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**

glencoe.com

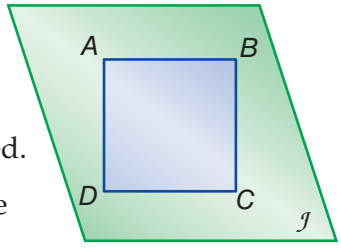
CCSS 7.G.3

# 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.

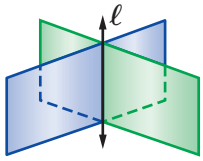
1. Name the two-dimensional shapes that make up the sides of the Washington Monument.
2. If you observed the building from directly above, what two-dimensional figure would you see?
3. How are two- and three-dimensional figures related?

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.

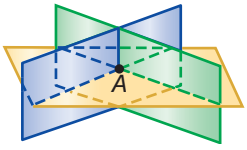



Just as two lines in a plane can intersect or be parallel, there are different ways that planes may be related in space.

Intersect in a Line



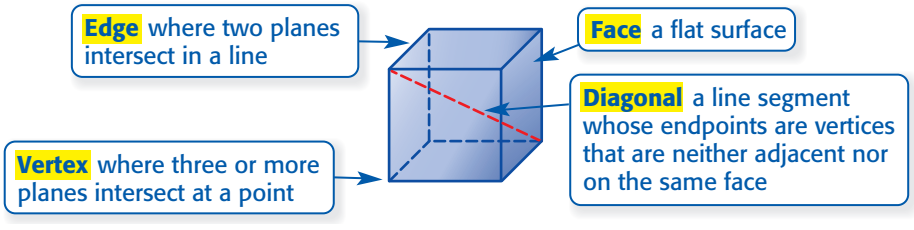

Intersect at a Point




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*.

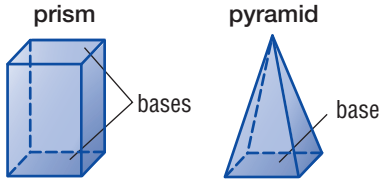


**QUICK Review**

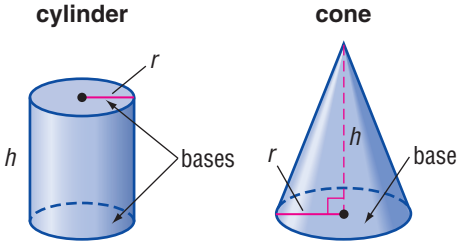
**Polygons**

| 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.



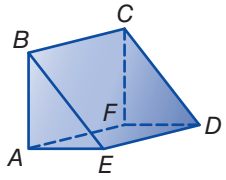

**Study Tip**

**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

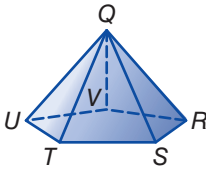
**Identify the figure. Then name the bases, faces, edges, and vertices.**

**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*

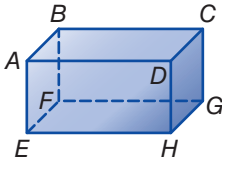
**2**



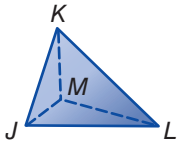

The figure has one base that is a pentagon, so it is a pentagonal pyramid.
**base** *RSTUV*
**faces** *RSTUV*, *QVR*, *QRS*, *QST*, *QTU*, *QUV*
**edges** $\overline{QR}$, $\overline{QS}$, $\overline{QT}$, $\overline{QU}$, $\overline{QV}$, $\overline{VR}$, $\overline{RS}$, $\overline{ST}$, $\overline{TU}$,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

**CHECK Your Progress**

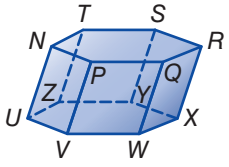
**a.**




**b.**




**c.**

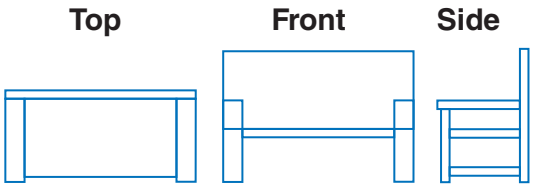


**Real-World Link**
A well-landscaped lawn and garden can increase the value of a home up to 15%.

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

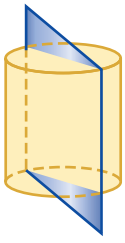
**d.** **TOOLBOX** Draw and label the top, front, and side views of the toolbox shown.

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

## EXAMPLE Identify Cross Sections

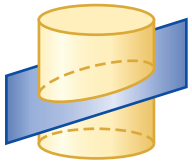
**4** **Describe the shape resulting from a vertical, angled, and horizontal cross section of a cylinder.**

**Vertical Slice**



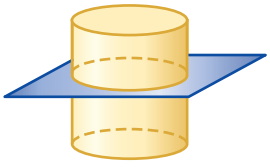
The cross section is a rectangle.

**Angled Slice**



The cross section is an oval.

**Horizontal Slice**



The cross section is a circle.

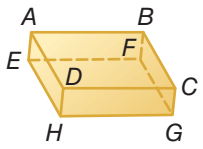
### CHECK Your Progress

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

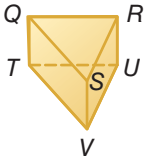
## CHECK Your Understanding

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

**1.**




**2.**

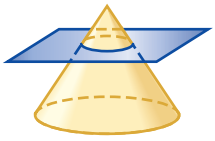



**3.**


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

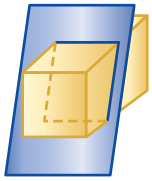
**Example 4** **Describe the shape resulting from each cross section.**

**5.**



**6.**

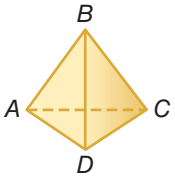
**7.**



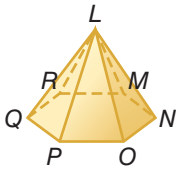
## Practice and Problem Solving

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

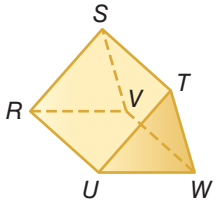
**8.**




**9.**




**10.**

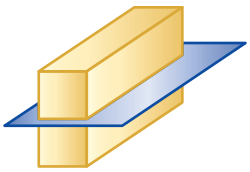



**Example 3** **11. BUILDINGS** Draw and label the top, front, and side views of the building.

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

**Example 4** **Describe the shape resulting from each cross section.**

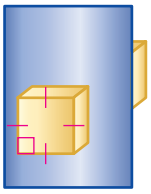
**13.**



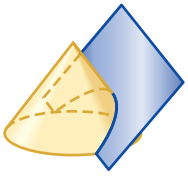
**14.**

**15.**

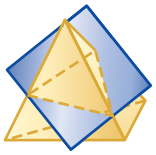
**16.**



**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*.

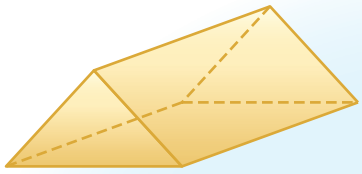
**a.** Draw a basketball with a vertical, angled, and horizontal slice.

**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.






**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?

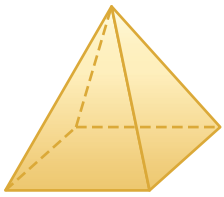
**A.**

**C.**

**B.**

**D.**

**29.** The figure below is a square pyramid.



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

**F.**

**H.**

**G.**

**I.**