



Sir Cumference and the Sword in the Cone

Activities for teachers and students

By Cindy Neuschwander

Solid geometry is present everywhere in our physical world! *Sir Cumference and the Sword in the Cone* and the following activities can help students to better understand this area of mathematics.

What's what with geometric solids?

Prior to reading *Sir Cumference and the Sword in the Cone*, introduce students to the following terms using physical models:

- face:** A flat, two dimensional shape with straight sides (plane figure) that is one side of a solid shape
vertex: A point where two or more line segments, lines, or rays meet to form an angle. The plural of vertex is **vertices**.
edge: A line segment created where two flat faces meet.

Having students write these terms with illustrations in a math journal can help them to remember and reference these definitions.

Teach or review the following solids: cube, rectangular prism, triangular prism, square pyramid, cone, and cylinder. Adding in a variation of the square pyramid, the tetrahedron, is another good basic solid to include.

Geometric Nets become Solid Shapes

Read *Sir Cumference and the Sword in the Cone*. Have students choose one or more of the six geometric nets represented in the story. Have each student fold and fasten edges of their selected net(s) using clear tape. When students are finished, have each one share the attributes of his or her shape. "My cube has six faces" or "There are five vertices on my pyramid." Make sure that the attributes of all the story shapes are shared. These paper figures can be displayed, or students can keep the shapes they have built.

The Test of Two

After geometric solids have been created out of flat geometric nets, teachers and students can consolidate information about all of the solids on the attached spreadsheet. Review the story, focusing specifically on pages 9-12 of the book. Have students record information on the three attributes: flat faces, vertices, and straight edges.

A Swiss mathematician, Leonhard Euler, created a formula that expressed a relationship between the faces, vertices and edges of solid shapes. He discovered that adding when the numbers of flat faces of any solid shape to its corresponding vertices (or corner points) and then subtracting that sum from the number of straight edges, the result would be represented by a total of two.

When the result was two, that meant that that solid shape could be classified as a polyhedron. Any solid shapes whose totals were not two cannot be considered polyhedrons.

After sharing this information about polyhedrons, have students share their thinking about adding the flat faces and vertices of the shapes in the story. Then students can subtract those totals from the straight edges of each shape to see whether or not each shape passes the ‘*Test of Two*’.

What’s not part of the Test of Two?

In the story, Radius and Vertex are searching for King Arthur’s sword, Edgecalibur. The clues in the story let them know that the hiding place of the sword is in a shape that does *not* pass the test of twos. Knowing this, students can eliminate many shapes and see which shapes Radius and Vertex focused on as they continued to seek the sword.

Solid shapes with curved surfaces, such as cones, cylinders and spheres, can be problematic for students. Cones and cylinders have no faces because a face is defined as a two dimensional shape with straight sides. But the cones and cylinders do have bases. Cones and cylinders also have no straight edges since their bases are curved. Spheres have none of the aforementioned attributes since they are round solids.

Extensions

For students who are curious about the *Test of Twos* or wish to test it further, have them construct other geometric nets. These can be found on a variety of websites but a good one is www.lifeisastoryproblem.org/explore/net. There are many more, complex solid shapes they can construct. They can then count faces, vertices, and straight edges, adding the faces and vertices, and subtracting that total from the number of straight edges to see if that shape is a polyhedron. This can be fun and challenging with shapes like dodecahedrons.

Students can bring in physical examples of solid shapes that they have found in the real world for display and attribute study. Objects as simple as a toilet paper or certain candy bar boxes are good examples of geometric solids.

Who was Leonhard Euler?

Sharing information about this Swiss mathematician can be an enriching lesson. Born on April 15, 1707 in Basel Switzerland, he was the son of a mathematician and minister who wanted his son to follow him into the ministry. Instead, Leonhard Euler chose to become a mathematician. He was said to have had an unusual ability to concentrate.

He became blind in one eye as a young man and lost sight in his second eye at age 50. Even so, he was still able to perform complicated mathematical calculations in his mind. He was a prolific writer and recorded his thinking in over 80 volumes and thousands of letters. He even wrote elementary school math books for children in Russia! In addition to the *Test of Twos*, Leonhard Euler was the first mathematician to use the pi symbol for the ratio of the circumference to the diameter in circles, letters *a*, *b*, and *c* for the sides of a triangle.

During his life, he lived in Russia and Germany. He died of a stroke on September 18, 1783.