Exploring Geometric Solids

Explore the five regular polyhedra at your table. Write a definition that describes a regular polyhedron.

For each polyhedron, determine the number of faces, edges and vertices. Record the data in one table.

Write a generalization (formula) that expresses the relationship between the number of faces, edges and vertices.

Does this relationship continue with irregular polyhedrons? Use the Polydrons to create irregular polyhedra. Do they follow the same formula as the regular polyhedra?

Can you create a polyhedron that does not follow the formula? If so, describe the polyhedron.

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Lesson Summary
Students will explore the relationship between the number of faces, edges, and vertices in regular and irregular polyhedra. They will use these attributes to develop an understanding of Euler's formula for polyhedra.

Background
Platonic solids (also called regular polyhedra) are convex polyhedra with equivalent faces composed of congruent regular polygons. There are exactly five Platonic solids. They were known to the ancient Greeks and Plato equated them to the "elements": tetrahedron=fire; cube=earth; icosahedron=water; octahedron=air; and dodecahedron=the constellations and cosmos. Leonard Euler discovered a formula that describes all 3-dimensional polyhedra. $V - E + F = 2$. This formula looks simple, but it describes a fundamental property of all 3-dimensional solids and tells us something very profound about shape and space.
http://plus.maths.org/content/eulers-polyhedron-formula

Vocabulary
polyhedron (pl. polyhedra), attribute, vertex (pl. vertices), face, edge, regular polygon

Materials
polyhedra models (can be constructed from nets), polydrons can be purchased at:
http://www.enasco.com/c/math/Geometry/Construction+Kits/Polydron%26%23174%3B/

Lesson
1. Have students in groups of 4-6 and give them a set of the Platonic solids to explore.
2. Ask students to explore these solids in terms of three attributes: number of faces, number of edges, and number of vertices.
3. Students record data in a table they create.
4. Students examine the table to find a generalization (formula).
5. Students used polydrons to create irregular polyhedra to determine whether the formula they have generalized works for all polyhedra.
6. Challenge question: can you create a polyhedra that does not follow the formula?

(a simpler version of this exploration can be found in Everyday Mathematics 5th grade lesson 11.1)