Geometry (properties of shape, position and direction)

February 2017

Approved by GB: March 2017

Next review due: Feb 2020

Purpose of Policy

Geometry (properties of shape, position and direction) are significant parts of the Mathematics Primary Curriculum. This policy will form the basis upon which we map out the learning for Geometry (properties of shape, position and direction)in Mathematics at Key Stage 2. It will outline progression across the year groups, and will inform new teachers of expectations.

Our policy recognises Mathematics as a functional tool and a valuable key life skill. We want all children leaving Churchfields Junior School to not only be numerate, but to be able to transfer their mathematical skills to other curricular areas and into everyday life. We want to impart to our children that Mathematics is not confined to just acquiring mathematical skills, but most importantly it is about fostering inquiring minds, inciting enthusiasm and valuing curiosity.

The policy reflects the views of all the staff of the school. It has been drawn up following consultation and has full agreement of the Governing Body and staff. All staff are fully aware of their role in its implementation. Staff have access to the Policy on the school's server via the Teacher's Drive. Parents are also able to access a copy of the policy via the school website.

Aims and Outcomes

- To present Geometry (properties of shape, position and direction) in meaningful contexts and to embed a range of practical activities designed to enhance children's mathematical experiences.
- To ensure that common errors and misconceptions in Geometry (properties of shape, position and direction) are addressed.
- To provide staff with an outline of expectations in Geometry (properties of shape, position and direction).
- To provide parents with an outline of expectations in Geometry (properties of shape, position and direction).
- To ensure continuity and progression in the children's learning of Geometry (properties of shape, position and direction), in relation to the following areas:

Geometry (properties of shape, position and direction) , including:

Shape and Space

In order for children to gain sound knowledge and understanding of Geometry (properties of shape, position and direction) in general, we must adhere to the following principles, in order to avoid creating general misconceptions:

a)	Children are shown a wide range of varying examples to avoid creating any common misconceptions.
b)	Links are always made to real life contexts to give the learning meaning.
c)	Children are given opportunities to explore concepts, and discover links and patterns for themselves.
d)	Children experience an equal balance of 2D shape, 3D shape, patterns and symmetry, angles and co-ordinates and compass points.
e)	Children have the opportunity to carry out investigations involving shape and space.
f)	Children have the opportunity to use ICT to support their understanding of shape and space.
g)	Children progress through the steps outlined, and do not repeat the same learning.

(i) Mathematical Vocabulary

Children need to acquire appropriate vocabulary so that they can participate in the activities and lessons that are part of classroom life. There is, however, an even more important reason: mathematical language is crucial to children's development of thinking. If children don't have the vocabulary to talk about shape, space and measures, they cannot make progress in understanding these areas of mathematical knowledge. Teachers need to plan the introduction of new words in a suitable context, for example, with relevant objects, apparatus, pictures or diagrams. They must explain their meanings carefully and rehearse them several times. Teachers must encourage their use in context, particularly through questioning and children to use the terminology in their explanations and reasoning. Every opportunity must be taken to draw attention to the words in whole class, group and individual contexts. The final stages are learning to read and write new mathematical vocabulary in a range of circumstances, ultimately spelling the relevant words correctly, especially when justifying their ideas and explaining the processes.

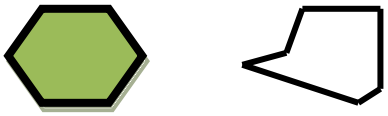
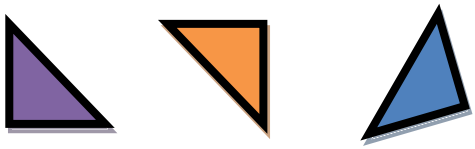
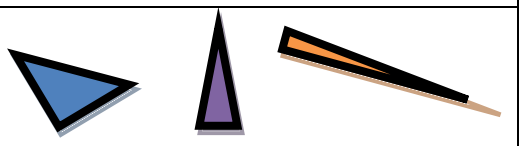
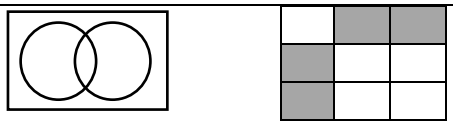
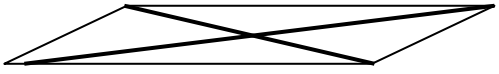
The following table outlines the progression of mathematical vocabulary in relation to Geometry (properties of shape, position and direction).

	KS1	Year 3	Year 4	Year 5	Year 6
Generic	Shape, pattern Flat Curved, straight Round Hollow, solid Corner Face, side, edge, end Sort Make, build draw	**KS1 words plus:** Point, pointed Surface Acute Obtuse Reflex Right angle	**KS1 and Year 3 words plus:** Vertex Vertices Layer Diagram Line Construct, sketch Radius, diameter Net Angle Base Square-based Regular, irregular Open, closed	**KS1, Year 3 and 4 words plus:** Congruent Concentric Arc Intersecting, intersection Plane Tangram Concave Convex	**KS1, Year 3, 4 and 5 words plus:**
2D Shape	Circle Triangle Square Rectangle Star	**KS1 words plus:** Circular Triangular Rectangular Pentagon Hexagon Octagon Right-angled quadrilateral semi-circle	**KS1 and Year 3 words plus:** Pentagonal Hexagonal Octagonal Two-dimensional Equilateral, Isosceles Oblong Heptagon Polygon Regular Irregular	**KS1, Year 3 and 4 words plus:** Scalene Rhombus Kite Parallelogram trapezium	**KS1, Year 3, 4 and 5 words plus:** **Circumference**
3D Shape	Cube Pyramid Sphere Cone	**KS1 words plus:** Cuboid Cylinder Pyramid Surface Prism Hemi-sphere Vertex Vertices	**KS1 and Year 3 words plus:** Three-dimensional Spherical Cylindrical Tetrahedron Polyhedron Base Square based Net	**KS1, Year 3 and 4 words plus:** Octahedron dodecahedron	**KS1, Year 3, 4 and 5 words plus:**
Patterns and Symmetry	Size Bigger, larger, smaller Symmetrical Pattern	**KS1 words plus:** Line of symmetry Fold Mirror line	**KS1 and Year 3 words plus:** Reflect	**KS1, Year 3 and 4 words plus:** Axis Reflective symmetry	**KS1, Year 3, 4 and 5 words plus:** **Plane**

	Repeating match	Reflection			
Position, Direction and Movement	Position Over, under Above, below Top, bottom, side On, in Outside, inside Around, In front, behind Front, back Before, after Beside, next to Opposite Apart Between Middle, edge Corner Direction Left, right Up, down Forwards, backwards, sideways Across Close, far, near Along Through To, from, towards, away from Movement Slide Roll Turn stretch	**KS1 words plus:** Underneath Centre Journey Whole turn Half turn Quarter turn Route Higher, lower Clockwise, anti-clockwise Right angle Straight line	**KS1 and Year 3 words plus:** Translation Map, plan Ascend, descend Grid Row, column Compass point North, East, South, West Horizontal, vertical Diagonal Angle Origin Co-ordinates North-east, north-west, south-east, south-west Rotate Degree Ruler, set square Angle measurer Compasses	**KS1, Year 3 and 4 words plus:** Parallel, perpendicular x-axis, y-axis quadrant rotation acute obtuse protractor relfex	**KS1, Year 3, 4 and 5 words plus:**

2D Shape

In order for children to gain sound knowledge and understanding of 2D shape, we must adhere to the following principles, in order to avoid creating general misconceptions:

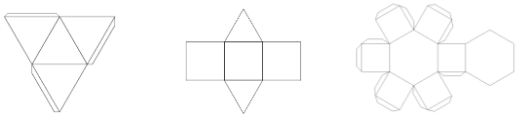
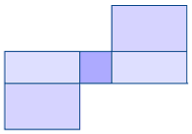
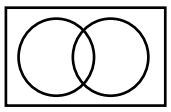
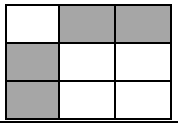
a) Children experience irregular, as well as regular shapes.	
b) Children experience shapes in varying orientations	
c) Children experience shapes and properties of shape (e.g. perpendicular lines) in real life examples, as well as in standard mathematical shapes.	E.g. the clock is circular, the windows are rectangular etc.
d) Children have opportunities to draw and make shapes, as well as name them.	E.g. using pencil, straws, geo-boards and elastic bands, card and scissors, paint etc.
e) Children explore how shapes are used in art and design, and in religious and cultural symbols.	
f) Children experience a wide range of triangular shapes, so that we avoid the misconception that all triangles are equilateral.	
g) Children experience using a set of properties to match to a 2D shape, rather than just seeing a shape and describing its properties.	E.g. My shape has 4 sides and no parallel lines. What shape am I? (kite)
h) Children experience sorting shapes using comparisons of properties as well as experiencing sorting shapes using their own criteria and understanding using different criteria will result in shapes being separated into different groups.	E.g. has parallel lines, does not have parallel lines
i) Children experience using a range of Venn, Caroll and Tree diagrams as tools for sorting 2D shapes.	
j) Children understand that some shapes fit more than one criteria.	E.g. A triangle can be both isosceles and scalene. A square is a special type of rectangle.
k) Children experience shapes with concave edges, as well as convex.	
l) Children understand that diagonal lines are not always at 45º.	

There should be a clear progression in the teaching and learning of 2D shape throughout the year groups.

	KS1	Year 3	Year 4	Year 5	Year 6
2D shape names	Name familiar 2-D shapes such as circle, square and triangle. Recognise and name shapes in the outdoor environment.	Names and properties of **2-D shapes** including pentagons, hexagons and octagons, both regular and irregular. Recognise shapes in different orientations.	Name quadrilaterals including rhombus, parallelogram, trapezium and kite. Name equilateral triangles and isosceles triangles and know the term polygon and that polygons can be regular or irregular.	Name equilateral triangles and isosceles triangles and heptagons, and know the term polygon and that polygons can be regular or irregular. Identigy concave and convex lines/polygons.	Name all types of triangle equilateral, isosceles, scalene, and right-angled. To illustrate and name parts of a circle.
Properties and sorting	Use computer programmes to sort and match 2D shapes, using properties. Recognise how shapes fit together and why. Describe shapes.	Classify shapes according to their properties. Ask yes or no questions about a shape in order to identify it. Use simple Carroll diagrams and Venn diagrams.	Choose a shape to match a property i.e. reversing the process. Use a tree diagram to classify shapes. To identify acute and obtuse angles.	Classify polygons, using Carroll or Venn diagrams and **justify their reasoning**.	Investigate properties such as the diagonals of shapes, and parallel and perpendicular lines.
Constructing/ drawing	Use pictures to represent what they see. Use shapes to draw around to create pictures.	Use pin-boards to make shapes. Draw regular and irregular 2D shapes with reflective symmetry.	Combine 4 squares to make a new shape. Name the new shape by counting edges. Create shapes using a variety of equipment, e.g. folding cutting, constructions kits. To help identify lines of symmetry.	Draw polygons on triangular paper. Draw given angles and measure them in degrees. To draw lines to the nearest millimetre.	Draw different types of triangle using pencil and paper. Measure dimensions of shapes. Draw shapes with parallel and perpendicular lines. Draw shapes from given dimensions and angles. To identify and find missing angles.
Problem Solving		Solve puzzles such as 'How many rectangles can you see in this diagram?' Visualise shapes to solve problems.	Investigate ways of folding shapes into halves/quarters etc. Discuss properties problems such as 'can a triangle have 2 right angles?.	Explore polygons that have equal sides but unequal angles and vice versa. Investigate the maximum number of right angles possible in all polygons. Identify missing angles and lengths.	Investigate shapes that can be made from placing squares/triangles edge to edge.

(ii) 3D Shape

In order for children to gain sound knowledge and understanding of 2D shape, we must adhere to the following principles, in order to avoid creating general misconceptions:

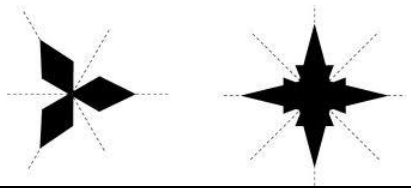
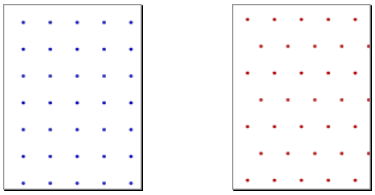
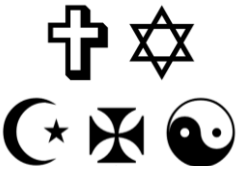
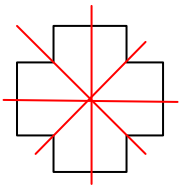
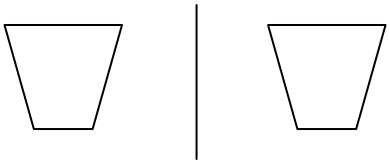
a) Children experience irregular, as well as regular shapes.	
b) Children experience shapes and properties of shape (e.g. perpendicular lines) in real life examples, as well as in standard mathematical shapes	E.g. pencil cases, Toblerone bars etc.
c) Children have opportunities to draw and make nets of shapes.	
d) Children explore how 3D shapes are used in art and design.	E.g. sculptures
e) Children experience nets of shapes that don't always create a complete 3d shape.	
f) Children experience different cross sections of 3D shapes, including diagonal cuts.	
g) Children experience using a set of properties to match to a 3D shape, rather than just seeing a shape and describing its properties.	E.g My shape has 4 identical triangular faces. What shape am I? (triangular based pyramid)
h) Children experience sorting shapes using comparisons of properties as well as experiencing sorting shapes using their own criteria and understanding using different criteria will result in shapes being separated into different groups.	E.g Has perpendicular faces, does not have perpendicular faces.
i) Children experience using a range of Venn, Caroll and Tree diagrams as tools for sorting 3D shapes.	 
j) Children have opportunities to create 3D shapes as well as name them.	E.g. Using Plastercine, Lego, k'nex, straws etc.
k) Children experience making scale 3D models.	E.g. Children make models of their bedrooms.
l) Children experience unfolding packaging to explore their nets and experience how there can be different nets for the same 3D shape.	E.g. unfolding smarties tubes, cereal boxes and toblerone bars.
m) Children experience visualising 3D shapes from 2D shapes.	E.g. children re-create a 3D structure using multilink, from a photograph of the model.

There should be a clear progression in the teaching and learning of 3D shape across all year groups. Throughout the year groups.

	KS1	Year 3	Year 4	Year 5	Year 6
3D shape names	Name cones, cubes, cuboids and spheres	Name shapes in different orientations, and from 2D representations	Name various prisms	Name various pyramids	To build simple 3D shapes.
Properties and sorting	Talk about shapes using corner, edge, side, flat, straight and round Identify similarities and differences Select a shape by listening to descriptions. Use simple Venn diagrams	Predict which 3D shapes will roll and which will not. Sort using criteria such as 'has a triangular face, does not have a triangular face'. Use simple Carroll diagrams to develop understanding of 'not'. Sort and classify according to own criteria,	Know that prisms have the same cross section throughout its length and identical faces at both ends Sort shapes using criteria such as vertices, edges and corners Use Carroll diagrams with 2 criteria	Identify shapes in a 'feely bag' based on properties.	Know whether the amount of edges meeting at a vertex is the same for all vertices in a shape, or different. Identify parallel and perpendicular edges Compare and classify geometric shapes.
Constructing	Use pictures to represent what they see Use shape blocks to build structures such as bridges.	Use construction kits to build models and count their faces Use interlocking cubes to create shapes shown in 2D pictures	Build an unseen shape from a description of properties	Understand and create nets Recreate 3D model from photographs	To make and draw a range of accrate nets of a range of shapes including prisms and pyramids.
Problem Solving		investigate statements about different shapes. Justify and explain different classifications of shapes. Find 3D shapes in the environment and solve real life problems.	Investigate general statements e.g.' the number of edges of a prism is always a multiple of 3'	Explore different cuboids that can be made from a set numbers of cubes (set volume)	Explore finding all possible nets for a cube. To visualise where patterns drawn on a 3D shape will occur on its net.

(iii) Patterns and Symmetry

In order for children to gain sound knowledge and understanding of patterns and symmetry, we must adhere to the following principles, in order to avoid creating general misconceptions:

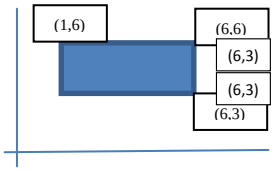
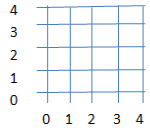
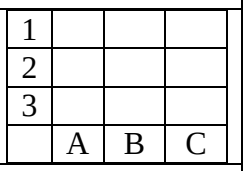
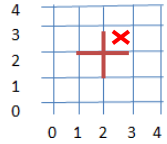
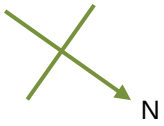
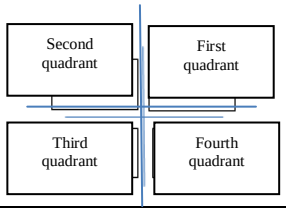
a) Children experience symmetry around non horizontal and vertical lines.	E.g. 
b) Children experience rotational symmetry, as well as lines of symmetry.	E.g. 
c) Children experience symmetry on isometric, as well as squared paper.	E.g. 
d) Children recognise the lines of symmetry in real life examples.	E.g. road signs, flags, insects, capital letters etc. 
e) Children explore how symmetry is used in art and design, and in religious and cultural symbols.	E.g. 
f) Children experience that often more than one line of symmetry is present.	E.g. 
g) Children experience identifying and drawing symmetry and reflections where the shape is located away from the reflection line, and where not all lines are parallel/perpendicular.	E.g. 

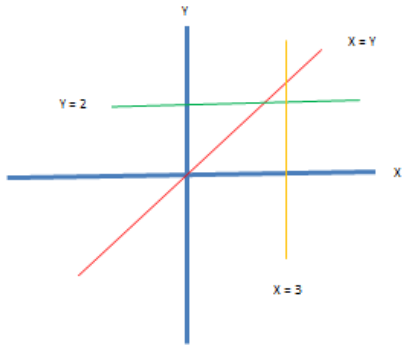
There should be a clear progression in the teaching and learning of patterns and symmetry throughout the year groups.

	KS1	Year 3	Year 4	Year 5	Year 6
Patterns	Createpatterns using familiar objects Use computer programmes to create patterns	Create patterns using several shapes. Describe and discuss patterns. Find missing shapes in patterns and explain why. Create symmetrical patterns	Create symmetrical patterns using shapes or peg boards.	Generate complex patterns and look at tessellations.	Create and analyse patterns of shapes algebraically.
Symmetry		Recognise symmetry in objects and pictures. Use different practical techniques to experiment with symmetry.	Use a mirror or folding to check symmetry. Complete symmetrical pictures. Identify 2D shapes that are symmetrical.	Identify and create shapes that are not symmetrical Understand that shapes can have multiple lines of symmetry	To create shapes with multiple lines of symmetry. To understand planes of symmetry.
Problem solving	Use patterns to solve problems e.g. what will be the next shape in the pattern?	Explain how to continue a pattern. Investigate symmetry by folding, using mirrors etc.	Create all possible symmetrical patterns out of a prescribed set of shapes. Investigate the link between regular and irregular shapes and symmetry.	Investigate symmetry of 2D shapes e.g. 'Is there a link between the number of sides and the number of lines of symmetry?'	Solve problems such as 'place 8 squares together to make a shape with 2 lines of symmetry. How many different ways can you do it?' Justify your answers.

(iv) Coordinates, translation and reflection.

In order for children to gain sound knowledge and understanding of coordinates, translation and reflection, we must adhere to the following principles, in order to avoid creating general misconceptions:

a) Children experience a wide variety of scales, other than steps of 1.	E.g. scales increasing in multiples 2, 3, 5, 10, 0.5, 0.1 etc.
b) Children experience problems using unlabelled axis.	E.g. 
c) Children understand the difference co-ordinates of line intersections, compared to co-ordinates of spaces.	E.g.  
d) Children experience co-ordinates in real life contexts.	E.g maps, A-Z etc.
e) Children experience co-ordinates of points which are not always at intersections.	E.g. 
f) Children experience compass points where North is not necessarily positioned vertically.	E.g. 
g) Children recognise that (4,1) and (1,4) have different positions.	E.g. Along the corridor and up the stairs!
h) Children make links between co-ordinates and compass points.	E.g. moving one step west from point (5,2) will get you to point (4,2).
i) Children experience all 4 quadrants and know that they are named in a specific order.	E.g. 
j) Children experience locating missing points of shapes on grids, and calculating their co-ordinates.	E.g. See example (b)
k) Children experience shapes that cross into more than one quadrant.	E.g. 

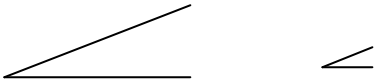
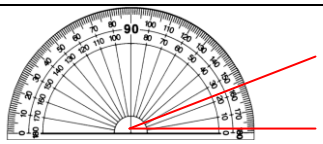
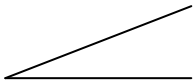
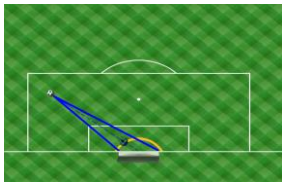
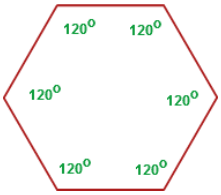
l) Children understand that you can create and name lines on a co-ordinate grid.	E.g. 

There is a clear progression of skills across all year groups.

	KS1	Year 3	Year 4	Year 5	Year 6
Reflection		Understand that the relationships between symmetry and a reflection. Use mirrors to help identify lines of symmetry.	Understand that shapes can be reflected e.g in water.	Predict where a shape will be after a reflection along one of its sides Use ICT to reflect shapes. To reflect a a shape in all 4 quadrants.	Reflect shapes where not all sides of the shape are parallel or perpendicular to the mirror line
Translation		Describe movements between positions – left, right, 2 squares.	Describe movements between positions as translation (left, right, up down).	To translate a shape (in all 4 quadrants).	To draw and translate shapes on the coordinate plane. To express translations algebraically.
Coordinates			To plot specific points. To use coordinate plotting ICT tools. To describe position on a 2D grid as coordinates. To draw a pair of axes.	To use a 2D grid in all 4 quadrants.	To describe positions on all 4 quadrants. To draw and label all 4 quadrants with equal scaling. To use the properties of shapes to predict missing coordinates.

h) Angles

In order for children to gain sound knowledge and understanding of angles, we must adhere to the following principles, in order to avoid creating general misconceptions:

a) Children know that an angle is a measure of turn.	E.g. Half a turn is equal to 180°
b) Children know that the size of the angle does not relate to the size of the picture.	E.g.  The angles are the same size even though one picture is bigger than the other
c) Children experience angles in various orientations, not just on a horizontal plane.	E.g. 
d) Children know when to use the inner and outer scales on a protractor.	E.g.  20° or 160° ?
e) Children routinely estimate the size of an angle before measuring it, using their knowledge of acute, obtuse and reflex angles.	E.g. this angle is acute, so I know it is going to measure less than 90° 
f) Children make links the angles in real life contexts.	E.g. sport, architecture. 
g) Children have the opportunity to draw as well as measure angles.	E.g. To construct a regular shape. 

There should be a clear progression in the teaching and learning of angles.

	KS1	Year 3	Year 4	Year 5	Year 6
Angle **General**	.	Place 2 right angles together and know that they form a straight line Know that a whole turn is 360° or four right angles. Begin to use terms such as acute, obtuse, right angle and reflex. To identify angles in the environments. To recognise angles as the properties of a shape. To recognise angles as a description of a turn.	Use terms such as acute, obtuse, right angle and reflex in real life contexts. Link right angles and perpendicular lines.	Calculate missing angles on a straight line by subtracting from 180°. To compare and order angles. To estimate and compare angles.	Know that angles in triangle equal 180°, and angles in a quadrilateral and about a point equal 360° Use these facts to calculate missing angles.
Angles in shapes	Describe angles in shapes as being smaller than, equal to, or bigger than a right angle. Use a set square to compare angles inside a shape	Identify right angles in shapes.	Establish that all of the angles in a regular shape are the same. Discover that opposite angles of a parallelogram are equal. Understand that irregular shapes have different angles.	Measure angles inside irregular shapes and recognise that they are different.	Investigate the angles inside quadrilaterals to establish which are the same Identify missing angles in shapes.
Constructing angles	Use strips of card to create an angle maker to show angles smaller than, equal to, or bigger than a right angle.	Use a ruler and guide lines to draw shapes with right angles.	. Draw regular shapes using given measures.	Draw angles using a protractor.	Draw shapes accurately using a protractor. Use given angles to construct 2D shapes.
Measuring angles		Estimate angles of 90°, 60°, 45° and 30°, Use set squares to check and measure	Use a protractor to measure angles in regular shapes	Make sensible estimates of angles less than 180°, and measure them within 5° of accuracy using a protractor	Measure angles between lines of symmetry Record angles in regular polygons against the number of sides and describe the relationship they discover

There should be a clear progression in the teaching and learning of co-ordinates and compass points. Children should progress through the following 6 steps, all the time keeping in mind the principles set out above.

Review

This policy is monitored through:

- Regular scrutiny of children's books
- Regular monitoring of teaching plans
- Evaluation and review of assessment data
- Lesson observations to monitor the quality of teaching and implementation of teaching plans
- Pupil interviews

This policy is reviewed by staff and governors every three years. The next review is due Feb 2020. Parents are most welcome to view copies of this document via the school's website and comments are invited from anyone involved in the life of the school.