COMMON CORE

1-1 Understanding Points, Lines, and Planes

CC.9-12.G.CO.1 Know precise definitions…based on the undefined notions of point, line…

Objectives

Identify, name, and draw points, lines, segments, rays, and planes.

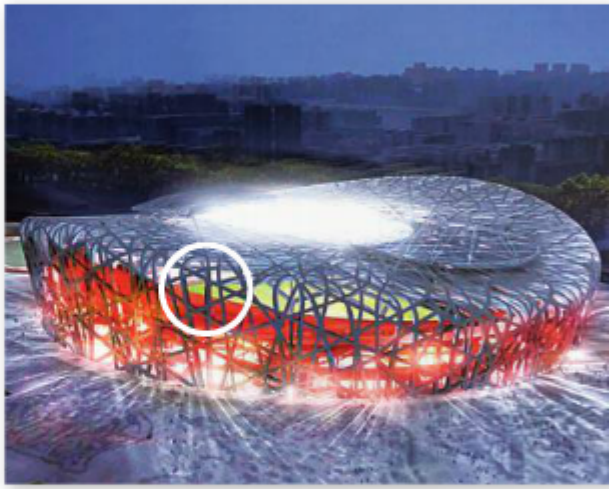
Apply basic facts about points, lines, and planes.

Vocabulary

undefined term
point
line
plane
collinear
coplanar
segment
endpoint
ray
opposite rays
postulate

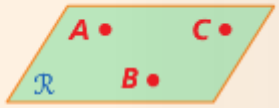
Who uses this?

Architects use representations of points, lines, and planes to create models of buildings. Interwoven segments were used to model the beams of Beijing's National Stadium for the 2008 Olympics.



The most basic figures in geometry are **undefined terms**, which cannot be defined by using other figures. The undefined terms *point*, *line*, and *plane* are the building blocks of geometry.

Undefined Terms

TERM	NAME	DIAGRAM
A **point** names a location and has no size. It is represented by a dot.	A capital letter point *P*	*P* •
A **plane** is a flat surface that has no thickness and extends forever.	A script capital letter or three points not on a line plane $\mathcal{R}$ or plane *ABC*	

Points that lie on the same line are **collinear**. K, L, and M are collinear. K, L, and N are *noncollinear*. Points that lie in the same plane are **coplanar**. Otherwise they are *noncoplanar*.

EXAMPLE 1 Naming Points, Lines, and Planes

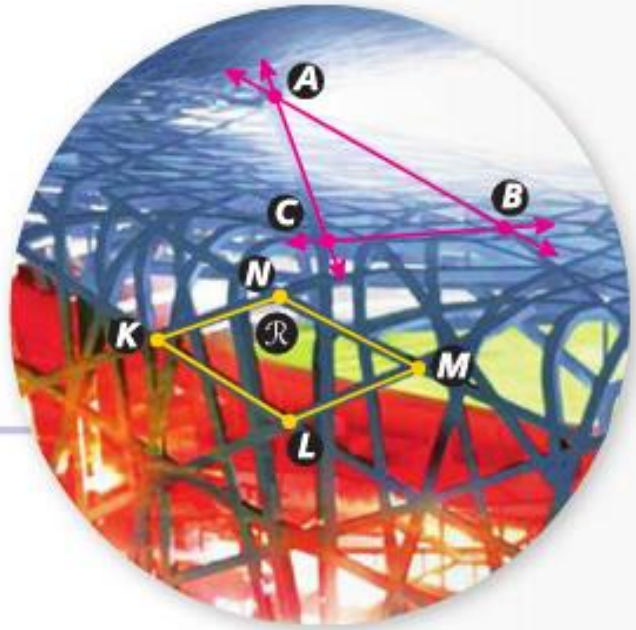
Refer to the design in the roof of Beijing's National Stadium.

A **Name four coplanar points.**

K, L, M, and N all lie in plane $\mathcal{R}$.

B **Name three lines.**

$\overleftrightarrow{AB}$, $\overleftrightarrow{BC}$, and $\overleftrightarrow{CA}$.



Helpful Hint

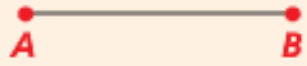
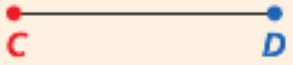
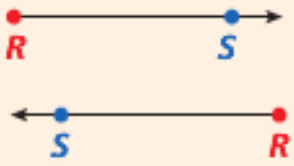
A plane may be named by any three noncollinear points on that plane. Plane ABC may also be named BCA, CAB, CBA, ACB, or BAC.

CHECK IT OUT!

1. Use the diagram to name two planes.

Know it! Note

Segments and Rays

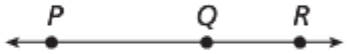
DEFINITION	NAME	DIAGRAM
A **segment**, or line segment, is the part of a line consisting of two points and all points between them.	The two endpoints $\overline{AB}$ or $\overline{BA}$	
An **endpoint** is a point at one end of a segment or the starting point of a *ray.*	A capital letter *C* and *D*	
A **ray** is a part of a line that starts at an endpoint and extends forever in one direction.	Its endpoint and any other point on the ray $\overrightarrow{RS}$	
Opposite rays are two rays that have a common endpoint and form a line.	The common endpoint and any other point on each ray $\overrightarrow{EF}$ and $\overrightarrow{EG}$	

EXAMPLE 2 Drawing Segments and Rays

Draw and label each of the following.

A **a segment with endpoints U and V**

B **opposite rays with a common endpoint Q**



CHECK IT OUT! **2.** Draw and label a ray with endpoint M that contains N.

A **postulate**, or *axiom*, is a statement that is accepted as true without proof. Postulates about points, lines, and planes help describe geometric properties.

Know it! Note

Postulates — Points, Lines, and Planes

1-1-1 Through any two points there is exactly one line.

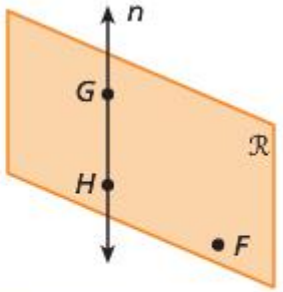
1-1-2 Through any three noncollinear points there is exactly one plane containing them.

1-1-3 If two points lie in a plane, then the line containing those points lies in the plane.

EXAMPLE 3 Identifying Points and Lines in a Plane

Name a line that passes through two points.

There is exactly one line n passing through G and H.



CHECK IT OUT! **3.** Name a plane that contains three noncollinear points.

Recall that a system of equations is a set of two or more equations containing two or more of the same variables. The coordinates of the solution of the system satisfy all equations in the system. These coordinates also locate the point where all the graphs of the equations in the system *intersect*.

An *intersection* is the set of all points that two or more figures have in common. The next two postulates describe intersections involving lines and planes.

Postulates **Intersection of Lines and Planes**

1-1-4 If two lines intersect, then they intersect in exactly one point.

1-1-5 If two planes intersect, then they intersect in exactly one line.

Use a dashed line to show the hidden parts of any figure that you are drawing. A dashed line will indicate the part of the figure that is not seen.

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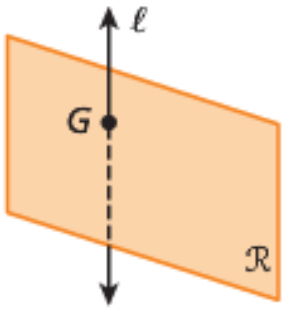
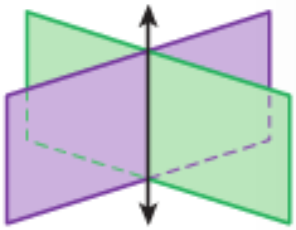
EXAMPLE 4 Representing Intersections

Sketch a figure that shows each of the following.

A **A line intersects a plane, but does not lie in the plane.**



B **Two planes intersect in one line.**



CHECK IT OUT!

4. Sketch a figure that shows two lines intersect in one point in a plane, but only one of the lines lies in the plane.

MATHEMATICAL PRACTICES

THINK AND DISCUSS

1. Explain why any two points are collinear.
2. Which postulate explains the fact that two straight roads cannot cross each other more than once?
3. Explain why points and lines may be coplanar even when the plane containing them is not drawn.
4. Name all the possible lines, segments, and rays for the points A and B. Then give the maximum number of planes that can be determined by these points.

Know it! Note

5. **GET ORGANIZED** Copy and complete the graphic organizer below. In each box, name, describe, and illustrate one of the undefined terms.