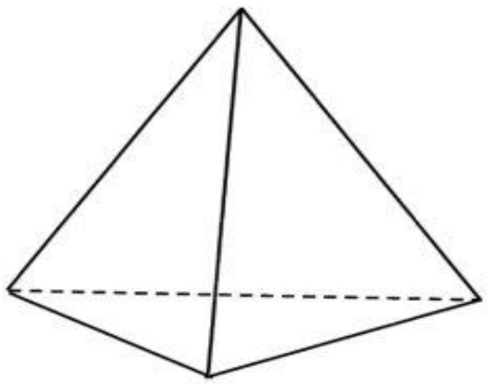
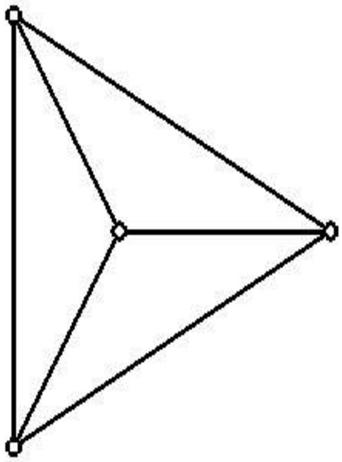
Geometry and Shapes

Activity 1 Tetrahedron



- Imagine the tetrahedron below. Consider placing your hand on the top vertex and gently push the point into the base until the shape becomes flat – and 2dimensional. It would look a bit like image on the below.



Investigate

- Count the number of faces, edges and vertices in both diagrams. They should be the same. Agreed?
- For your flat image, can you find a formula that links number of faces, edges and vertices? [Decide whether or not you count the space outside the shape a region.]
- Draw a cube. Repeat the squashing process to flatten the cube. What the resulting image look like? Draw it.
- Count the number of faces, edges and vertices in both diagrams. They should be the same. For the flattened image, can you find a formula that links number of faces, edges and vertices? This formula is usually called **Euler's Formula.**

Activity 2 - Polyhedra

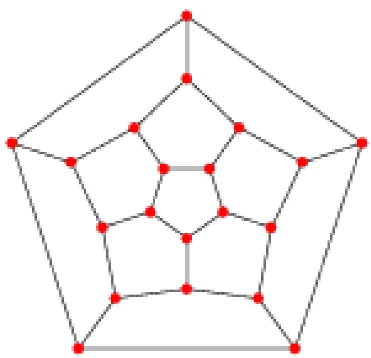
- Write down the formula you found in Activity 1. (We called this Euler's formula).

Investigate

What other shapes does this work for?

- Does your formula work for other 3-D shapes that have been flattened ? Experiment with a few. (eg pyramid, two pyramids joined long the square base – these form one type of **octahedron**)?

- The image below has been flattened in the same process as described above. What was the original 3-d shape? (Tricky to draw – but have a go).



- **Does Euler's Formula still work?**

- Draw a sphere. Imagine this is a globe with the world map on it. **Describe how you could arrive at a planar map – the ones you find in an Atlas.**
- This method of flattening an object into a planar image is called **Stereographic Projection**. It's very important with numbers called Complex Numbers. Complex numbers occur when we can't find the roots of a quadratic equation (such as $x^2 + 1 = 0.$)

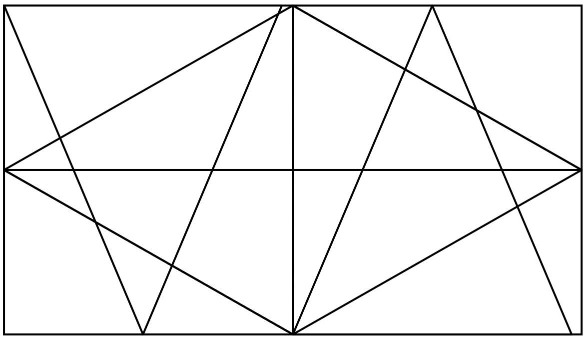
Have you seen this "squashing process" in Maths before? When?

Who might use this in their jobs?

(shapes on this page are from nrich.maths.org/6291/note)

Activity 3 Colourings

Imagine this is a floor covering. Your Aunt wants to paint the floor so that adjacent areas have different colours. Adjacent areas share a common edge or boundary.



Investigate

- How many different colours will she need? Will 2 be enough? Do you need 3? **Always choose the Minimum number of colours.**
- **Can you draw a floor where 2 colours aren't enough?**

Notice this floor is made up of all straight lines. What about colouring different shapes?

- Draw a bicycle wheel – how many colours do you need to colour between the spokes?
- Experiment with intersecting circles. How many colours do you need?
- Imagine the map of Great Britain. Do a quick sketch of it (it doesn't have to be perfect). How many colours do you need now for the different countries?

By now you may have some results you want to collect together. A Table might help.

Shape	**Number of colours**
Floor – all straight lines	

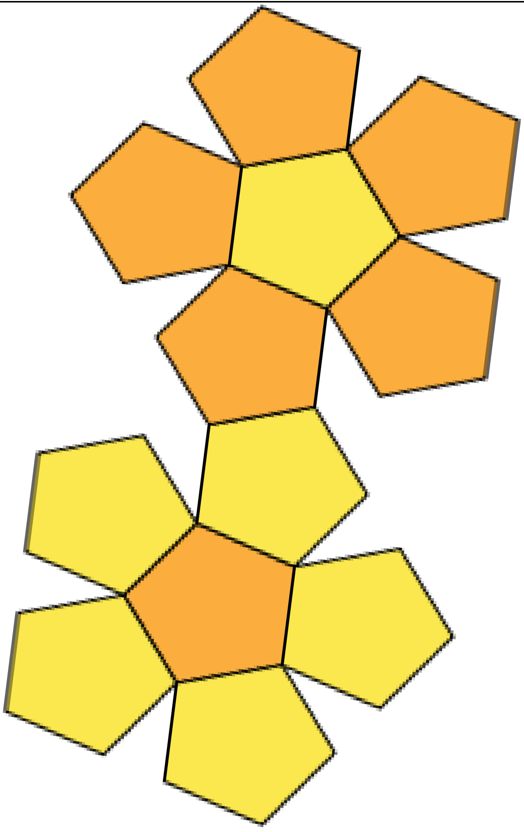
- Make a **Möbius Strip**. Cut a piece of paper, approximately 15cm long and 2 cm wide. Hold it lengthwise and twist it and then tape the long ends together. Divide the surface into sections – as many as you like. How many colours do you need?

This is a famous problem called the **Four-Colour Problem**. Computers were used to solve this in 1976 by Appel & Haken.

Activity 4 Cut out & Making shapes ----nets

Look at the net below.

Each face is a special shape. Check to see if the edges all the same length. What's the face called? How many faces does this shape have? How many vertices are there in total?



- Draw a dot on one edge of a pair of edges that will meet and pencil in a small flap on this edge. (You could skip this part).
- Cut the shape out and tape it together.

It's called a **Dodecahedron.**

(This net is from Wikipedia.)