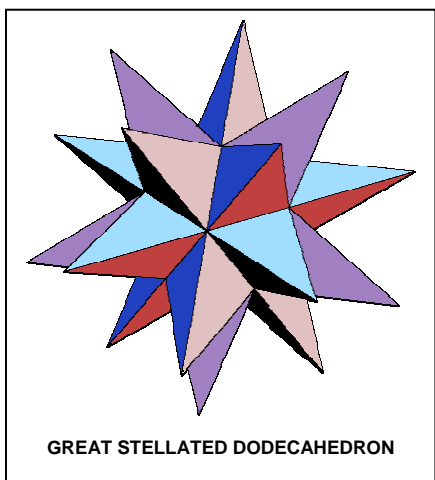


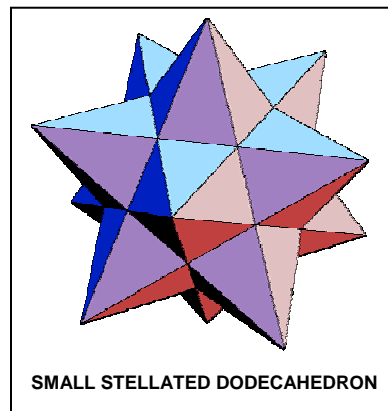
# The Kepler-Poinsot Polyhedra



GREAT STELLATED DODECAHEDRON

A polyhedron is a three-dimensional solid whose faces are polygons joined at their edges. A polyhedron is said to be *regular* if its faces are made up of *regular polygons*. A regular polygon is a polygon with sides of equal length placed symmetrically around a common center. Because the five regular polyhedra appear prominently in Plato's *Timaeus*, they are called the Platonic Solids.

If we do not require that the solids be convex, and Euclid did not, then there are other possibilities. In the **great stellated dodecahedron** and the **small**

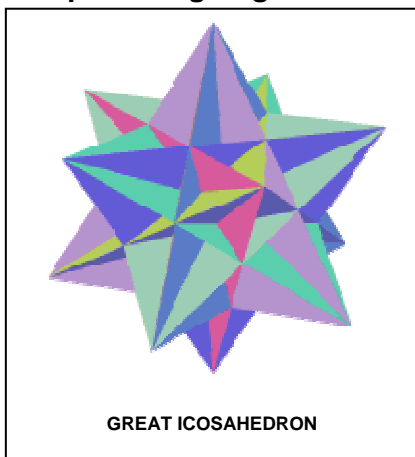


SMALL STELLATED DODECAHEDRON

**stellated dodecahedron**, the faces are pentagrams. It is easier to see which parts of the exterior belong to which pentagram if you look at a six-colored model of the great stellated dodecahedron and a six-colored model of the small stellated dodecahedron. The center of each pentagram is hidden inside the polyhedron. These two polyhedra were described by Johannes Kepler in 1619, and he deserves credit for first understanding them mathematically, but a 16th century drawing by Wentzel Jamnitzer (1508-1585)

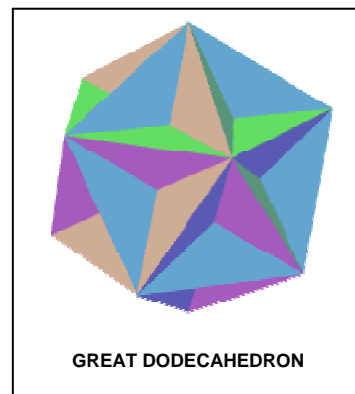
<http://www.georgehart.com/virtual-polyhedra/jamnitzer.html> is very similar to the

former and a 15th century mosaic attributed to Paolo Uccello (1397-1475) <http://www.georgehart.com/virtual-polyhedra/uccello.html> illustrates the latter.



GREAT ICOSAEDRON

In the **great icosahedron** and **great dodecahedron** (described by Louis Poinsot in 1809, although Jamnitzer made a picture of the great dodecahedron in 1568) the faces (20 triangles and 12 pentagons, respectively) which meet at each vertex "go around twice" and intersect each other, in a manner which is the 3D analog



GREAT DODECAHEDRON

to what happens in 2D with a pentagram.

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John [von Neumann (1903 – 1957)], with whom I had many conversations, could not separate mathematics from life; he saw mathematics wherever he looked. His feel for nature inspired him to be a better mathematician and his mathematics inspired him to better understand nature.



C.V. Newsom  
 "The Image of the Mathematician," *Amer. Math. Monthly* 79 (1972) p. 879  
 as quoted in Rosemary Schmalz, *Out of the Mouths of Mathematicians*,  
 Math. Asso. of America, ©1993, p. 213