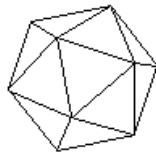


Why Only Five

We have looked at five Platonic solids so far and it turns out that these are the only ones. A good question is why are there only five? Before we attack this question we really need to know what a Platonic solid is. A good definition is below.

Definition: **Platonic solid**. A polyhedron is called a **regular polyhedron** or **Platonic solid** if

- it is convex

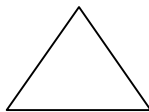


My sides are not "caved in"

- all of its faces are identical regular polygons (the edges are all the same length)
- there are the same number of faces at each vertex.

The important thing is that there must be the same number of faces at each vertex and faces are all the same polygon (so the faces are the same size and shape).

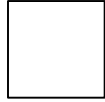
Equilateral triangle faces



Let's start by building all of the possible Platonic solids that are constructed from triangles. A good way to approach this is to look at a single vertex and ask the question, "What are the smallest and largest number of triangles I can place at the vertex?"

1. a. What is the smallest number of triangles that are needed around a single vertex?
b. Why can't we have any fewer?
c. What Platonic solid is formed?
2. a. What is the largest number of triangles that are needed around a single vertex?
b. Why can't we have any more?
c. What Platonic solid is formed?
3. Did we find any more possibilities? Why?

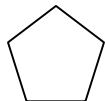
Square faces



Now let's build all of the possible Platonic solids that are constructed from squares. Again we ask the question, "What are the smallest and largest number of squares I can place at the vertex?"

1.
 - a. What is the smallest number of squares that can be put around a single vertex?
 - b. Why can't we have any fewer?
 - c. What Platonic solid is formed?
2. What is the largest number of squares? Why can't we have any more?
3. Did we find any more possibilities? Why?

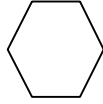
Pentagon faces



Now let's build all of the possible Platonic solids that are constructed from pentagons. Again we ask the question, "What are the smallest and largest number of pentagons I can place at the vertex?"

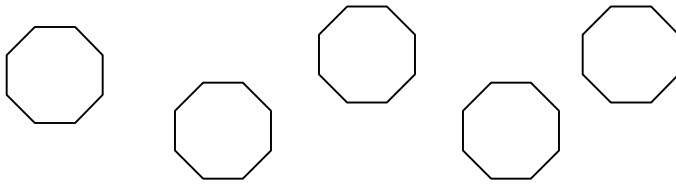
1.
 - a. What is the smallest number of pentagons that are needed around a single vertex?
 - b. Why can't we have any fewer?
 - c. What Platonic solid is formed?
2. What is the largest number of pentagons? Why can't we have any more?
3. Did we find any more possibilities? Why?

Hexagon faces



Now let's build all of the possible Platonic solids that are constructed from hexagons. Again we ask the question, "What are the smallest and largest number of hexagons I can place at the vertex?"

1. What is the smallest number of hexagons that can be placed around a single vertex? Why can't we have any fewer?
2. What is the largest number of hexagons that can be placed around a single vertex? Why can't we have any more?
3. For each of the values from the smallest to largest find the ones that correspond to a Platonic solid we have already looked at.
4. Did we find any more possibilities? Why?



What will happen for polygonal faces that have 7 or more sides?

