|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Investigating properties of shapes* | | | | *4 hours* |
| **Key concepts** | | **The Big Picture**: [Properties of Shape progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPropertiesShape.xlsx) | | |
| * use the properties of rectangles to deduce related facts and find missing lengths and angles * distinguish between regular and irregular polygons based on reasoning about equal sides and angles | | | | |
|  | | | | |
| Possible learning intentions | | Possible success criteria | | |
| * Explore the properties of rectangles * Investigate polygons | | * Know the definition and properties of a rectangle * Use the properties of rectangles to find missing lengths and angles * Use the properties of rectangles to find points on a coordinate grid * Know the definition of a polygon * Know the difference between a regular and an irregular polygon * Identify whether or not a polygon is regular * Use the properties of polygons to find missing lengths and angles | | |
| Prerequisites | Mathematical language | | Pedagogical notes | |
| * Identify right angles * Use coordinates in the first quadrant   **Bring on the Maths+: Moving on up!**  Position and direction: v2 | Rectangle  Square  Quadrilateral  (Regular / irregular) polygon, pentagon, hexagon, octagon  (Right) angle  Parallel  Perpendicular  Coordinates  **Notation**  Dash notation to represent equal lengths in shapes and geometric diagrams  Right angle notation  (Cartesian) coordinates | | Note that a square is a rectangle but a rectangle is not necessarily a square.  A square is a regular quadrilateral.  Pupils may also know names of other polygons such as heptagon (7 sides), nonagon (9 sides), decagon (10 sides) and dodecagon (12 sides).  NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National+Curriculum+Glossary.pdf)  **Common approaches** | |
| Reasoning opportunities and probing questions | Suggested activities | | Possible misconceptions | |
| * Convince me that a square is a rectangle * Show me an example of a hexagon. And another, and another, … * What is the same and what is different: | KM: [Shape work](http://kangaroomaths.com/free_resources/teaching/geometry/shape_work.docx): Rectangle, Packing squares  NRICH: [Egyptian Rope](http://nrich.maths.org/public/viewer.php?obj_id=982)  NRICH: Use the [virtual geoboard](http://nrich.maths.org/2883) to explore how regular polygons can be made using equally spaced points around a circle, and ways of constructing rectangles on any of the three type of board  KM: [6 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/6_point_circles.pdf), [8 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/8_point_circles.pdf) and [12 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/12_point_circles.pdf) can be used to support the above idea  **Learning review**  [www.diagnosticquestions.com](http://www.diagnosticquestions.com) | | * Some pupils may think that a ‘regular’ polygon is a ‘normal’ polygon * Some pupils may think that all polygons have to be regular * Some pupils may use coordinates the wrong way round; for example, interpreting the point (3,2) as 3 up and 2 across (to the right) | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Investigating properties of shapes* | | | | *6 hours* |
| **Key concepts** | | **The Big Picture**: [Properties of Shape progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPropertiesShape.xlsx) | | |
| * compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons * illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius | | | | |
|  | | | | |
| Possible learning intentions | | Possible success criteria | | |
| * Investigate properties of 2D shapes * Investigate angles in polygons * Understand and use the vocabulary of circles   **Bring on the Maths+: Moving on up!**  Properties of shapes: v5 | | * Know the definitions of special triangles * Know the definitions of special quadrilaterals * Classify 2D shapes using given categories; e.g. number of sides, symmetry * Know the angle sum of a triangle * Know the angle sum of a quadrilateral * Know how to find the angle sum of a any polygon * Use the angle sum of a triangle to find missing angles * Find the missing angle in an isosceles triangle when only one angle is known * Use the angle sum of a quadrilateral to find missing angles * Know how to find the size of one angle in any regular polygon | | |
| Prerequisites | Mathematical language | | Pedagogical notes | |
| * Know the properties of rectangles * Know the difference between a regular and an irregular polygon * Add and subtract numbers up to three digits | Quadrilateral, Square, Rectangle, Parallelogram, (Isosceles) Trapezium, Kite, Rhombus, Delta, Arrowhead  Triangle, Scalene, Right-angled, Isosceles, Equilateral  Polygon, Regular, Irregular  Pentagon, Hexagon, Octagon, Decagon, Dodecagon  Circle, Radius, Diameter, Circumference, Centre  Parallel  Diagonal  Angle  **Notation**  Dash notation to represent equal lengths in shapes and geometric diagrams  Right angle notation | | Ensure that pupils do not use the word ‘diamond’ to describe a kite, or a square that is 45° to the horizontal. ‘Diamond’ is not the mathematical name of any shape.  A square is a special case of a rectangle. An oblong is a rectangle that is not a square.  A rhombus is a special case of a parallelogram.  All polygons up to 20 sides have names, although many have alternatives based on either Latin or Greek.  Splitting any polygon into triangles (by drawing all diagonals from one vertex) will allow pupils to find the angle sum of the polygon.  NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National+Curriculum+Glossary.pdf)  **Common approaches**  *All teachers refer to a ‘delta’ instead of an ‘arrowhead’*  *Every classroom has a set of* [*triangle posters*](http://kangaroomaths.com/free_resources/display/triangles.pdf) *and* [*quadrilateral posters*](http://kangaroomaths.com/free_resources/display/quadrilaterals.pdf) *on the wall* | |
| Reasoning opportunities and probing questions | Suggested activities | | Possible misconceptions | |
| * Convince me that a rhombus is a parallelogram * Jenny writes that ‘Diameter = 2 × Radius’. Kenny writes that ‘Radius = 2 × Diameter’. Who is correct? * What is the same and what is different: a square and a rectangle? | KM: [Shape work](http://kangaroomaths.com/free_resources/teaching/geometry/shape_work.docx): Many of the activities are suitable for this unit.  KM: [Dotty activities](http://kangaroomaths.com/free_resources/teaching/geometry/3x3_4x4_5x5_dotty_activities.docx)  KM: [Investigating polygons](http://kangaroomaths.com/free_resources/teaching/geometry/investigating_polygons.docx). Tasks one and two.  KM: [Special polygons](http://kangaroomaths.com/free_resources/teaching/geometry/special_polygons.docx)  NRICH: [Where Are They?](http://nrich.maths.org/public/viewer.php?obj_id=1058)  NRICH: [Round a Hexagon](http://nrich.maths.org/8095)  NRICH: [Quadrilaterals](http://nrich.maths.org/public/viewer.php?obj_id=962)  KM: [6 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/6_point_circles.pdf), [8 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/8_point_circles.pdf) and [12 point circles](http://kangaroomaths.com/free_resources/teaching/geometry/12_point_circles.pdf) can be used to support and extend the above idea  **Learning review**  [www.diagnosticquestions.com](http://www.diagnosticquestions.com) | | * Some pupils may think that a ‘regular’ polygon is a ‘normal’ polygon * Some pupils may think that all polygons have to be regular * Some pupils may think that a square is only square if ‘horizontal’, and even that a ‘non-horizontal’ square is called a diamond * The equal angles of an isosceles triangle are not always the ‘base angles’ as some pupils may think | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Investigating properties of shapes* | | | | *6 hours* |
| **Key concepts** | | **The Big Picture**: [Properties of Shape progression map](http://kangaroomaths.com/free_resources/planning/KM_MathematicsProgression_GeometryPropertiesShape.xlsx) | | |
| * identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres * derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus; and triangles and other plane figures using appropriate language | | | | |
|  | | | | |
| Possible learning intentions | | Possible success criteria | | |
| * Investigate the properties of 3D shapes * Explore quadrilaterals * Explore triangles | | * Know the vocabulary of 3D shapes * Know the connection between faces, edges and vertices in 3D shapes * Visualise a 3D shape from its net * Recall the names and shapes of special triangles and quadrilaterals * Know the meaning of a diagonal of a polygon * Know the properties of the special quadrilaterals (including diagonals) * Apply the properties of triangles to solve problems * Apply the properties of quadrilaterals to solve problems | | |
| Prerequisites | Mathematical language | | Pedagogical notes | |
| * Know the names of common 3D shapes * Know the meaning of face, edge, vertex * Understand the principle of a net * Know the names of special triangles * Know the names of special quadrilaterals * Know the meaning of parallel, perpendicular * Know the notation for equal sides, parallel sides, right angles   **Bring on the Maths+: Moving on up!**  Properties of shapes: v1, v2 | Face, Edge, Vertex (Vertices)  Cube, Cuboid, Prism, Cylinder, Pyramid, Cone, Sphere  Quadrilateral  Square, Rectangle, Parallelogram, (Isosceles) Trapezium, Kite, Rhombus  Delta, Arrowhead  Diagonal  Perpendicular  Parallel  Triangle  Scalene, Right-angled, Isosceles, Equilateral  **Notation**  Dash notation to represent equal lengths in shapes and geometric diagrams  Right angle notation | | Ensure that pupils do not use the word ‘diamond’ to describe a kite, or a square that is 45° to the horizontal. ‘Diamond’ is not the mathematical name of any shape.  A cube is a special case of a cuboid and a rhombus is a special case of a parallelogram  A prism must have a polygonal cross-section, and therefore a cylinder is not a prism. Similarly, a cone is not a pyramid.  NCETM: [Departmental workshop: 2D shapes](https://www.ncetm.org.uk/resources/12889)  NCETM: [Glossary](https://www.ncetm.org.uk/public/files/17308038/National+Curriculum+Glossary.pdf)  **Common approaches**  *Every classroom has a set of* [*triangle posters*](http://kangaroomaths.com/free_resources/display/triangles.pdf) *and* [*quadrilateral posters*](http://kangaroomaths.com/free_resources/display/quadrilaterals.pdf) *on the wall*  *Models of 3D shapes to be used by all students during this unit of work* | |
| Reasoning opportunities and probing questions | Suggested activities | | Possible misconceptions | |
| * Show me an example of a trapezium. And another. And another … * Always / Sometimes / Never: The number of vertices in a 3D shape is greater than the number of edges * Which quadrilaterals are special examples of other quadrilaterals? Why? Can you create a ‘quadrilateral family tree’? * What is the same and what is different: Rhombus / Parallelogram? | KM: [Euler’s formula](http://kangaroomaths.com/free_resources/teaching/geometry/eulers_formula.docx)  KM: [Visualising 3D shapes](http://kangaroomaths.com/free_resources/teaching/geometry/visualising_3d_shapes.docx)  KM: [Dotty activities](http://kangaroomaths.com/free_resources/teaching/geometry/3x3_4x4_5x5_dotty_activities.docx): Shapes on dotty paper  KM: [What's special about quadrilaterals?](http://kangaroomaths.com/free_resources/teaching/geometry/special_quadrilaterals.docx)  Constructing quadrilaterals from diagonals and summarising results.  KM: [Investigating polygons](http://kangaroomaths.com/free_resources/teaching/geometry/investigating_polygons.docx). Tasks one and two should be carried out with irregular polygons.  NRICH: [Property chart](http://nrich.maths.org/2927)  NRICH: [Quadrilaterals game](http://nrich.maths.org/2924)  **Learning review**  [www.diagnosticquestions.com](http://www.diagnosticquestions.com) | | * Some pupils may think that all trapezia are isosceles * Some pupils may think that a diagonal cannot be horizontal or vertical * Two line segments that do not touch are perpendicular if they would meet at right angles when extended. Therefore the diagonals of an arrowhead (delta) are perpendicular despite what some pupils may think * Some pupils may think that a square is only square if ‘horizontal’, and even that a ‘non-horizontal’ square is called a diamond * The equal angles of an isosceles triangle are not always the ‘base angles’ as some pupils may think | |