

## SHAPE AND SPACE

### Pupils should be taught to:

Describe and visualise 3-D and 2-D shapes; classify them according to their properties

### As outcomes, Year 4 pupils should, for example:

Use, read and write the words:

*pattern, shape, 2-D, two-dimensional, 3-D, three-dimensional... line, side, edge, face, surface, base, point, angle, vertex, vertices... centre, radius, diameter...*

*net... make, build, construct, draw, sketch...*

and adjectives such as: *curved, straight... regular, irregular...*

*concave, convex... closed, open... circular, triangular, hexagonal, cylindrical, spherical... square-based, right-angled...*

Name, classify and describe 2-D and 3-D shapes:

*circle, semi-circle, triangle, equilateral triangle, isosceles triangle, quadrilateral, rectangle, oblong, square, pentagon, hexagon, heptagon, octagon, polygon... cube, cuboid, pyramid, sphere, hemi-sphere, cylinder, cone, prism, tetrahedron, polyhedron...*

For example:

#### 3-D shapes

Know that in a polyhedron:

- each face is a flat surface and is a polygon;
- an edge is the straight line where two faces meet;
- a vertex is the point where three or more edges meet.

Know that a prism has two identical end faces and the same cross-section throughout its length.

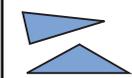
Collect, name and describe examples.

#### 2-D shapes

Know that a polygon is a closed, flat shape with three or more straight sides, and that regular polygons have all their sides and all their angles equal.

Know the angle and side properties of isosceles and equilateral triangles, and use them: for example, to make triangular patterns.

Name and classify polygons.

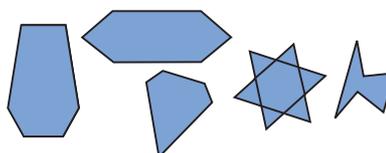
	triangles	quadrilaterals
regular		
irregular	 	  

Know some of their properties. For example:

- all heptagons have seven sides;
- a quadrilateral is any shape with four straight sides;
- the square and the equilateral triangle are examples of regular polygons;
- an isosceles triangle is an example of an irregular polygon;
- a polygon can be concave or convex.

Identify particular shapes from a mixed set.

For example, which of these shapes are hexagons?



**As outcomes, Year 5 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:  
*congruent...*

Continue to name and describe shapes, extending to:  
*scalene triangle... octahedron...*

For example:

**3-D shapes**

Classify solids according to properties such as:

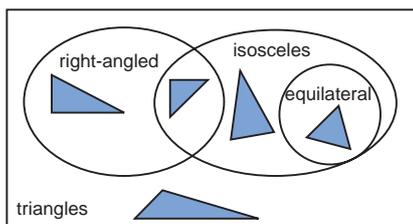
- the shapes of the faces;
- the number of faces, edges, vertices;
- whether or not any face is right-angled;
- whether the number of edges meeting at each vertex is the same or different.

**2-D shapes**

Recognise properties of rectangles such as:

- all four angles are right angles;
- opposite sides are equal and parallel;
- the diagonals bisect one another.

Name and classify triangles.



Know some of their properties. For example:

- in an equilateral triangle all three sides are equal in length and all three angles are equal in size;
- an isosceles triangle has two equal sides and two equal angles;
- in a scalene triangle no two sides or angles are equal;
- in a right-angled triangle one of the angles is a right angle.

Use a 'binary tree' computer program to sort and identify a set of 2-D shapes.

See also reflective symmetry (page 107).

**As outcomes, Year 6 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:  
*concentric... tangram...  
circumference, arc...*

Continue to name and describe shapes, extending to:  
*parallelogram, rhombus, kite, trapezium...  
dodecahedron...*

For example:

**3-D shapes**

Describe properties of 3-D shapes, such as parallel or perpendicular faces or edges.

**2-D shapes**

Name and begin to classify quadrilaterals, using criteria such as parallel sides, equal angles, equal sides, lines of symmetry...

Know properties such as:

- a parallelogram has its opposite sides equal and parallel;
- a rhombus is a parallelogram with four equal sides;
- a rectangle has four right angles and its opposite sides are equal;
- a square is a rectangle with four equal sides;
- a trapezium has one pair of opposite parallel sides;
- a kite has two pairs of adjacent sides equal.

Begin to know properties such as:

- the diagonals of any square, rhombus or kite intersect at right angles;
- the diagonals of any square, rectangle, rhombus or parallelogram bisect one another.

See also reflective symmetry (page 107).

## SHAPE AND SPACE

### Pupils should be taught to:

**Make shapes and patterns with increasing accuracy**

### As outcomes, Year 4 pupils should, for example:

Construct models, shapes and patterns with increasing accuracy. For example:

#### *3-D shapes*

Identify simple nets of 3-D shapes. For example, unfold packets which are cubes or cuboids to identify their nets.

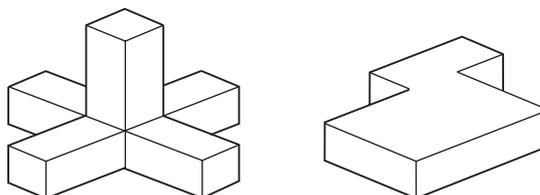
Make polyhedra such as cubes, cuboids, pyramids and prisms, using straws and pipe cleaners to make 'skeleton' shapes, or construction kits to make 'solid' shapes...

Count the number of faces and edges. Recognise properties such as:

- all pyramids have an even number of edges;
- the number of straight edges in a prism is a multiple of 3;
- the number of faces of a pyramid is one more than the number of edges of the base;
- the number of faces of a prism is two more than the number of edges of an end face...

Visualise 3-D shapes from 2-D drawings.

For example, work out the least number of cubes needed to build these shapes.



#### *2-D shapes*

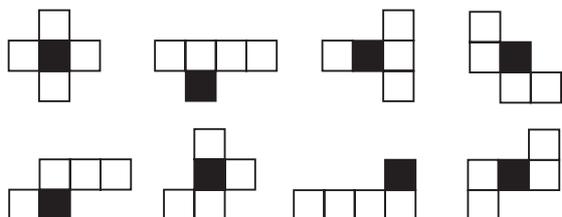
Construct different polygons by paper folding or on a pinboard, and discuss properties such as lines of symmetry.

As outcomes, Year 5 pupils should, for example:

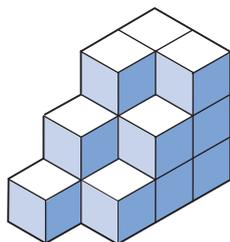
Construct models, shapes and patterns with increasing accuracy. For example:

3-D shapes

Identify the different nets for an open cube (five square faces). (The black square shows each cube's 'base'.)



Visualise 3-D shapes from 2-D drawings. For example, work out the least number of unit cubes needed to turn this shape into a cuboid.

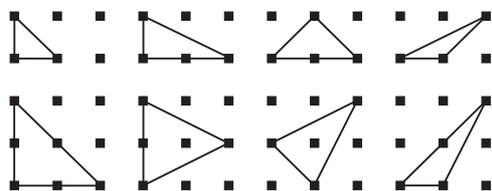


2-D shapes

Use a pinboard to make shapes.

For example, make:

- different triangles on 3 x 3 pinboard;
- different squares on a 5 x 5 pinboard.



Discuss properties such as which of these triangles are scalene, or which has the greatest area.

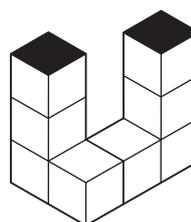
As outcomes, Year 6 pupils should, for example:

Construct models, shapes and patterns with increasing accuracy. For example:

3-D shapes

Identify the different nets for a closed cube (six square faces).

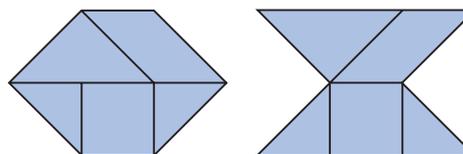
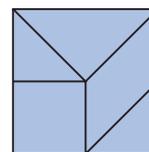
Visualise 3-D shapes from 2-D drawings. For example, find and justify the least number of cubes needed to cover and join the shaded faces.



2-D shapes

Investigate the different polygons that can be made using tangram pieces.

For example, reassemble the five tangram pieces to form hexagons.



Use turtle graphics to draw polygons. Discuss the geometric features of the shapes made.

## SHAPE AND SPACE

### Pupils should be taught to:

Recognise reflective symmetry in 2-D shapes, reflections and translations

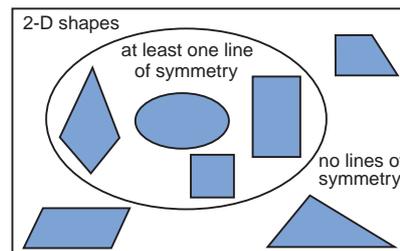
### As outcomes, Year 4 pupils should, for example:

Use, read and write:

*mirror line, line of symmetry, line symmetry, symmetrical, reflect, reflection, translation...*

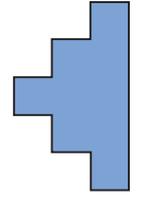
Identify and sketch two or more lines of reflective symmetry, and recognise shapes with no lines of symmetry. For example:

- Identify whether designs, logos, advertisements... have a line of symmetry.
- Classify 2-D shapes according to their lines of symmetry.



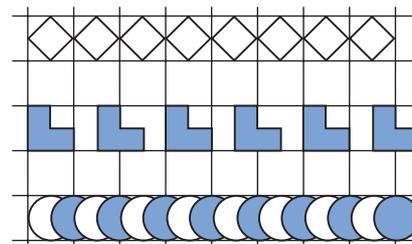
Sketch the reflection of a simple shape in a mirror line parallel to one edge, where the edges of the shape or the lines of the pattern are parallel or perpendicular to the mirror line.

For example:



Know that equivalent points are the same (shortest) distance from the line of symmetry.

Make patterns by repeatedly translating a shape.



Use a computer program to:

- create a pattern and reflect it in a horizontal or vertical line;
- create a 'tile' and translate it repeatedly along a line.

Predict and discuss the patterns made.

### As outcomes, Year 5 pupils should, for example:

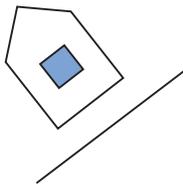
Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:  
*axis of symmetry, reflective symmetry...*

Recognise the number of axes of reflective symmetry in regular polygons. For example:

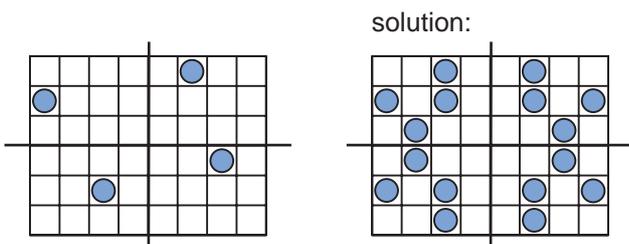
- Draw regular and irregular polygons on squared paper and cut them out. Test for symmetry using a mirror and by folding. Say which fold symmetrically more than once.
- Investigate the lines of symmetry in regular polygons.

Know that the number of lines of symmetry in a regular polygon is equal to the number of sides, so a square has four lines of symmetry and an equilateral triangle has three.

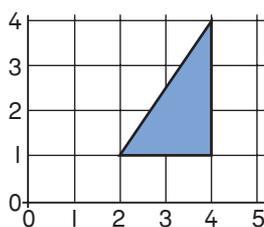
Sketch the reflection of a simple shape in a mirror line parallel to one edge, where the edges of the shape are not all parallel or perpendicular to the mirror line.



Complete symmetrical patterns on squared paper with two lines of symmetry at right angles. For example, complete this pattern:



Sketch the position of a simple shape after it has been translated, say, 2 units to the left.

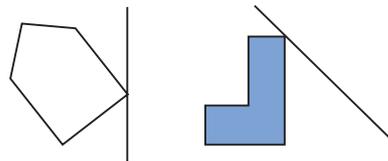


Use a computer program to create a 'tile' and use it by alternately translating the tile and its reflection along a line. Predict and discuss the patterns made.

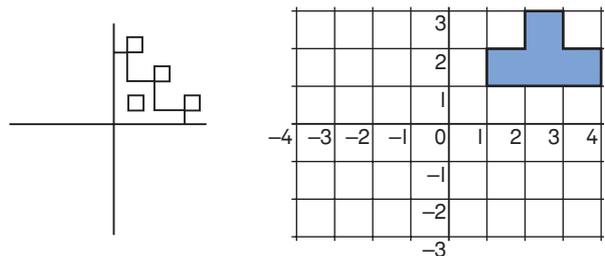
### As outcomes, Year 6 pupils should, for example:

Use, read and write, spelling correctly, the vocabulary from the previous year.

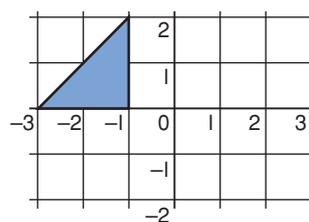
Sketch the reflection of a simple shape in a mirror line touching it at one point, where the edges of the shape are not necessarily parallel or perpendicular to the mirror line.



Sketch the reflection of a simple shape in two mirror lines at right angles, where the sides of the shape are parallel or perpendicular to the mirror line.



Sketch the position of a simple shape after it has been translated, say, 3 units to the right, then 2 units down.



Use a computer program to transform shapes. Predict and discuss the patterns made.

## SHAPE AND SPACE

### Pupils should be taught to:

Recognise positions and directions, and use co-ordinates

### As outcomes, Year 4 pupils should, for example:

Use, read and write:

prepositions and everyday words to describe position and direction...

*position, direction...*

*ascend, descend... journey, route, map, plan...*

*grid, row, column, origin, co-ordinates...*

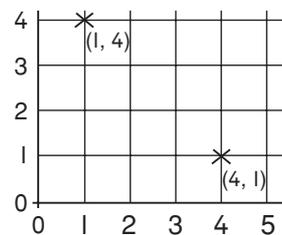
*compass point, north, south, east, west, north-east, north-west, south-east, south-west...*

*horizontal, vertical, diagonal...*

Describe and find the **position of a point on a grid of squares** where the lines are numbered.

Begin to understand the convention that (3, 2) describes a point found by starting from the origin (0, 0) and moving three lines across and two lines up.

Recognise that (4, 1) and (1, 4) describe different points.



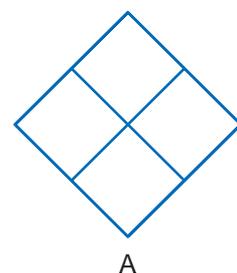
Recognise and identify simple examples of **horizontal or vertical lines** or edges in the environment. For example:

- the edge of the table is horizontal:
- the edge of the door is vertical...

Know that rows on a grid are described as horizontal, columns as vertical, and lines joining opposite corners as diagonals.

Use the eight **compass directions** N, S, E, W, NE, NW, SE, SW. For example:

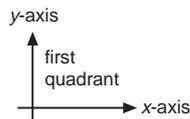
- Describe a south-east route from (1, 4) as going through the points (2, 3), (3, 2), (4, 1) and (5, 0).
- Work out that to travel along the grid lines for a total distance of 5 units from the origin takes you to (0, 5), (1, 4), (2, 3), (3, 2), (4, 1) or (5, 0).
- Describe all the different routes from A to B, travelling only north-east or north-west.



**As outcomes, Year 5 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:  
*x-axis, y-axis... quadrant...  
 parallel, perpendicular...*

**Read and plot points** using co-ordinates in the first quadrant.



Know the convention that (3, 2) describes a point found by starting from the origin (0, 0) and moving three lines across and two lines up.

Respond to questions such as:

- These points are the co-ordinates of the vertices of a shape: (1, 5), (2, 5), (4, 3), (2, 1), (1, 1). What is the name of the shape?
- Three of the vertices of a square are (2, 1), (2, 4) and (5, 4). What are the co-ordinates of the fourth vertex?

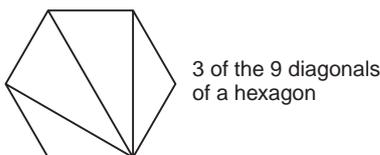
Know that:

- **perpendicular** lines are at right angles to each other;
- **parallel** lines are the same distance apart.

Recognise and identify parallel and perpendicular lines in the environment and in regular polygons such as the square, hexagon and octagon.

Know that a **diagonal** is a straight line drawn from a vertex of a polygon to a non-adjacent vertex. For example:

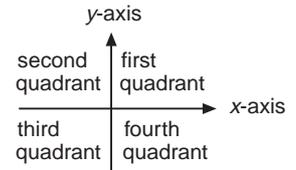
- Draw all the diagonals of a shape such as a pentagon or an octagon.



**As outcomes, Year 6 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:  
*intersecting, intersection...  
 plane...*

**Read and plot points** using co-ordinates beyond the first quadrant.



Respond to questions such as:

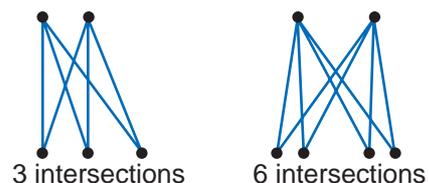
- The points (-1, 1), (2, 5) and (6, 2) are three of the four vertices of a square. What are the co-ordinates of the fourth vertex?
- Draw a polygon with each vertex lying in the first quadrant. Plot its reflection in the y-axis, and name the co-ordinates of the reflected shape.

Recognise **parallel and perpendicular lines** in quadrilaterals.

**See also properties of 3-D and 2-D shapes (page 103).**

Know that two lines that cross each other are called **intersecting lines**, and the point at which they cross is an intersection. For example:

- Identify all the intersections of lines drawn from 2 points to, say, 3, 4, 5... other points.



Predict the number of intersections from 2 points to 10 points.

## SHAPE AND SPACE

### Pupils should be taught to:

Make turns; estimate, draw and measure angles; recognise rotations

### As outcomes, Year 4 pupils should, for example:

Use, read and write:

*turn, rotate, whole turn, half turn, quarter turn...  
angle, right angle, straight line... degree...  
ruler, set square, angle measurer...*

Know that angles are measured in degrees and that:

- one whole turn is  $360^\circ$  or four right angles;
- a quarter turn is  $90^\circ$  or one right angle;
- half a right angle is  $45^\circ$ .

Know that the angles at the corners of rectangles and squares are  $90^\circ$ , and that the angles of an equilateral triangle are  $60^\circ$ .

Make and measure clockwise and anti-clockwise turns, describing them in degrees. For example:

- Make and describe turns of  $30^\circ$ ,  $60^\circ$ ,  $90^\circ$  using the hour hand on a clock: for example, from 10 o'clock to 2 o'clock, or 5 o'clock to 7 o'clock, or 2 o'clock to 3 o'clock.
- Make and describe turns using compass directions: for example, face west, turn clockwise by  $45^\circ$ , and say in which direction you are facing now.
- In geography, express day-to-day changes in wind direction from, say, south-west to west in degrees.
- Work out how many degrees the pointer turns from wash to spin.



Start to order angles. For example:

- Use a  $45^\circ$  or  $60^\circ$  set square to draw and measure angles of  $90^\circ$ ,  $60^\circ$ ,  $45^\circ$  and  $30^\circ$ .
- Recognise which of two angles is greater: for example, that an angle of  $60^\circ$  is greater than an angle of  $45^\circ$ .
- Place in order of size a set of angles, each less than two right angles.



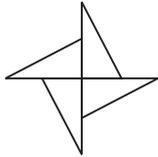
**As outcomes, Year 5 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:

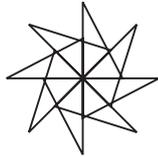
*rotation...*

*acute, obtuse... protractor...*

Make patterns by rotating shapes.



rotations of  $90^\circ$



rotations of  $45^\circ$

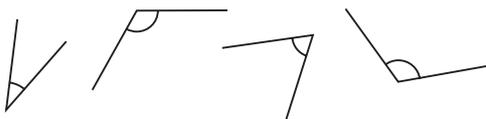
Recognise right angles and understand and use angle measure in degrees.

Begin to identify, estimate, order, measure and calculate acute, obtuse and right angles. Know that:

- an angle less than  $90^\circ$  is acute;
- an angle between  $90^\circ$  and  $180^\circ$  is obtuse;
- an angle of  $180^\circ$  is a straight line.

For example:

- Identify acute, obtuse and right angles in the classroom, and in 2-D shapes.
- Say which of these angles are acute, and which are obtuse.



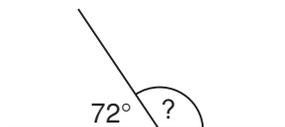
Estimate the size of each angle to the nearest  $5^\circ$ .

- Use a protractor to measure these angles to the nearest  $5^\circ$ .



- Use a protractor to draw angles of  $25^\circ$ ,  $80^\circ$ ,  $135^\circ$ .

- Calculate angles in a straight line.  
For example:

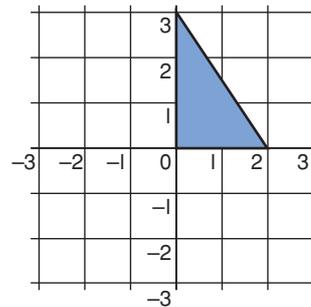


**As outcomes, Year 6 pupils should, for example:**

Use, read and write, spelling correctly, the vocabulary from the previous year, and extend to:

*reflex...*

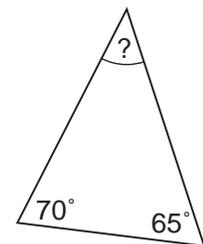
Sketch the position of a simple shape after a rotation of  $90^\circ$  or  $180^\circ$  about a vertex.



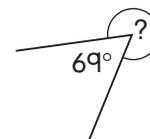
Identify, estimate, order, measure and calculate acute and obtuse angles.

For example:

- Estimate in degrees the size of each of a set of angles.
- Use a protractor to measure given angles to the nearest degree.
- Use a protractor to draw angles to the nearest degree.
- Check that the sum of the three angles of a triangle is  $180^\circ$  by measuring or paper folding. For example, draw and cut out a triangle. Tear off the three corners and rearrange them to make a straight line.
- Calculate the third angle of a triangle, given the other two.



- Calculate angles at a point.  
For example:



- Use a Logo procedure to explore the external angle properties of regular polygons