Three-Dimensional Figures

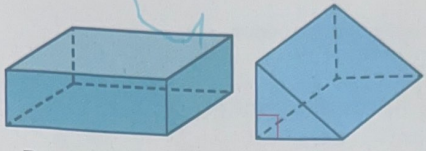
I Can... describe three-dimensional figures and determine the shapes resulting from horizontal, vertical, and angled cross sections.

What Vocabulary Will You Learn?
bases
cone
cross section
cylinder
edge
face
plane
polyhedron
prism
pyramid
vertices

Learn Describe Three-Dimensional Figures

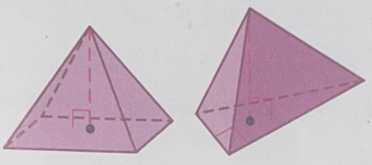
A **polyhedron** is a three-dimensional figure, or solid, with flat surfaces that are polygons. Prisms and pyramids are types of polyhedra. Polyhedra is the plural of polyhedron.

A **prism** is a three-dimensional figure with at least two congruent parallel faces called **bases** that are polygons. Prisms are named by the shape of their base.



Rectangular Prism Triangular Prism

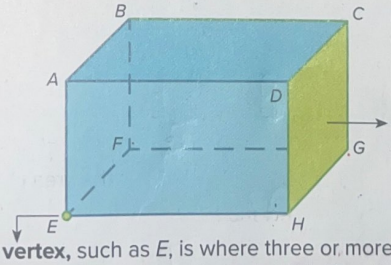
A **pyramid** is a three-dimensional figure with one base that is a polygon and other faces that are triangles. Pyramids are also named by the shape of their base.



Rectangular Pyramid Triangular Pyramid

The diagram shows the parts of a prism: the **faces**, the **edges**, and the **vertices**.

An **edge** is the line segment where two faces of a polyhedron meet. $\overline{BC}$ is an edge.



A **face** is a flat surface of a polyhedron. Rectangle *DCGH* is a face.

A **vertex**, such as *E*, is where three or more faces of a polyhedron intersect. **Vertices** is the plural of vertex.

(continued on next page)

face: a flat surface

* Rectangular prism have 6 faces because there are two congruent parallel bases that are faces, and four additional faces
- have 12 edges because the number of faces and vertices does not change

Your Notes

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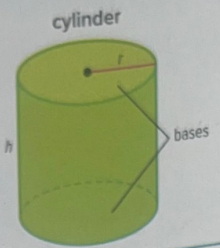
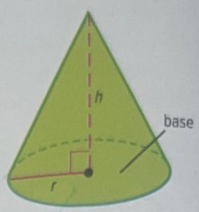
There are also solids that are *not* polyhedra. A **cylinder** is a three-dimensional figure with two parallel and congruent circular bases connected by a curved surface. A **cone** has one circular base connected by a curved side to a single point, called an *apex*.

cylinder



cone



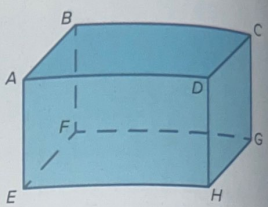
Talk About It!

Why are cylinders and cones not polyhedra?

Because polyhedra are figures with flat surface and factor that surfaces and faces that are polygons Both cylender and cones have curved

Example 1 Describe Three-Dimensional Figures

The figure shown is a rectangular prism.



Find the number of faces, edges, and vertices.

The faces are the flat surfaces of the prism. The prism has a top face, a bottom face, two side faces, a front face, and a back face.

The edges are the line segments where two faces meet.

Edges: $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, $\overline{AD}$, $\overline{CG}$, $\overline{GH}$, $\overline{DH}$, $\overline{FG}$, $\overline{EH}$, $\overline{EF}$, $\overline{AE}$, $\overline{BF}$

The vertices are *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*.

So, a rectangular prism has 6 faces, 12 edges, and 8 vertices.

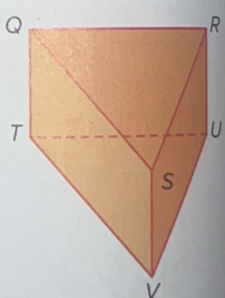
Talk About It!

Any rectangular prism has six faces. Consider other prisms, such as triangular prisms and pentagonal prisms. How can you find the number of faces, if the base is a polygon with *n* sides?

The number of faces a polydedron has if the base is apolygon with (n) sides is n+2

Check

The figure shown is a triangular prism. Find the number of faces, edges, and vertices.



faces: 5

edges: 9

vertices: 6

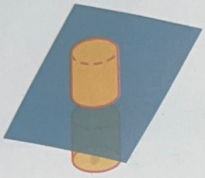
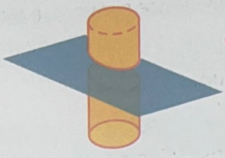
Go Online You can complete an Extra Example online.

Learn Describe Cross Sections of Three-Dimensional Figures

A **plane** is a flat surface that extends forever in all directions. The intersection of a solid and a plane is called a **cross section** of the solid.

Go Online Watch the video to see the cross sections of different three-dimensional figures.

The video shows various three-dimensional figures and their cross sections. The table shows the three cross sections of a cylinder.

Horizontal	Vertical	Angled
A horizontal cross section results in a circle.	A vertical cross section results in a rectangle.	An angled cross section results in an oval.
		

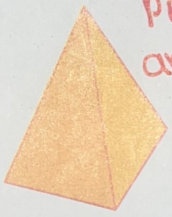
Talk About It!
Cross sections are sometimes used to show the interiors of buildings, cars, airplanes, and even bugs! Research to find examples of cross sections and explain how they might be used.

A cross section of a building might be used to show the interiors of the rooms and furniture inside A CT scan produces cross section area of a human body diagnose illness

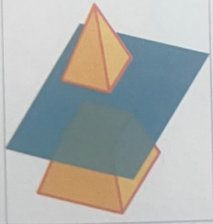
Example 2 Describe Cross Sections of Three-Dimensional Figures

A square pyramid is shown.

Describe the shape resulting from a horizontal cross section, a vertical cross section, and an angled cross section.



The table shows the result of each cross section.

Horizontal	Vertical	Angled
A horizontal cross section results in a square.	A vertical cross section results in a triangle.	An angled cross section results in a trapezoid.
		

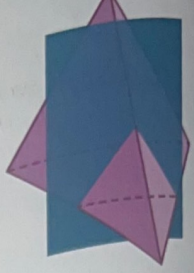
Talk About It!
Why is the cross section through the center of a sphere always a circle, no matter which way it is sliced?

A sphere has the same shape and size from any angle so is always circle

Check

Describe the shape resulting from the vertical cross section of the triangular pyramid.

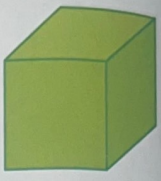
Triangle



Think About It!

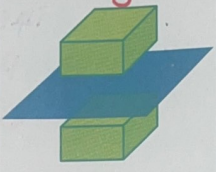
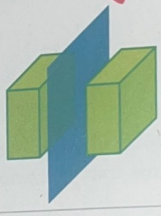
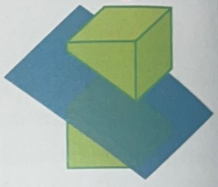
How will you visualize how the cross sections will look?

Example 3 Describe Cross Sections of Three-Dimensional Figures



A rectangular prism is shown.

Describe the shape resulting from a vertical cross section, a horizontal cross section, and an angled cross section.

Horizontal	Vertical	Angled
A horizontal cross section results in a rectangle	A vertical cross section results in a rectangle	An angled cross section results in a rectangle
		

So, a rectangular prism has a rectangular vertical cross section, a rectangular horizontal cross section, and a rectangular angled cross section.

Talk About It!

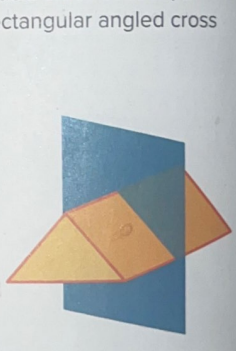
Mario states that all of the faces of a cube are squares. For this reason, the shape resulting from the cross section of a cube is always a square, no matter which way the cube is sliced. Explain why Mario is incorrect and draw a counterexample.

An angled cross section of the cube will result in the shape of rectangle because the angle distance across the cube is longer than the lenght, width or height of the cube

Check

Describe the shape resulting from the cross section of the triangular prism.

triangle



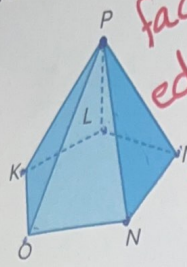
Go Online You can complete an Extra Example online.

Name _____ Period Aya Hameed

Go Online You can complete your homework online.

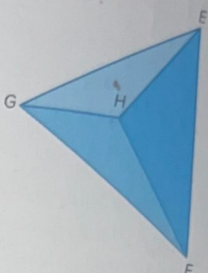
Practice

1. The figure shown is a pentagonal pyramid. Find the number of faces, edges, and vertices. (Example 1)



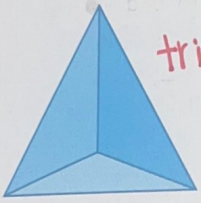
face 6
edges 10
vertics 6

2. The figure shown is a triangular pyramid. Find the number of faces, edges, and vertices. (Example 1)



4
6
4

3. A triangular pyramid is shown. Describe the shape resulting from a horizontal cross section, a vertical cross section, and an angled cross section. (Examples 2 and 3)



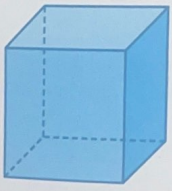
triangle, triangle
triangle

4. A cylinder is shown. Describe the shape resulting from a horizontal cross section, a vertical cross section, and an angled cross section. (Examples 2 and 3)

circle, rectangle, circle

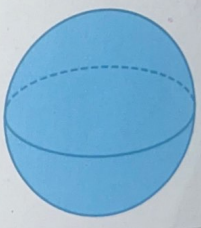
Test Practice

5. A cube is shown. Describe the shape resulting from a horizontal cross section, a vertical cross section, and an angled cross section. (Examples 2 and 3)



square, square, rectangle

6. **Open Response** A sphere is shown. Describe the shape resulting from a horizontal cross section, a vertical cross section, and an angled cross section.



circle, circle, circle

Apply

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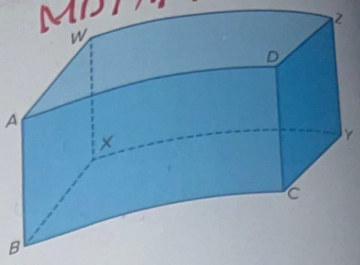
Mrs/ Aya

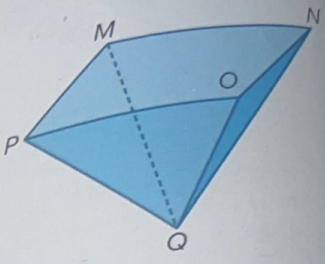
7. Refer to the figure. Identify the figure. Find the number of faces, edges, and vertices. Then describe a real-world object that resembles this figure.



rectangular prism 6, 12, 8

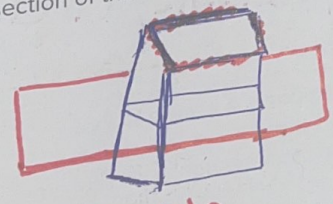
a tissue box

8. Refer to the figure. Identify the figure. Find the number of faces, edges, and vertices. Then describe a real-world object that resembles this figure.



rectangular prism 5, 8, 5

9. Select a real-world three-dimensional object. Draw the object and describe the resulting shape from a horizontal cross section of the object.



rectangle

10. MP **Reason Abstractly** Determine if the following statements are *always*, *sometimes*, or *never* true. Explain your reasoning.

a. A prism has a rectangular base.

sometimes, A triangular prism has a triangle for a base

b. The lateral faces of a pyramid (the faces that are not the base) are triangles.

always A pyramids base can be any Polygon but its intern face are always triang

11. Determine if the following statement is *true* or *false*. If false, provide a counterexample.

A prism always has an even number of vertices.

true

12. Determine if the following statement is tru or *false*. If false, provide a counterexampl

A prism always has 2 bases and 4 faces.

false, A triangular prism has 2 bases and 3 face