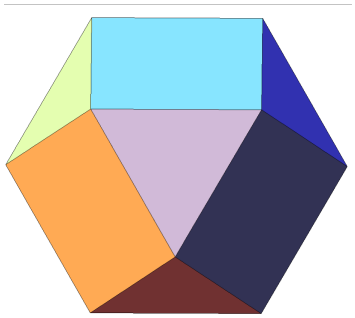
POLYHEDRA[1] CHALLENGE: TEACHER'S GUIDE

Overview

The picture below shows a cuboctahedron:



ESSENTIAL DEFINITION **Every corner looks exactly the same**: as you go around it, you see a triangle, a square, a triangle, and a square. By recording the number of sides of each of these shapes that meet at any corner, we can call it a (3,4,3,4) polyhedron. Or we can say, "The recipe for a cuboctahedron is (3,4,3,4)." If your polyhedron does not meet this definition, then we'll say the recipe is "impossible", even if you can construct it.

Instructions

1. Make a model of the cuboctahedron pictured above. You'll find its recipe at the top of the table on the back.
2. How many triangles and how many squares are needed to make a cuboctahedron? Use your result to begin filling out the table on the next page.
3. Once you've built the shapes, **fill in the chart on the next page**. All values must be correct for you to get the points for each item (construction, polygonal parts, and VEF[2] values).
4. Are any recipes are impossible? Explain and note in the table on the back.
5. The final row of the table has an empty spot for you to enter **your own recipe** that meets the definition!

Suggestions

1. Have the students invent their own names for the polyhedra.
2. Consider other sorts of notation for describing each solid, e.g. a *face vector*. A cube would be (8, 12, 6), for 8 vertices, 12 edges, and 6 faces.
3. Ask what is the smallest number of vertices a polyhedron can have. Edges? Faces?
4. Is it possible to have an odd number of vertices? Edges? Faces?
5. A *Platonic Solid* has 1) faces that are all regular polygons, 2) all faces are identical, and 3) all vertices are identical. Which of the constructed shapes are Platonic?

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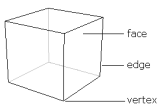
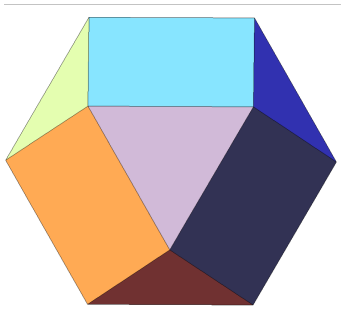
[1] A polyhedron (plural polyhedra or polyhedrons)is a solid in three dimensions with flat *polygonal* faces, straight edges and sharp corners or vertices. All of the polygons (equilateral triangles, squares, and pentagons) used in your faces are regular—meaning that they have all equal angles and all sides are of equal length.

[2] A polyhedron consists of polygonal *faces*, the polygons' sides are known as *edges*, and the corners known as *vertices*.



POLYHEDRA CHALLENGE

Make a solid shape know as a polyhedron according to the recipes in the table below. A *recipe* is a list of the number of sides of each polygon (shape) meeting at *every* corner (or *vertex*)—**in order**. All *vertices* (plural of vertex) must look the same! Here is a picture of a (3,4,3,4) *cuboctahedron*:



Recipe	Did you make it?	Triangles	Squares	Pentagons	Faces	Edges	Verticies
(3,4,3,4)							
(4,4,4)							
(3,3,3)							
(5,5,5)							
(3,3,3,3)							
(3,5,3,5)							
(3,3,3,3,3)							
(3,3,5)							
(3,3,3,5)							
(3,3,3,3,3,3)							

←Invent your own recipes!