

Lesson 12

Main Idea

Identify and draw three-dimensional figures.

New Vocabulary

coplanar
parallel
solid
polyhedron
edge
face
vertex
diagonal
prism
base
pyramid
cylinder
cone
cross section

Math Online

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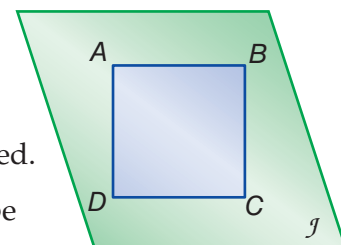
Cross Sections

MONUMENTS A two-dimensional figure, like a rectangle, has two dimensions: length and width. A three-dimensional figure, like a building, has three dimensions: length, width, and height.

1. Name the two-dimensional shapes that make up the sides of the Washington Monument.
2. If you observed the building from directly above, what two-dimensional figure would you see?
3. How are two- and three-dimensional figures related?

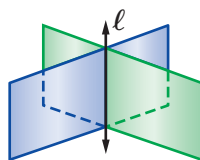


The figure at the right shows rectangle $ABCD$. Lines AB and DC are **coplanar** because they lie in the same plane. They are also **parallel** because they will never intersect, no matter how far they are extended.

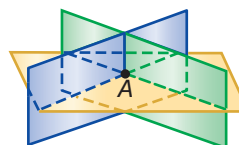


Just as two lines in a plane can intersect or be parallel, there are different ways that planes may be related in space.

Intersect in a Line



Intersect at a Point

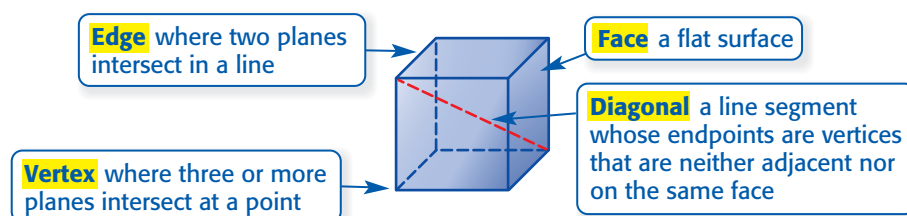


No Intersection



These are called **parallel planes**.

Intersecting planes can also form three-dimensional figures or **solids**. A **polyhedron** is a solid with flat surfaces that are polygons. Some terms associated with three-dimensional figures are *edge*, *face*, *vertex*, and *diagonal*.

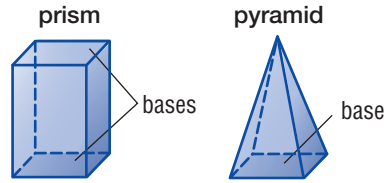


QUICK Review

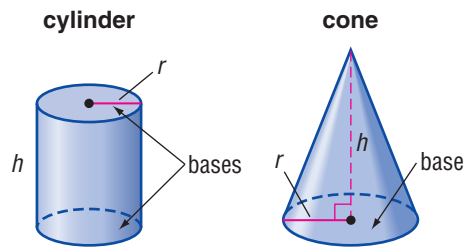
Polygons

Sides	Name
5	pentagon
6	hexagon
7	heptagon
8	octagon
9	nonagon
10	decagon

A **prism** is a polyhedron with two parallel, congruent faces called **bases**. A **pyramid** is a polyhedron with one base that is a polygon and faces that are triangles. Prisms and pyramids are named by the shape of their bases.



There are also solids that are not polyhedrons. A **cylinder** is a three-dimensional figure with congruent, parallel bases that are circles connected with a curved side. A **cone** has one circular base and a vertex connected by a curved side.



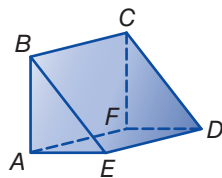
Study Tip

Common Error In the drawing of a rectangular prism, the bases do not have to be on the top and bottom. Any two parallel rectangles are bases. In a triangular pyramid, any face is a base.

EXAMPLES Identify Solids

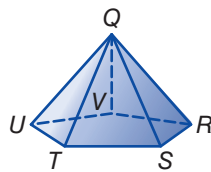
Identify the figure. Then name the bases, faces, edges, and vertices.

1



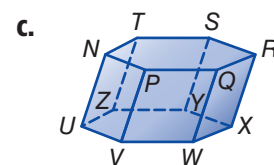
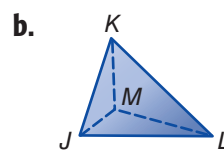
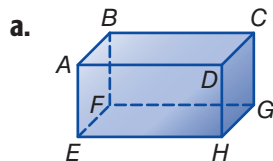
The figure has two parallel congruent bases that are triangles, so it is a triangular prism.
bases ABE , FCD
faces ABE , FCD , $BCDE$, $FAED$, $ABCF$
edges \overline{AB} , \overline{BE} , \overline{EA} , \overline{FC} , \overline{CD} , \overline{DF} , \overline{BC} , \overline{ED} , \overline{AF}
vertices A , B , C , D , E , F

2



The figure has one base that is a pentagon, so it is a pentagonal pyramid.
base $RSTUV$
faces $RSTUV$, QVR , QRS , QST , QTU , QUV
edges \overline{QR} , \overline{QS} , \overline{QT} , \overline{QU} , \overline{QV} , \overline{VR} , \overline{RS} , \overline{ST} , \overline{TU} , \overline{UV}
vertices Q , R , S , T , U , V

CHECK Your Progress



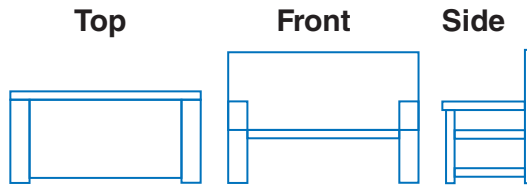


Real-World Link
 A well-landscaped lawn and garden can increase the value of a home up to 15%.

You can use three-dimensional drawings of objects to describe how different parts of the objects are related in space.

REAL-WORLD EXAMPLE Analyze Drawings

3 FURNITURE The photo shows a garden bench. Draw and label the top, front, and side views of the bench.



✓ CHECK Your Progress

d. TOOLBOX Draw and label the top, front, and side views of the toolbox shown.

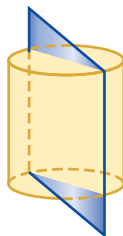


The intersection of a solid and a plane is called a **cross section** of the solid.

EXAMPLE Identify Cross Sections

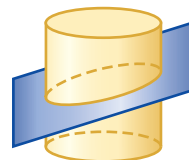
4 Describe the shape resulting from a vertical, angled, and horizontal cross section of a cylinder.

Vertical Slice



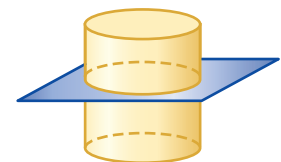
The cross section is a rectangle.

Angled Slice



The cross section is an oval.

Horizontal Slice



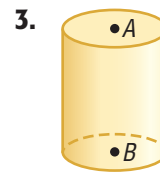
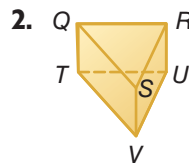
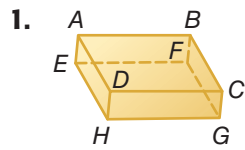
The cross section is a circle.

✓ CHECK Your Progress

e. Describe the shape resulting from a vertical, angled, and horizontal cross section of a square pyramid.

✓ CHECK Your Understanding

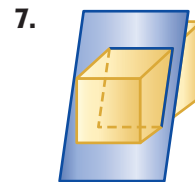
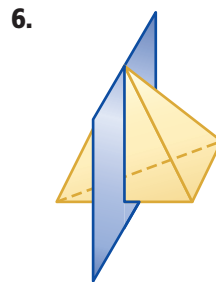
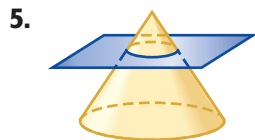
Examples 1 and 2 Identify each figure. Then name the bases, faces, edges, and vertices.



Example 3 4. **AQUARIUMS** Draw and label the top, front, and side views of the aquarium shown.

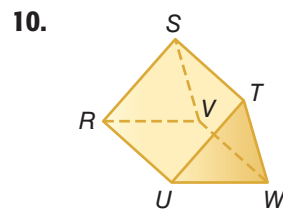
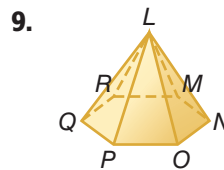
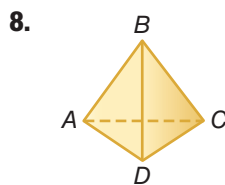


Example 4 Describe the shape resulting from each cross section.



Practice and Problem Solving

Examples 1 and 2 Identify each figure. Then name the bases, faces, edges and vertices.



Example 3 11. **BUILDINGS** Draw and label the top, front, and side views of the building.

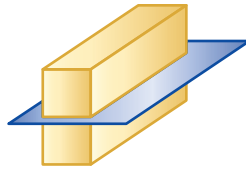


12. **TENT** Draw and label the top, front, and side views of the tent.



Example 4 Describe the shape resulting from each cross section.

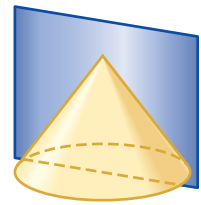
13.



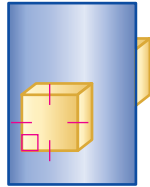
14.



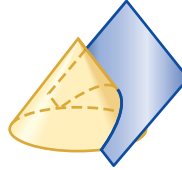
15.



16.



17.



18.



19. State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.

Two planes in three-dimensional space can intersect at one point.

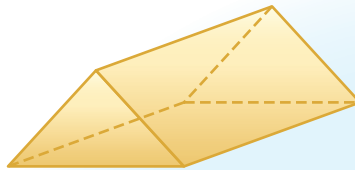
20. **SPORTS** A standard basketball is shaped like a *sphere*.

- a. Draw a basketball with a vertical, angled, and horizontal slice.
- b. Describe the cross section made by each slice.

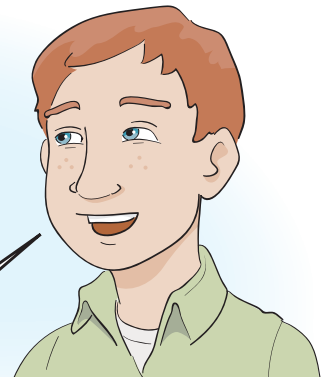


H.O.T. Problems

21. **OPEN ENDED** Draw the cross sections of a polyhedron, cylinder, or cone. Exchange papers with another student. Identify the three-dimensional figures represented by the cross sections.
22. **FIND THE ERROR** Brian is identifying the figure below. Find his mistake and correct it.



The figure has a triangular base.
It is a triangular pyramid.



CHALLENGE Determine whether each statement is *always*, *sometimes*, or *never* true. Explain your reasoning.

23. A prism has 2 bases and 4 faces.
24. A pyramid has parallel faces.
25. **WRITE MATH** Explain whether a top-front-side view diagram *always* provides enough information to draw a figure. If not, provide a counterexample.



Test Practice

26. Benita received the gift box shown.



Which drawing **best** represents the top view of the gift box?

- A.
- B.
- C.
- D.

27. Which of the following is NOT an example of a polyhedron?

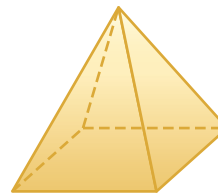
- F. cylinder
- G. rectangular prism
- H. octagonal pyramid
- I. triangular prism

28. Which of the following represents a side view of the figure below?



- A.
- B.
- C.
- D.

29. The figure below is a square pyramid.



Which of the following is NOT a cross section from the square pyramid?

- F.
- G.
- H.
- I.