• recognize and appreciate different proofs of Pythagoras' Theorem including those in Ancient China • recognize the existence of irrational numbers and surds • use Pythagoras' Theorem and its converse to solve problems • appreciate the dynamic element of mathematics knowledge through studying the story of the first crisis of mathematics • **investigate and compare the approaches behind in proving Pythagoras' Theorem in different cultures • **explore various methods in finding square root	8
Quadrilaterals	• extend the idea of deductive reasoning in handling geometric problems involving quadrilaterals • deduce the properties of various types of quadrilaterals but with focus on parallelograms and special quadrilaterals • perform simple proofs related with parallelograms • understand and use the mid-point and intercept theorems to find unknowns	15

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The objectives underlined are considered as **non-foundation** part of the syllabus.

Unit	Learning objectives	Suggested time ratio
Learning Geometry through an Analytic Approach		
Introduction to Coordinates	• understand and use the rectangular and polar coordinate systems to describe positions of points in a plane • able to locate a point in a plane by means of an ordered pair in the rectangular coordinate system • describe intuitively the effects of transformation such as translation, reflection with respect to lines parallel to x-axis, y-axis and rotation about the origin through multiples of 90° on points in coordinate planes • calculate areas of figures that can be cut into or formed by common 2-D rectilinear figures	9
Coordinate Geometry of Straight Lines	• understand and use formulas of distance and slope • use ratio to find the coordinates of the internal point of division and mid-point • understand the conditions for parallel lines and perpendicular lines • appreciate the analytic approach to prove results relating to rectilinear figures besides deductive approach • choose and use appropriate methods to prove results relating to rectilinear figures • **explore the formula for external point of division	12
Trigonometry		
Trigonometric Ratios and Using Trigonometry	• understand the sine, cosine and tangent ratios for angles between 0° to 90° • explore the properties and relations of trigonometric ratios • explore the exact value of trigonometric ratios on special angles 30°, 45°, 60° • rationalize the denominators such as $\sqrt{2}$ • apply trigonometric ratios to find measures of 2-D figures • introduce the ideas of bearing, gradient, angle of elevation, angle of depression and solve related 2-dimensional problems	26

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