IDEA 75

USING ATM MATS 1

An amazing resource, sold by the ATM, www.atm.org.uk and created by Adrian Pinel, are 2-D 'beer' MATs. These are, in the main, regular polygons with a common edge length and this property makes MATs highly suitable for producing 2D tessellation designs. This in turn can lead to students classifying tessellations and working out internal angles of polygons.

The main use of MATs is to make 3D solids and, together with small amounts of Copydex glue, all kinds of solids can be created.

The first idea I offer is based upon students working only with equilateral triangle and square MATs in the first instance. The intention behind this restriction is to create an opportunity for students to explore a problem, of finding convex-angled solids, within specific parameters.

As solids emerge students can:

- Attempt to name them.
- Count how many Faces (F), Vertices (V) and Edges (E) each has.
- Seek the connection between F, V, and E or Euler's Rule ($F + V = E + 2$).

With equilateral triangle MATs three of the five Platonic solids can be made (tetrahedron, octahedron and icosahedron). Using the square MAT students can easily produce a cube (or a hexahedron) which is another Platonic solid. (To gain the complete set of five Platonic solids students will need to use twelve pentagon MATs to make a dodecahedron.)

Asking students to prove there are just five Platonic solids will provide a suitable challenge.

There are more solids to be made using combinations of square and equilateral triangle MATs, for example a triangular prism, a square-based anti-prism and a cuboctahedron which is made from six squares and eight equilateral triangles.

IDEA 76

USING ATM MATS 2

This is a development of the ideas suggested in Idea 75. A further rich area for exploration is to find all the different convex-angled solids, using triangular MATs only. There is a finite set and these are called deltahedra, and as before, three of these are Platonic solids: the tetrahedron, octahedron and icosahedron. The challenge is for students to find the remaining deltahedra.

This holds an interesting mathematical 'blip' which occurs when Faces, Vertices and Edges are counted for each deltahedra, resulting in a 'missing' set of values in what appears initially to be a straightforward sequence. The names of the remaining five deltahedra are anything other than straightforward! However, salvation is at hand in *Mathematical Models* by H.M. Cundy and A.P. Rollett (Clarendon Press, 1952, pp. 135, 136).

A further challenge is for students to examine the symmetries of the 'non-Platonic' deltahedra; a task that will keep the highest attaining mathematicians engaged.

A further idea is for students to explore the relationship between the tetrahedron and the octahedron. KS4 or KS5 students can be posed the problem of calculating the dihedral (or the solid) angles, between pairs of faces, for these solids. This will require students to solve a problem in 3D using trigonometry.

For younger students there is an opportunity for them to see a combination of tetrahedrons and the octahedrons fill 3D space. This can lead to some interesting shapes being created and for the possibility of creating a 3D 'mobile' display.

This task is developed in the final part of Idea 84.