Activity 2: Tessellations

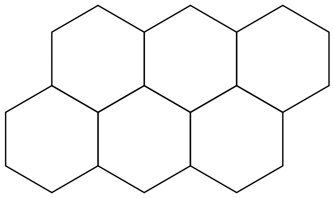
A tessellation is a mosaic or tiling pattern, made from shapes which fit together exactly. A dictionary definition: *an arrangement or close fitting of minute parts or distinct colours.*

'Tessella' links to the Latin *tessera* (plural *tesserae*) meaning small (usually cubic) pieces of marble, glass, tile etc used to make mosaic pavements or the like.

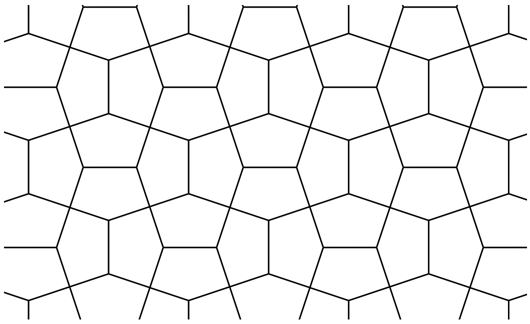
▲ Can you think of any examples of tessellations you have seen?

A challenge

▲ Which regular polygons tessellate?



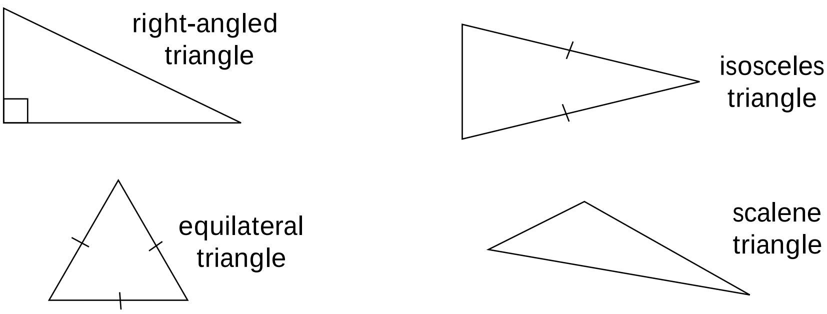
This tessellation is often found in the streets of Cairo and in Islamic decorations. It is called the Cairo tessellation.



▲ Can you see how the Cairo tessellation is formed?

A challenge

▲ Do all triangles tessellate? Explain your answer.



You could check your idea by drawing a triangle on card and using it as a template to draw round.

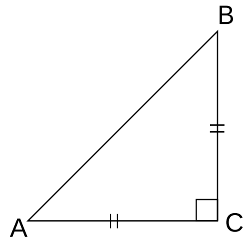
Another challenge

▲ Do all quadrilaterals tessellate? Try squares, rectangles, parallelograms, kites…

Activity 3: Looking at ratios

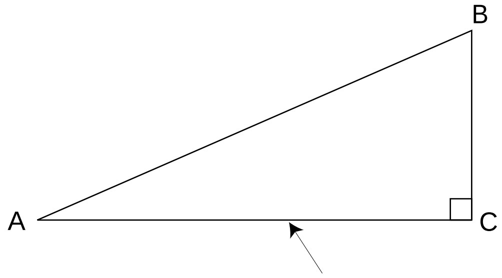
▲ Draw a right-angled isosceles triangle.

What can you say about the two missing angles?

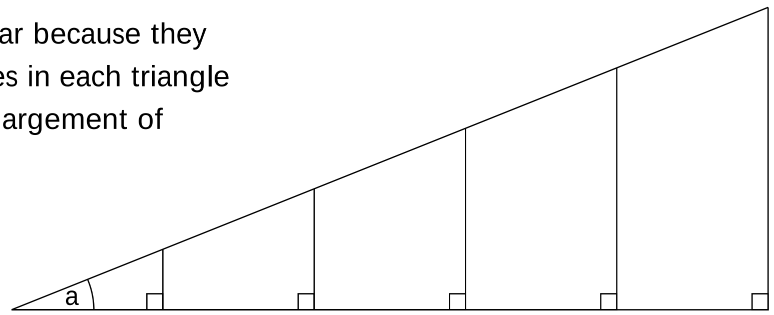


Leaving the right angle at C, what happens to the angle at A as you change the lengths of AC and BC?

Investigate and record your results carefully. Summarise your findings.



The five triangles are similar because they have the same three angles in each triangle and each triangle is an enlargement of the small triangle.



▲ For each of the five triangles measure the height (opposite the angle a) and the base (next to the angle a).

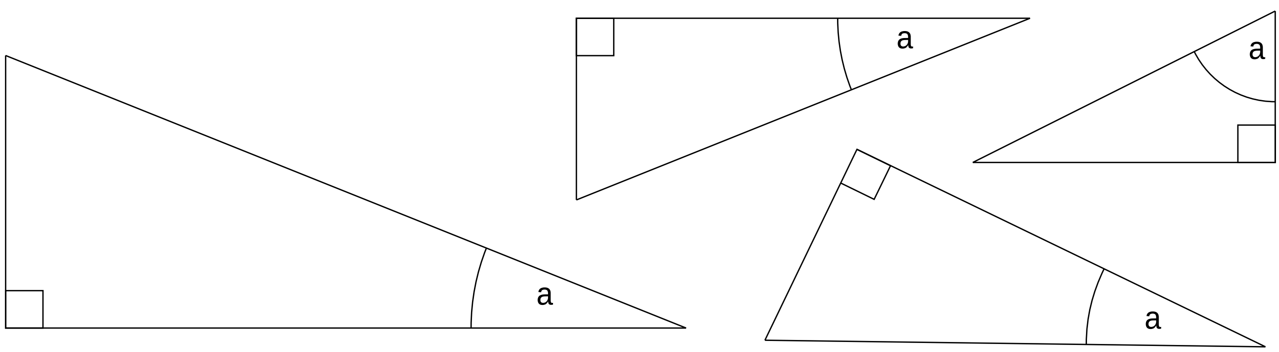
Then divide the height of each triangle by the base: $\frac{\text{height}}{\text{base}} = ?$

What do you notice about your answers?
Measure angle a.

Work out the ratio $\frac{\text{height}}{\text{base}}$ for each of the following triangles.

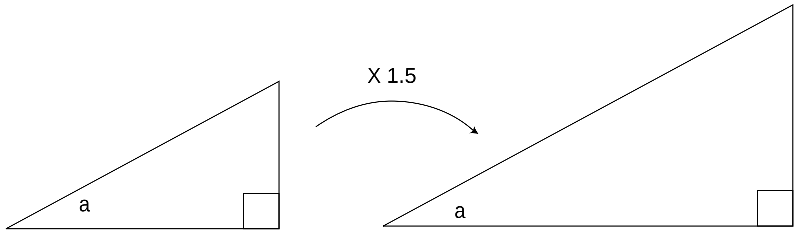
Are the triangles similar to the five above?

What can you say about angle a in each of these triangles?

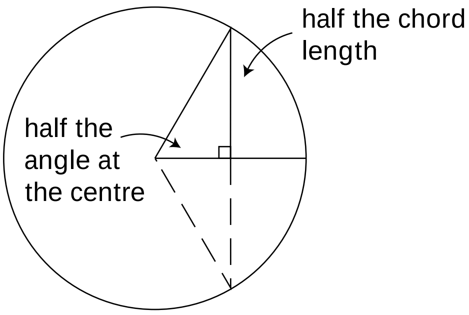


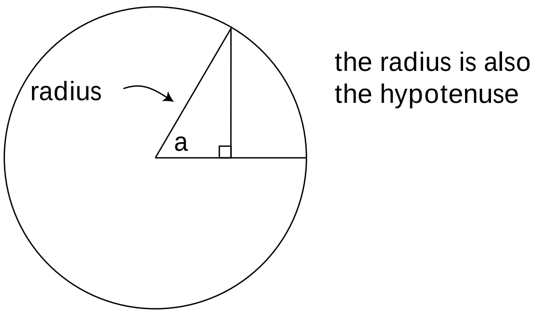
Activity 5: Sine ratio

As with the tangent ratio, the sine ratio of an angle is based on the similarity of triangles.

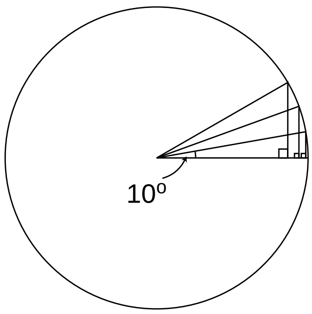


The sine ratio originates from using the chord of a circle.





▲ Work in small groups for this activity.
Each member of the group draws a circle on graph paper.
Draw a radius in the circle.
From the radius draw angles at the centre of 10, 20, 30, etc degrees.
Draw right-angled triangles, as in the diagram.



The sine ratio is $\dfrac{\text{length of side opposite angle a}}{\text{length of hypotenuse}}$

Complete a table of your results and extend it as far as you can.

Angle	Sine ratio by measuring	Sine ratio from tables	Sine ratio from calculator
10° 20°	$\dfrac{\text{opposite}}{\text{hypotenuse}}$	You need sine tables	Use $\boxed{\text{SIN}}$

How do your answers compare with those in the tables and from the calculator?

Topic 2: Polygons and Polyhedra

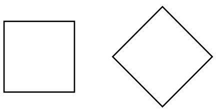
Polygons and polyhedra appear extensively in Attainment Target 3, Shape, Space and Measures, throughout all the levels. In this topic it is not possible to include materials for all the ideas in the brainstorm. Symmetry is covered in Topic 5: Location and Transformation.

For historical and cultural background, there are readily available resources: pupils' own cultural backgrounds, shapes in everyday life, and historical references like the Pyramids of Giza, which can be found in an encyclopaedia. Use historical sites in the area and examples from the close vicinity of the school. Encourage questioning. For instance, why do we measure angles in degrees? The Babylonians defined 360 degrees in a full turn, which linked to their calendar; the whole turn represents the whole year. Pupils need to estimate angle sizes before they measure them. *Angle 90*, a MicroSMILE program, is a useful activity for estimating angles.

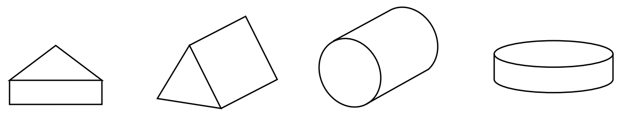
The language of polygons and polyhedra can lead to interesting discussions. What is a triangle? Pupils can refer to the three straight sides and ignore the word itself, which refers to three angles. Encourage pupils to explore the meanings of words such as acute, obtuse and reflex, and their mathematical interpretations.

From classroom experience and research about how children learn mathematics, it is possible to anticipate difficulties which pupils may encounter. Sometimes teachers compound pupils' problems through descriptions and examples used in the classroom. *Children Learning Mathematics* (Dickson, Brown and Gibson, 1984) is very readable. It includes much evidence of pupils' problems with shape and space. Pupils often find it more difficult to name shapes when they are not in a familiar orientation.

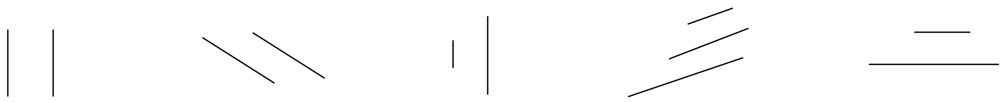
In 2-D



In 3-D



When preparing work it is important to include shapes in different orientations and sizes. Parallelism can cause problems for some pupils. Equality of length seems to become a criterion for parallelism. Will your pupils recognise that the following are parallel? Try some small-scale research in your classroom.



Can pupils distinguish between oblongs, rectangles and squares? A square is a special case of a rectangle, but an oblong is not a square.

Can pupils recognise right angles? Pupils may be influenced by the length of the arms or orientation of the angle. Far more pupils identify a and b as right angles than c or d.

This problem may also prevent pupils from recognising right angles in shapes. The length of the arms of an angle may dominate over the amount of turn. When planning a topic, and the content of a lesson, bear in mind the misconceptions that pupils seem to acquire, and try to avoid them. No doubt there are more examples of problems and misconceptions. Discussion with colleagues provides an opportunity to share experiences and to identify teaching principles and commonality in teaching these basic ideas.

There are many ways of classifying 2-D and 3-D shapes: using a flowchart, Venn diagram and a two-way table; sorting by angle properties, parallel sides and symmetry; regular and non-regular polygons, prisms and pyramids, polyhedra and non-polyhedra. The brainstorm of this topic illustrates the natural progression from polygons, through 2-D representations of 3-D shapes, to polyhedra. The topic gives