3-D Shapes

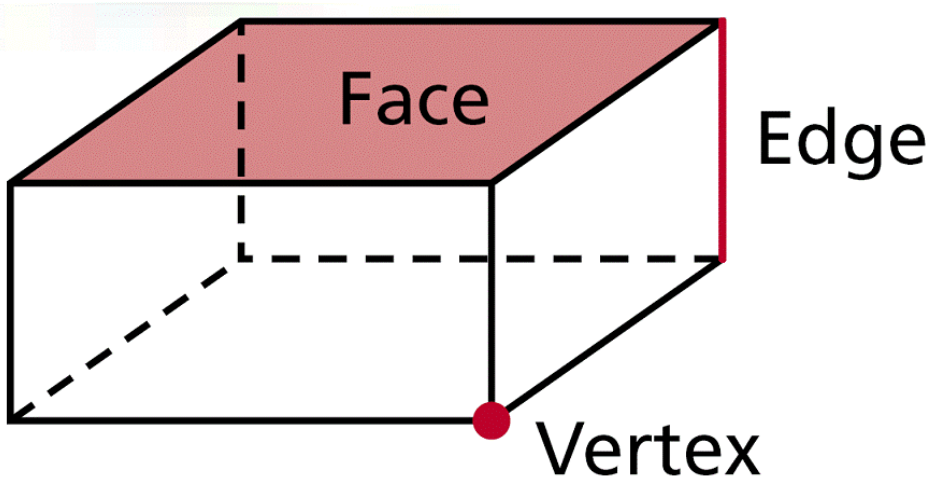
Unit 6: Lesson 1

Solid Geometry

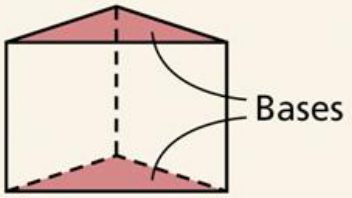
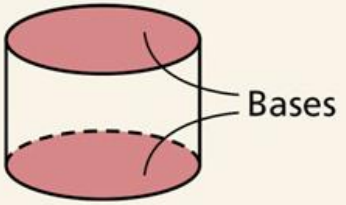
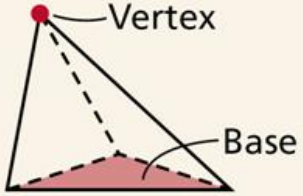
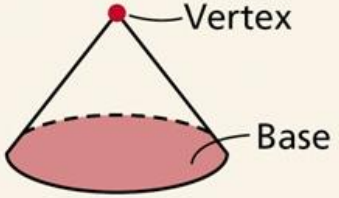
Objectives and Student Expectations

- TEKS: G6A, G6B, G5A
- The student will describe and draw the intersection of a given plane with various 3-D figures
- The student will use nets to represent and construct 3-D figures.
- The student will use geometric pattern to develop algebraic expressions representing geometric properties

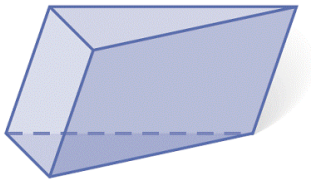
Three-dimensional figures, or solids, can be made up of flat or curved surfaces. Each flat surface is called a **face**. An **edge** is the segment that is the intersection of two faces. A **vertex** is the point that is the intersection of three or more faces.



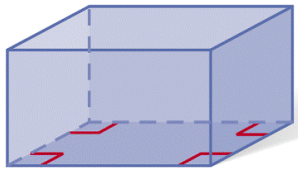
Three-Dimensional Figures

TERM	EXAMPLE
A **prism** is formed by two parallel congruent polygonal faces called *bases* connected by faces that are parallelograms.	
A **cylinder** is formed by two parallel congruent circular bases and a curved surface that connects the bases.	
A **pyramid** is formed by a polygonal base and triangular faces that meet at a common vertex.	
A **cone** is formed by a circular base and a curved surface that connects the base to a vertex.	

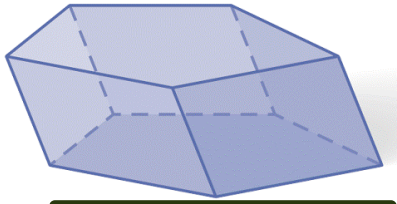
A **cube** is a prism with six square faces. Other prisms and pyramids are named for the shape of their bases.



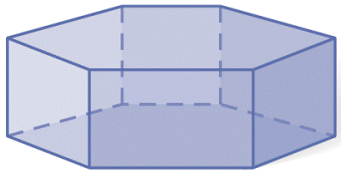
Triangular Prism



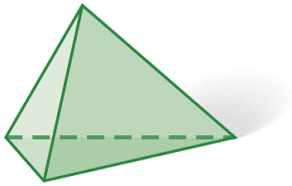
Rectangular Prism



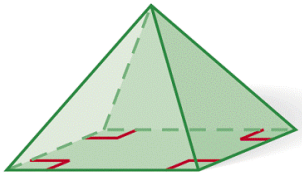
Pentagonal Prism



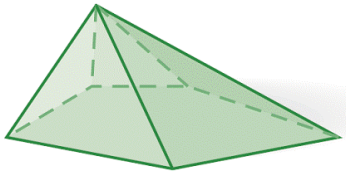
Hexagonal Prism



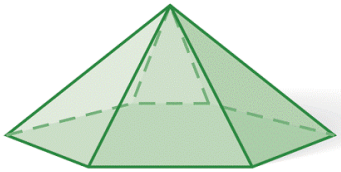
Triangular Pyramid



Rectangular Pyramid



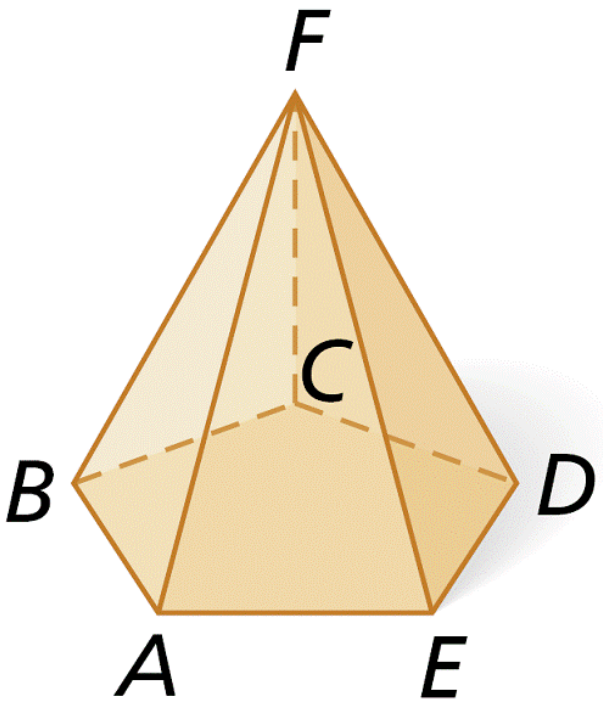
Pentagonal Pyramid



Hexagonal Pyramid

Example: 1

Classify the figure. Name the vertices, edges, and bases.



pentagonal pyramid

vertices: *A*, *B*, *C*, *D*, *E*, *F*

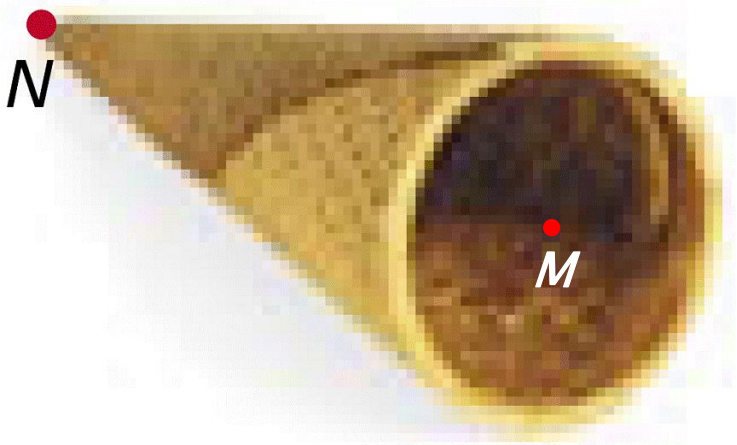
edges: $\overline{AB}, \overline{BC}, \overline{CD}, \overline{DE}, \overline{EA}, \overline{AF}, \overline{BF}, \overline{CF}, \overline{DF}, \overline{EF}$

faces: □AFB, □AFE, □EFD, □DFC, □CFB

base: Pentagon *ABCDE*

Example: 2

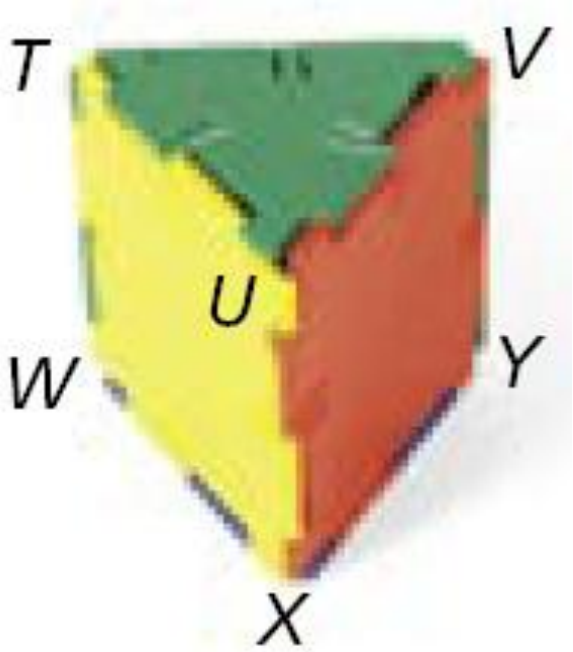
Classify the figure.



cone

Example: 3

Classify the figure.

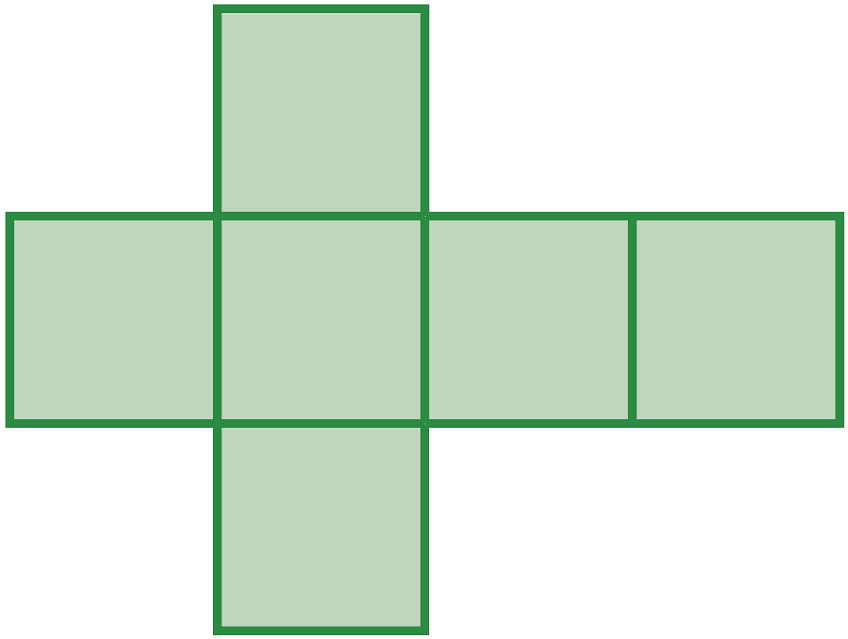


triangular prism

A **net** is a diagram of the surfaces of a three-dimensional figure that can be folded to form the three-dimensional figure. To identify a three-dimensional figure from a net, look at the number of faces and the shape of each face.

Example: 4

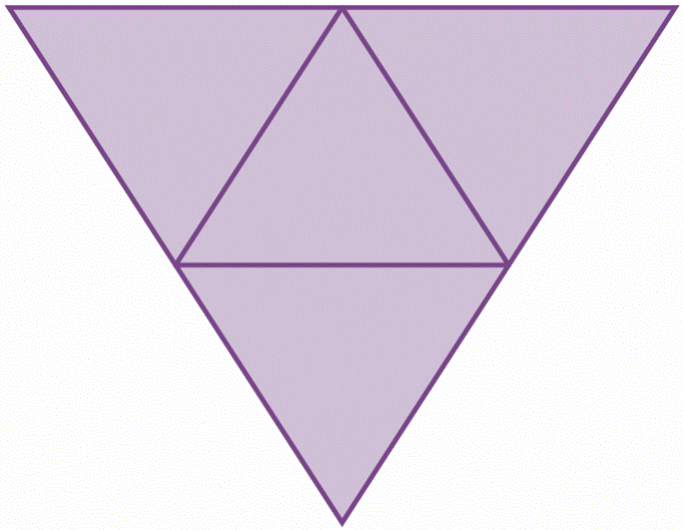
Describe the three-dimensional figure that can be made from the given net.



The net has six congruent square faces. So the net forms a cube.

Example: 5

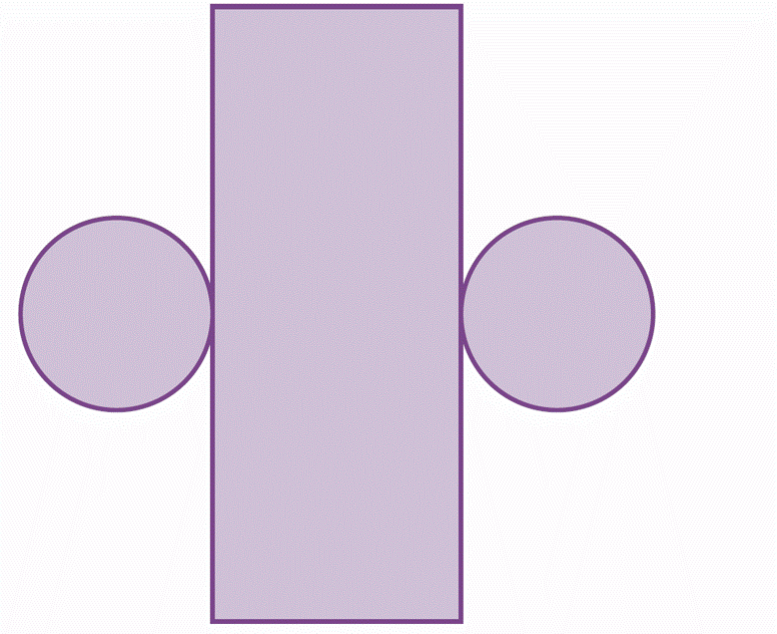
Describe the three-dimensional figure that can be made from the given net.



The net has four congruent triangular faces. So the net forms a triangular pyramid.

Example: 6

Describe the three-dimensional figure that can be made from the given net.



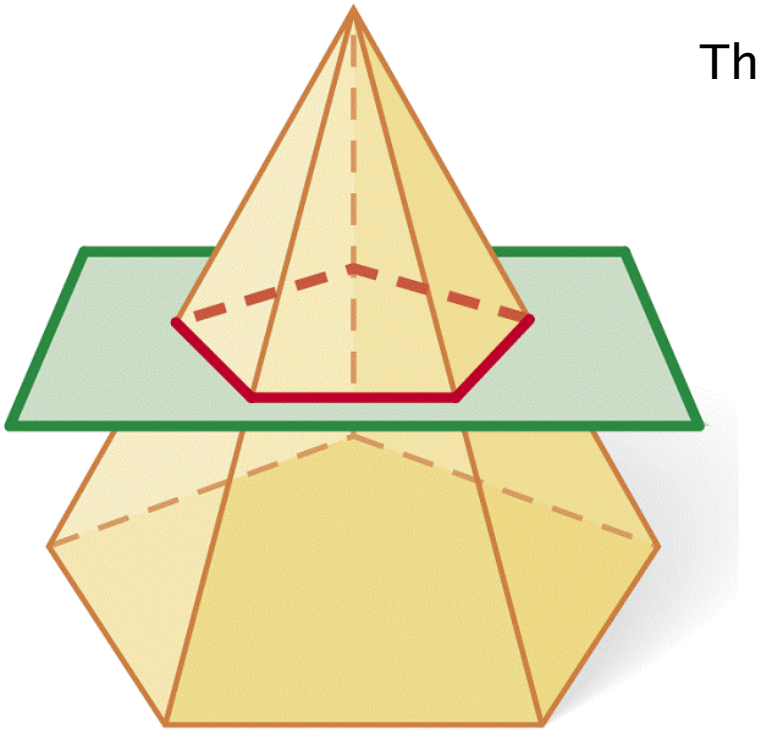
The net has two circular faces and one rectangular face. These are the bases and curved surface of a cylinder. So the net forms a

cylinder.

A **cross section** is the intersection of a three-dimensional figure and a plane.

Example: 7

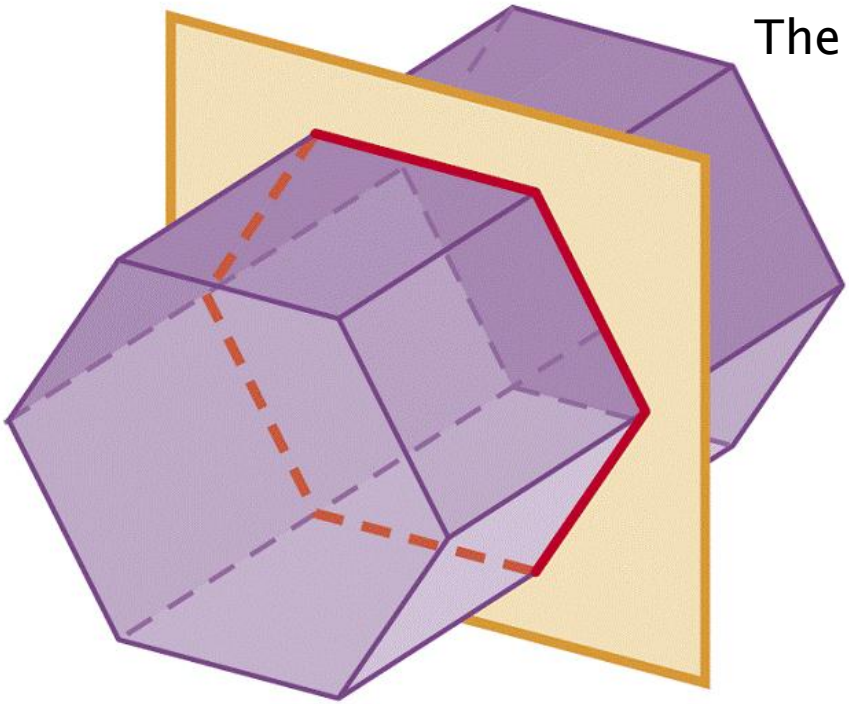
Describe the cross section.



The cross section is a pentagon.

Example: 8

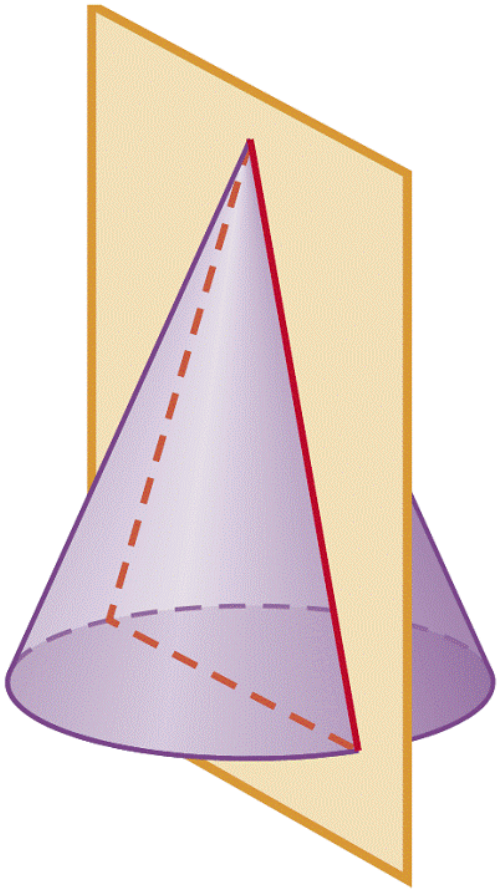
Describe the cross section.



The cross section is a hexagon.

Example: 9

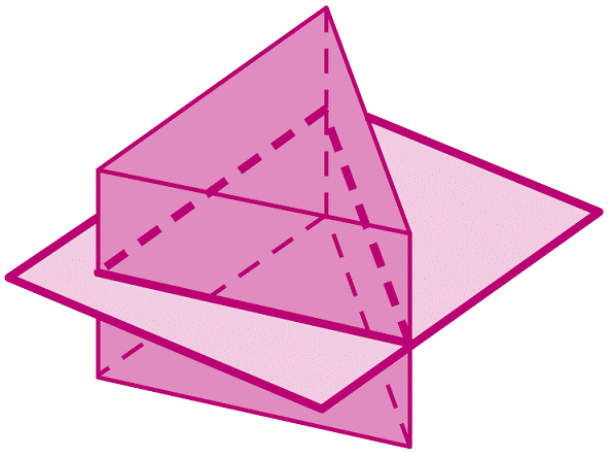
Describe the cross section.



The cross section is a **triangle**.

Example: 10

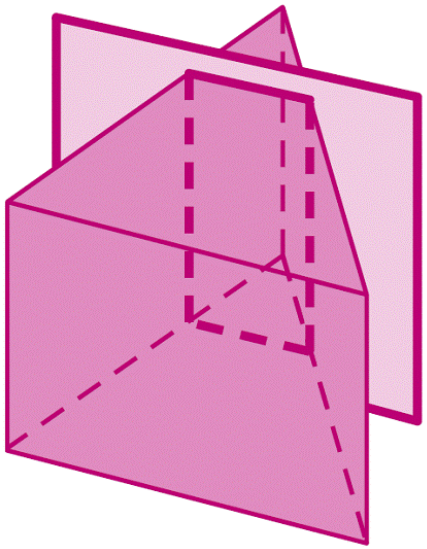
A piece of cheese is a prism with equilateral triangular bases. How can you slice the cheese to make a equilateral triangle?



Cut parallel to the bases.

Example: 11

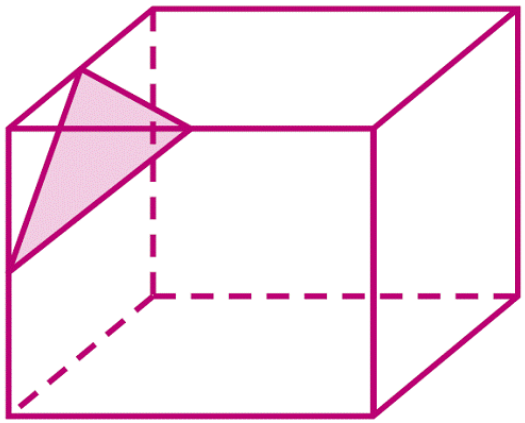
A piece of cheese is a prism with equilateral triangular bases. How can you slice the cheese to make a rectangle?



Cut perpendicular to the bases.

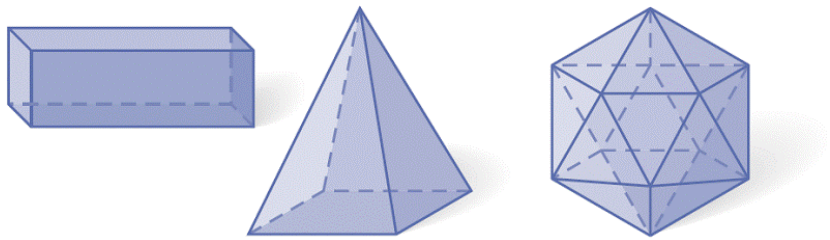
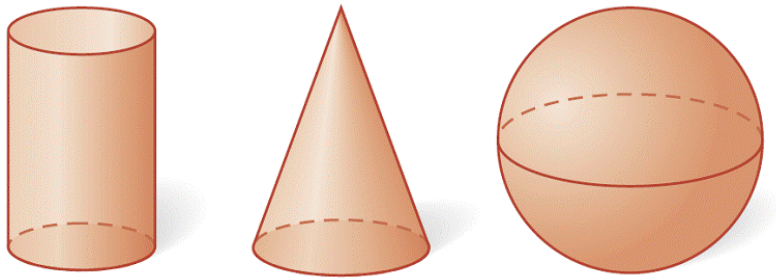
Example: 12

How can a chef cut a cube-shaped watermelon to make slices with triangular faces?



Cut through the midpoints of 3 edges that meet at 1 vertex.

A **polyhedron** is formed by four or more polygons that intersect only at their edges. Prisms and pyramids are polyhedrons, but cylinders and cones are not.

Polyhedrons	Not polyhedrons
	

Euler's Formula

For any polyhedron with V vertices, E edges, and F faces, $V - E + F = 2$.

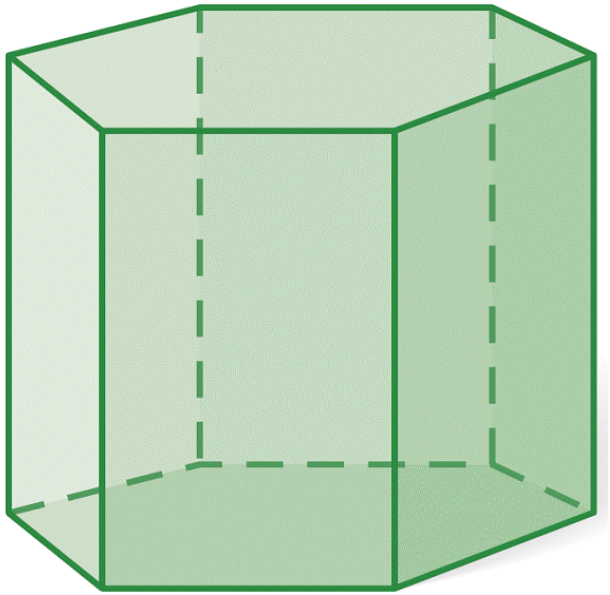
$$F+V = E+2$$

Reading Math

Euler is pronounced "Oiler."

Example: 13

Find the number of vertices, edges, and faces of the polyhedron. Use your results to verify Euler's formula.



$V = 12,\ E = 18,\ F = 8$

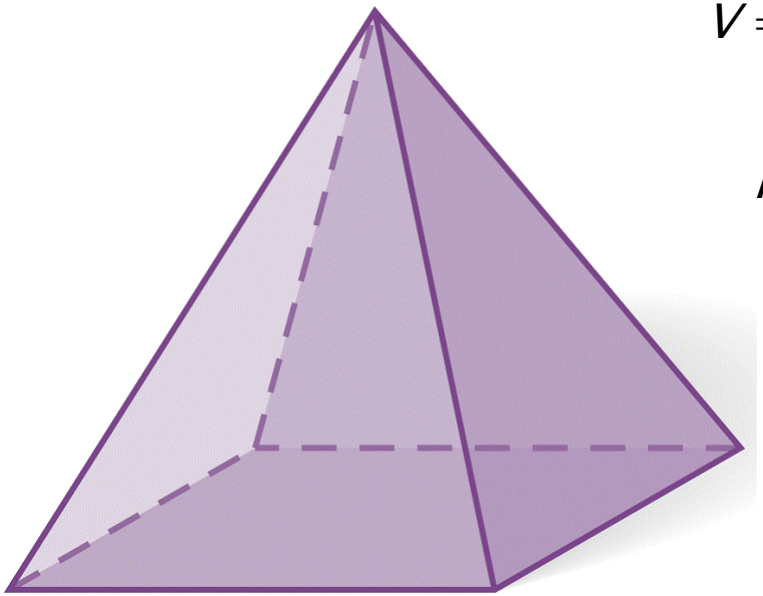
$F + V = E + 2$ *Use Euler's Formula.*

$8 + 12 = 18 + 2$ *Substitute.*

$20 = 20$ *Simplify.*

Example: 14

Find the number of vertices, edges, and faces of the polyhedron. Use your results to verify Euler's formula.



$V = 5,\ E = 8,\ F = 5$

$F + V = E + 2$ *Use Euler's Formula.*

$5 + 5 = 8 + 2$ *Substitute.*

$10 = 10$ *Simplify.*

Example: 15

A shape has 6 vertices and 8 faces. How many edges does it have?

$F+V = E+2$ *Use Euler's Formula.*

$8+6 = E+2$ *Substitute.*

$14 = E+2$ *Combine like terms.*

$12 = E$ *Subtract 2 from each side.*

Example: 16

A shape has 12 edges and 7 faces. How many vertices does it have?

$F+V = E+2$ *Use Euler's Formula.*

$7+V = 12+2$ *Substitute.*

$7+V = 14$ *Combine like terms.*

$V = 7$ *Subtract 7 from each side.*