Geometry

Teaching for mastery in primary maths
Geometry

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Introduction

In these chapters, pupils will classify shapes with increasingly complex geometric properties and learn the vocabulary needed to describe them.

To begin with, pupils will develop their ability to recognise, describe, draw, compare and sort different shapes using appropriate vocabulary. As they progress, pupils will draw shapes with increasing accuracy, develop the mathematical reasoning required to analyse them and their properties, and confidently describe the relationships between them.

The study of geometry offers pupils an opportunity to reinforce and extend their understanding of number and measurement, especially as they use measuring instruments with increasing accuracy.

Chapter 1: Recognising 2D and 3D shapes

In this chapter, pupils handle, recognise and name common 2D and 3D shapes.

Early on, pupils develop a fluency in naming 2D and 3D shapes, as well as the ability to identify them in everyday objects. They identify common 2D shapes as being rectangles, circles or triangles and recognise that a square is a special kind of rectangle. In terms of common 3D shapes, pupils are able to identify cubes, cuboids, pyramids and spheres. They use 3D shapes to understand 2D shapes, by exploring their surfaces (ie, a cube can be used to understand a square).

Pupils recognise 2D and 3D shapes in different sizes and orientations. They also know that rectangles, triangles, cuboids and pyramids are not always similar to one another. They recognise and create repeating patterns with objects and shapes.
Chapter 2: 
**Turns**

*In this chapter, pupils describe position, direction and motion, including whole, half, quarter and three-quarter turns.*

Pupils make whole, half, quarter and three-quarter turns in both directions and connect turning clockwise with the movement on a clock face. They use the language of turns to describe position, direction and motion, as well as “left”, “right”, “top”, “middle”, “bottom”, “on top of”, “in front of”, “above”, “between”, “around”, “near”, “close”, “far”, “up”, “down”, “forwards”, “backwards”, “inside” and “outside”.

Chapter 3: 
**Shape and patterns**

*In this chapter, pupils compare, sort, identify and describe the properties of 2D and 3D shapes.*

Although comparing, sorting, ordering and arranging shapes and everyday objects is the formal focus in this chapter, these activities should be integrated throughout learning both within mathematics and beyond in pupils’ everyday lives at home and school.

Pupils handle and name a wide variety of common 2D and 3D shapes, including quadrilaterals, polygons, cuboids, prisms and cones. They identify the properties of each shape and compare and sort them on this basis, using language such as “sides”, “edges”, “vertices” and “faces”.

When it comes to 2D shapes, pupils identify and describe various properties, including the number of sides and lines of symmetry. For 3D shapes, they identify and describe properties, such as the number of edges, vertices and faces. Later, they identify 2D shapes on the surface of 3D ones (eg, a circle on a cylinder), as well as draw 2D shapes and create 3D ones.

Pupils describe repeating patterns made up of shapes, symbols and numbers. They order and arrange combinations of mathematical objects in patterns and sequences, including shapes in different orientations. The patterns they create may be repeating, symmetrical, increasing or decreasing. The more creative, the better!
Chapter 4: Rotation

In this chapter, pupils describe turn and movement in a straight line.

Pupils continue to use mathematical vocabulary to describe position, direction and motion, including movement in a straight line. They distinguish between rotation as a turn and in terms of right angles. They describe quarter, half and three-quarter turns, both clockwise and anti-clockwise.

Pupils describe turn by applying rotations in right angles. This ought to be done in practical contexts. For example, pupils may move themselves, give instructions to other pupils or program robots.

Chapter 5: Making shapes

In this chapter, pupils draw 2D shapes and make 3D shapes using modelling materials.

Pupils’ knowledge of the properties of shapes is extended include to symmetrical and non-symmetrical polygons and polyhedra. They continue to describe the properties of 2D and 3D shapes using technical vocabulary, now including that related to line lengths and angle sizes. They recognise and describe 3D shapes in different orientations.

Building on knowledge of length, weight, area and volume, pupils measure the perimeter of simple 2D shapes. They also connect decimals and rounding to the drawing and measuring straight lines in a variety of contexts.
Chapter 6: Angles

In this chapter, pupils recognise angle size as being the property of shape or the description of a turn.

Pupils recognise angles as being one of the properties of shape or the description of a turn. They identify right angles, recognise that two right angles make a half-turn, that three make three-quarters of a turn and that four make a complete turn. They also say whether angles are “greater than” or “less than” a right angle.

Additionally, pupils identify horizontal and vertical lines, as well as pairs of perpendicular and parallel lines.

Chapter 7: Classifying quadrilaterals and triangles

In this chapter, pupils compare and classify geometric shapes, including quadrilaterals and triangles.

Pupils compare and classify geometric shapes, including quadrilaterals and triangles, based on their properties and sizes in a variety of contexts. They continue to classify shapes using geometrical properties, extending this to the identification of different triangles (eg, isosceles, equilateral, scalene) and quadrilaterals (eg, parallelogram, rhombus, trapezium).

Chapter 8: Comparing angles

In this chapter, pupils identify acute and obtuse angles and compare and order angles up to two right angles by size.

Pupils extend their work on right angles and horizontal, vertical, perpendicular and parallel lines by using language such as “acute” and “obtuse” to compare and order angles. Ultimately, this helps them to prepare for protractor use. In addition, pupils also compare lengths and angles to decide whether a polygon is regular or irregular.
Chapter 9: Symmetry

In this chapter, pupils identify lines of symmetry in 2D shapes and complete symmetrical shapes.

Pupils observe symmetry in a variety of contexts across the curriculum, such as art and PE. Using a variety of media, they draw symmetric patterns to become familiar with different orientations of lines of symmetry. They also recognise line symmetry in a range of diagrams, including where it does not dissect the original shape.

Additionally, pupils identify lines of symmetry in 2D shapes, even when the lines are not horizontal or vertical. And, given a line of symmetry and one half of a symmetrical figure, they complete the figure.

Chapter 10: Coordinates and translations

In this chapter, pupils describe positions on a 2D grid as coordinates in the first quadrant.

Although pupils will have worked with graphs in previous chapters and topics, this is the first time they’ve been formally introduced to coordinates. The focus is on the first quadrant (where the x- and y-axis values are positive), as pupils are yet to meet negative numbers.

In time, pupils learn to draw a pair of axes, including equal scales and integer labels. They read, write and use pairs of coordinates, (eg, (2,5)), including using ICT tools to plot them.

Pupils describe positions as coordinates, as well as movements between positions as translations of a given unit to the left, right, up and down. They also plot specified points and draw sides to complete a given polygon.
Chapter 11: Exploring 2D representations of 3D shapes

In this chapter, pupils identify 3D shapes from 2D representations.

Pupils identify 3D shapes, including cubes and cuboids, from 2D representations. They experience many practical, real-life examples of the use of this, as well as across the curriculum (eg, in art and design).

Chapter 12: Drawing, measuring, comparing and finding angles

In this chapter, pupils reason and solve problems based on their understanding of angle size.

At this stage, pupils know that angles are measured in degrees and are able to draw and measure them. They develop accuracy when drawing lines with a ruler to the nearest millimetre and when measuring with a protractor. They use conventional markings for parallel lines and right angles.

Pupils make deductions about missing angles using angle sum facts and other properties, and relate these to missing number problems. In solving problems, pupils estimate and compare acute, obtuse and reflex angles. They also identify angles at a point in one whole turn (360°), angles at a point on a straight line or in a half-turn (180°) and other multiples of 90°.

Additionally, pupils use their knowledge of the properties of rectangles to deduce related facts and find missing lengths and angles. They distinguish between regular and irregular polygons based on reasoning about equal sides and angles.

Pupils start to use the term “diagonal” and make conjectures about the angles formed between sides, as well as between diagonals, parallel sides and other properties of quadrilaterals. They may use dynamic, geometry-focused ICT tools to support this.
Chapter 13:
Reflection and translation

In this chapter, pupils explore reflection and translation as transformations of a shape.

Building on previous work on symmetry and translations, pupils now identify, describe and
represent the position of a shape following a reflection or translation using the appropriate
language. In doing so, they demonstrate their understanding of the fact that although the
shape has moved, it has not changed.

Pupils recognise and use reflection and translation in a variety of diagrams. They continue
to explore this using the first quadrant of a 2D coordinates grid. Reflection should be in
lines that are parallel to the axes.

Chapter 14:
Missing angles and lengths

In this chapter, pupils use angle properties to find missing angles.

Building on learning from previous chapters, pupils make deductions about missing angles
using angle sum facts, as well as other properties, and relate these to missing number
problems. Additionally, they recognise angles where they meet at a point, are on a straight
line or are vertically opposite.

Chapter 15:
Building and drawing 2D and 3D shapes and nets

In this chapter, pupils draw 2D shapes and build 3D shapes.

Pupils draw 2D shapes to given dimensions and angles. They recognise, describe and
build simple 3D shapes, including making nets. They experience many practical, real-life
examples of the use of this, as well as across the curriculum (eg, in art and design).
Chapter 16:
Classifying shapes

In this chapter, pupils classify geometric shapes and find unknown angles.

Pupils continue to compare and classify geometric shapes based on their properties and sizes. They find unknown angles in any triangles, quadrilaterals and regular polygons.

Chapter 17:
Circles

In this chapter, pupils learn about the parts of a circle.

Pupils illustrate and name the parts of a circle, including its radius, diameter and circumference, and know that the diameter is twice the length of the radius. This knowledge is fundamental in preparing them to reason about the properties of circles at KS3, when they will explore the relationship between the length of the radius and the circumference.

Chapter 18:
Coordinates, translation and reflection

In this chapter, pupils use coordinates in all four quadrants and translate and reflect shapes using negative coordinates.

Pupils build on their existing knowledge of coordinates and transformations by using all four quadrants on a coordinate grid. With the introduction of negative coordinates, there is an opportunity to explore reflection in the x- and y-axes.

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