Lesson - Angles, shapes and symmetry

Year: Year 4

Hello, I am Otto! Angles and shapes are all around you: in the corner of a book, the hands of a clock, the roof of a house and the pattern on a tile. In this chapter you learn to name and compare angles, to classify triangles, quadrilaterals and other polygons, and to find lines of symmetry.

Starter activity

Open a door slowly. At first it makes a small gap, then a larger gap, and when it is wide open against the wall it has turned through a much bigger angle. Now look at the corner of a sheet of paper: it is always the same size. That special corner is called a right angle. Look around your classroom and find five right angles!

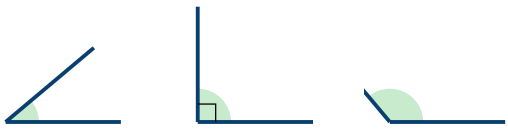
Angles

Definition: angle

An **angle** is the amount of turn between two straight lines that meet at a point. The point is called the **vertex**. We measure angles in **degrees** (°). One full turn is 360°, half a turn is 180° and a quarter turn is 90°.

Key fact: types of angle

- A **right angle** is exactly 90°, a quarter turn. It is shown by a small square in the corner.
- An **acute angle** is smaller than a right angle (less than 90°).
- An **obtuse angle** is bigger than a right angle but smaller than a straight line (between 90° and 180°).
- A **straight line** is 180°, and a **reflex angle** is bigger than 180°.



From left to right: an acute angle (40°), a right angle (90°) and an obtuse angle (130°). Acute angles are "sharp", like the point of a pencil. Obtuse angles are "wide", like a laptop screen opened right back.

Example 1

The hands of a clock point to 12 and to 4. Is the angle between them acute, right or obtuse?

The 12 and the 4 are 4 hour-marks apart. Each hour mark is 30° from the next, so the angle is 4 × 30° = 120°. This is bigger than 90° and smaller than 180°, so it is **obtuse**.

Method: comparing and ordering angles

1. Compare each angle with a right angle (the corner of a piece of paper).
2. Decide if it is smaller than the corner (acute) or bigger (obtuse).
3. To order angles, put the acute ones first, then the right angle, then the obtuse ones. Compare within each group by looking at how wide the opening is.

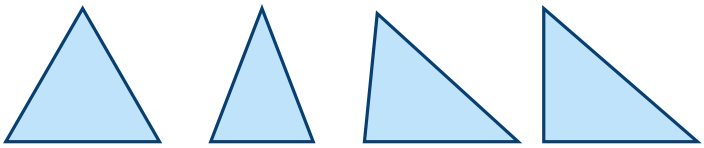
Watch out

The size of an angle does not depend on how long the lines are. Two lines drawn longer do not make the angle bigger. The angle is only the amount of turn between the two lines.

Triangles

Definition: triangle

A **triangle** is a flat shape with 3 straight sides and 3 angles. It is named by its sides. An **equilateral** triangle has 3 equal sides. An **isosceles** triangle has 2 equal sides. A **scalene** triangle has no equal sides. A **right-angled** triangle has one right angle.



An equilateral triangle has 3 equal angles. An isosceles triangle has 2 equal angles, opposite the equal sides.

Quadrilaterals and polygons

Definition: polygon

A **polygon** is a flat shape with straight sides that is completely closed. The names tell you how many sides a polygon has: triangle (3), quadrilateral (4), pentagon (5), hexagon (6), heptagon (7), octagon (8) and decagon (10). A **regular** polygon has all its sides equal and all its angles equal. An **irregular** polygon does not.

Quadrilateral	Properties
Square	4 equal sides, 4 right angles

Quadrilateral	Properties
Rectangle	2 pairs of equal sides, 4 right angles
Rhombus	4 equal sides, opposite angles equal
Parallelogram	2 pairs of equal, parallel sides
Trapezium	1 pair of parallel sides
Kite	2 pairs of equal sides next to each other

Example 2

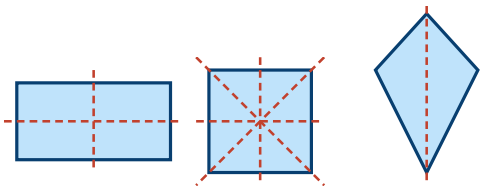
Name a shape with 6 sides, and say how many right angles a rectangle has.

A shape with 6 sides is a **hexagon**. A rectangle has **4 right angles**, one at each corner.

Symmetry

Definition: line of symmetry

A shape has a **line of symmetry** if you can fold it along the line so that one half fits exactly on top of the other half. The line is like a mirror: one half is the reflection of the other half. A shape can have no lines of symmetry, one line or several lines.



The rectangle has 2 lines of symmetry. The square has 4. The kite has 1. Notice that the diagonals of a rectangle are not lines of symmetry: folding along a diagonal does not make the halves match.

Rule: regular polygons

A regular polygon with n sides has exactly n lines of symmetry. An equilateral triangle has 3 lines, a square has 4, a regular pentagon has 5 and a regular hexagon has 6.

Example 3

How many lines of symmetry does the letter A have? And the letter S?

The letter A can be folded down the middle so that both halves match: it has **1** line of symmetry. The letter S has **no** lines of symmetry (it has a different kind of symmetry called rotation, which you will meet later).

Example 4

Complete the pattern: the mirror line is vertical. A shape has corners 2 squares left of the line and 3 squares up.

Reflect each corner across the mirror line, so that it is the same distance on the other side. A corner 2 squares to the left of the line goes to 2 squares to the right of the line, at the same height. So the new corner is **2 squares right and 3 squares up**.

Did you know?

Honeycomb cells are regular hexagons. Bees use hexagons because they fit together with no gaps and use the least wax for the biggest storage area. Butterflies have a line of symmetry down the middle of their bodies, and the pattern on one wing is a mirror image of the pattern on the other wing.

Otto's tip

To check a line of symmetry, imagine folding the shape or put a small mirror on the line. If the picture in the mirror looks like the half you cannot see, it is a line of symmetry. For angles, always compare with the corner of a piece of paper, which is a right angle.