

LessonTitle: Examining Geometric Solids		Geo 5.4
Utah State Core Standard and Indicators Geometry Standard 3.1 Process Standards 3-5		
Summary		
In this lesson, students build different solids using a choice of different materials. Then they analyze the characteristics and record them on a graphic organizer (see below or access the associated link). Next, the students access a Web site to find out about Platonic Solids, build nets for the solids and derive Euler's formula relating faces, edges and vertices of polyhedrons.		
Enduring Understanding	Essential Questions	
Classification of three dimensional geometric solids involves faces, vertices and edges and in the case of prisms, the shape of the base.	Why is classification of geometric solids important? How does it help us?	
Skill Focus	Vocabulary Focus	
<ul style="list-style-type: none"> Observing and classifying geometric solid characteristics 		
Assessment ideas:		
Have students keep a record of learning associated with defining and classifying quadrilaterals. This includes the Geometric solid characteristic sheet (below) as well as the record of terms from Geo 2.0		
Materials: Geometric solid building materials (see below), worksheets, centimeter graph paper, Classify and Capture game cards.		
Launch		
Explore		
<ul style="list-style-type: none"> How do you classify geometric solids? What are the similarities and differences among prisms, pyramids and cylinders? What are regular polyhedra? 		
Summarize		
Apply		

Directions: Students should continue to record their learning on the record of learning sheet from lesson 2.0.

For Geo 5.4a, Students should construct three dimensional figures using materials such as Geofix shapes and Polydrons. They might also use coffee stirrers, toothpicks, or straws to form edges and gumdrops, marshmallows, modeling clay or raisins for the vertices. If you use straws, then use string to thread through the straws and tie them together.

Use the worksheet below. SAVE THESE constructions for use in creating nets and exploring volume and surface area.

Access the graphic organizer (see associated link) to help students differentiate characteristics of different solids.

In order to play the Classify and Capture Geometric Solids game (see below), student groups should construct an example for each of the attribute cards—can include those done for #2 above. Perhaps student groups could

exchange sets of constructed shapes for playing the game. See directions in lesson 7.0 and polyhedron card set 3 below. (Taken from an article in Mathematics in the Middle School, NCTM, February 2003)

Have students use their constructions to test the strength of different solids.

For Geo 5.4b, students will need to be in groups of 5. Before drawing the nets, have each group cut open an empty cereal box, cutting along the edges in order to maintain one large flat surface.

Have models of the platonic solids available and let students draw nets free hand. Then have them construct and print their nets using Geometer's Sketchpad. See "Constructing Templates for the Platonic Solids" from Exploring Geometry with Geometer's Sketchpad, page 115. Once the students have created the nets, they can construct the platonic solids using paper or cardboard. If they use cardboard, they should score the edges in order to fold into place—then glue and decorate as desired.

SAVE THESE NETS for finding surface area and volume in succeeding activities.

For constructing nets with straight edge and compass, see this website :
mathforum.com/alejandre/workshops/net.html.

Euler's formula is $V = F - E + 2$

See also: illuminations.nctm.org/imath/3-5/GeometricSolids/GeoSolids2.html,
www.pgs.org/teachersource/mathline/lessonplans/pdf/msmp/letsfaceit.pdf

Geo 5.4a

Building, Describing and Classifying Geometric Solids

- 1) Build the solids below. Use coffee stirrers, toothpicks, or straws to form edges and gumdrops, marshmallows, modeling clay or raisins for the vertices.
- 2) Record the data below.

Geometric Solids	Shape of Base(s)	Number of Faces	Number of Vertices	Number of Edges
1) Large Square Prism, Cube				
2) Tall Rectangular Prism				
3) Short Rectangular Prism				
4) Triangular Prism				
5) Pentagonal Prism				
6) Square Pyramid				
7) Triangular Pyramid				
8) Pentagonal Pyramid				
9) Tetrahedron				
10) Decahedron				
11) Octahedron				
12) Nonahedron				
13) Dodecahedron				
14) Cylinder				
15) Cone				

4) What are regular polyhedron? _____

Classify and Capture Geometric Solid card set

Prisms	Not Prisms	Right Prisms
Pyramids	Not Pyramids	Not Right Prisms
Cylinders	Not Cylinders	Cones
Right Pyramids	Not Right Pyramids	Not Cones
Right Cylinders	Not Right Cylinders	Right Cones
Not Regular Polyhedra	Regular Polyhedra	Not Right Cones
Triangular Prisms	Square Prisms	Rectangular Prisms
Triangular Pyramids	Square Pyramids	Rectangular Pyramids
Semi Regular Polyhedra		

Geo 5.4b Patterns in Platonic Solids

1. Access the following website : www.georgehart.com/virtual-polyhedra/glossary.html
Observe the platonic solids. Or observe models in your classroom.

What are the platonic solids? What is a regular polyhedron?

2) Go to the word regular and click on Platonic solids or observe the models.

- The _____ has three squares at each corner
- The _____ has three equilateral triangles at each corner.
- The _____ has three regular pentagons at each corner.
- With four equilateral triangles, you get the _____
- With five equilateral triangles, the _____

3) Construct nets to build the Platonic Solids. To understand what a net is, cut a cereal box along the folded edges and then lay the cardboard flat. This is a net. Use the classroom models to sketch nets (These sketches will be turned in with this assignment) for the platonic solids. Compare your nets with others in the class. What do you observe?

4) Now construct and print nets for the Platonic solids using Geometer's Sketchpad. Obtain instructions from your teacher. With your printed nets, use paper or cardboard, to build models for the platonic solids. If you use cardboard, score the edges in order to fold into place—then glue and decorate as desired. These models will be turned in with this assignment.

5) In the mid-eighteenth Century, a Swiss mathematician named Leonard Euler discovered a relationship between faces and vertices and edges of Polyhedrons. Follow the steps of Euler in the following exercise.

	Faces	Edges	Vertices
Tetrahedron			
Cube			
Octahedron			
Dodecahedron			
Icosahedron			

Look for patterns in the table above. By adding, subtracting or multiplying V, F, and E (or a combination), you can discover a formula known as Euler's Formula.

Euler's Formula _____

Extra for experts: Follow the directions and learn to construct nets using straightedge and compass. mathforum.com/alejandre/workshops/net.html.