

## Shape and Space Work Scheme (Pilot 2008-9)

Before starting this Intermediate (Level 2) FSMQ students should be able to:

- measure lengths in and understand common metric and imperial units (millimetres, centimetres, metres, inches, feet)
- be able to use a protractor to measure angles
- understand basic ideas of area and volume including use of correct units such as  $\text{cm}^2$  and  $\text{cm}^3$
- be able to interpret drawings including the use of basic plans and elevations drawn to scale.

A suggested work scheme showing topic areas and methods to be covered is given below. This recommends a total of 60 guided learning hours that could be timetabled in a variety of ways eg 2 hours per week for 30 weeks, 4 hours per week for 15 weeks, 5 hours per week for 12 weeks. Although the topic areas are listed separately below, it would be beneficial at times to use a variety of skills within a piece of work. For example the Nuffield resource 'Costing the Job' involves taking measurements from scaled drawings as well as finding areas and working out the cost of painting a house. Some terms and techniques should be introduced as soon as possible and used throughout the course. These include:

- geometrical terms: parallel, perpendicular, bisect, perpendicular bisector, mid-point, horizontal, vertical, line segment, line, similarity, congruence, regular, polygons (triangles including obtuse angled, acute angled, equilateral, isosceles and right angled, quadrilaterals including rectangle, square, parallelogram, rhombus, trapezium and kite, pentagons, hexagons, octagons), circumference, arc, sector, cuboids, prisms (including triangular), cylinders, spheres and hemispheres, cones.
- using appropriate instruments (ruler, tape measure, micrometer, protractor) to take measurements to appropriate levels of accuracy with appropriate units and correct notation
- checking calculations using estimation, inverse operations and alternative methods.

Topic Area	Content	Nuffield Resource
<b>Plans and elevations</b> (2 hours)	Identify and sketch objects from plans and elevations. Sketch plans and elevations of objects. Include sufficient dimensional information to allow drawings to be correctly interpreted.	<b>Points of View</b> (starter) Introduces the representation of objects by plans and elevations. Includes use of dotted lines for hidden edges.
<b>Measure and calculate using scales</b> (5 hours)	Measure lengths on scale drawings using scales given in the forms $a:b$ , $a$ to $b$ , $a/b$ for all $a$ and $b$ (and forms related to students' other work). Use scale drawings to solve problems, deciding on the correct arithmetic to use (including addition, subtraction, multiplication, division of lengths).	<b>Drawing Shapes in Word</b> (starter) Shows students some of the basic drawing techniques available in Word.
<b>Draw scale diagrams</b> (8 hours)	Draw plans and elevations of 3 dimensional situations using scales such as 2:5, 1:150, 10:1, 2 to 5, 1/3 (eg plans of rooms, elevations of front of buildings etc.). Use dashed lines to show hidden detail and shading for cross-sections. Include the use of a ruler and set-square to draw parallel and perpendicular lines where appropriate.	<b>Make your own shapes in Word</b> (skills activity) Activity that shows students how to draw their own shapes in Word, with and without gridlines.
<b>Convert measurements</b> (4 hours)	Convert within and between metric and imperial systems, including inches, feet, yards, miles. Include the use of conversion factors and formulae (eg $L = 3.281$ for converting metres to feet). Solve problems by carrying out calculations with measurements.	<b>Convert Lengths</b> (skills activity) Bingo and dominoes games providing practice in length conversions.
		<b>Convert It!</b> (skills activity) Interactive spreadsheet for practice in converting metric lengths and distances.



Topic Area	Content	Nuffield Resource
<b>Plane shapes</b> (6 hours)	Recognise and classify plane shapes. Irregular and regular polygons with special cases (eg rectangles, squares, parallelograms, trapezia, rhombi, kites as special quadrilaterals). Know and use internal and external angle sums of triangles, quadrilaterals and other polygons. Solve problems involving angle calculations. Understand and use ideas of tessellation.	<b>Tessellations in Word</b> (skills activity) Activity that shows students how to draw tessellations in Word, with and without gridlines.
		<b>Tessellation Shapes</b> (skills activity) Collection of shapes to print on card and laminate.
		<b>Shape Sorter</b> (assignment) Design a shape sorter, using scale drawings, plans, elevations and geometrical terms.
<b>Constructions</b> (4 hours)	Use a ruler and compasses only to construct: <ul style="list-style-type: none"> <li>a line perpendicular to a given line through a given point</li> <li>the mid-point of a line segment</li> <li>the perpendicular bisector of a line segment</li> <li>the bisector of an angle</li> <li>a regular hexagon inscribed in a circle</li> <li>an equilateral triangle inscribed in a circle</li> </ul> Use ruler, compasses and protractor to construct: <ul style="list-style-type: none"> <li>triangles from information such as 2 base angles and the length of the base or from 3 lengths</li> </ul>	<b>Pentagon</b> (skills activity) Instructions for constructing a regular pentagon.
<b>Perimeters, areas, surface areas and volumes</b> (7 hours)	Calculate, using formulae in words and symbols and the <b>p</b> button on a calculator or 3.14: <ul style="list-style-type: none"> <li>circumference of circle = <math>p \times d = 2pr</math></li> <li>arc length for fractions of a circle</li> <li>area of circle = <math>pr^2</math></li> <li>area of sector of a circle</li> <li>perimeters and areas of rectangles, triangles, parallelograms, trapezia and composite shapes</li> <li>surface areas and volumes of cuboids, prisms (including triangular), cylinders, spheres, hemispheres, cones and composite shapes (not frustums)</li> </ul> Recognise that a measurement expressed to a given unit has a maximum error of half a unit and calculate upper and lower bounds to problems involving addition, subtraction and multiplication of lengths. Use formulae together with known values to find one unknown length.	<b>Costing the Job</b> (skills activity) Taking measurements from scaled elevations of a house, then finding area and cost of painting.
		<b>Errors</b> (skills activity) Powerpoint presentation showing errors in measurements and how errors accumulate in calculations involving measurements. Accompanying notes and worksheets.



Topic Area	Content	Nuffield Resource
<b>Symmetry and Transformations</b> (8 hours)	Carry out: <ul style="list-style-type: none"> <li>enlargement using positive, negative and fractional scale factors and a centre of enlargement</li> <li>reflection</li> <li>rotation using a centre of rotation and positive (anticlockwise) and negative (clockwise) angles</li> <li>combinations of these.</li> </ul> Recognise and classify reflection and rotational symmetry in both 2D and 3D, using lines and planes of symmetry and defining the order and centre of rotation. Understand ideas of similarity in terms of enlargement and scale factors. For 2 similar shapes use ratio to find the lengths of unknown sides. Calculate for a given length scale factor (including fractional scale factors), the effect on area and volume and vice versa.	<b>Crop Circle Geometry</b> (skills activity) After sketching and describing crop circles found on websites, students construct a geometrical design, describe symmetries and transformations then produce their own designs.
		<b>Suncatchers</b> (skills activity) Stained glass suncatchers for students to describe and design.
		<b>Victorian Tiles</b> (skills activity) Students look for geometrical shapes and symmetry in encaustic tile patterns then design a tessellation using geometrical shapes themselves.
		<b>Symmetry in Word</b> (skills activity) Students use the Rotate and Flip options in Word to draw figures with line and rotational symmetry.
<b>Pythagoras' Theorem</b> (4 hours)	Solve problems in 2 dimensions using $c^2 = a^2 + b^2$ to calculate lengths.	<b>Pythagoras</b> (skills activity) Powerpoint presentation, notes and worksheet. Links to useful websites.
<b>Make models</b> (4 hours)	Construct models from information given on diagrams or sketches. (Omit this section if short of time.)	
<b>Revision</b> (8 hours)	Revise topics and try past papers. <b>Discuss Data Sheet – make up and try questions based on it.</b>	

