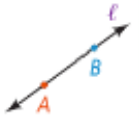
1-2 Points, Lines, and Planes

Content Standard
G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

Objective To understand basic terms and postulates of geometry

take note

Key Concept Undefined Terms

Term Description	How to Name It	Diagram
A **point** indicates a location and has no size.	You can represent a point by a dot and name it by a capital letter, such as A.	
A **line** is represented by a straight path that extends in two opposite directions without end and has no thickness. A line contains infinitely many points.	You can name a line by any two points on the line, such as $\overleftrightarrow{AB}$ (read "line AB") or $\overleftrightarrow{BA}$, or by a single lowercase letter, such as line ℓ.	
A **plane** is represented by a flat surface that extends without end and has no thickness. A plane contains infinitely many lines.	You can name a plane by a capital letter, such as plane P, or by at least three points in the plane that do not all lie on the same line, such as plane ABC.	

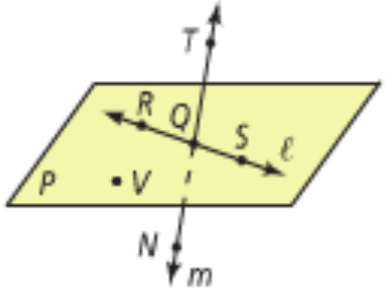
Points that lie on the same line are **collinear points.** Points and lines that lie in the same plane are **coplanar.** All the points of a line are coplanar.

Problem 1 Naming Points, Lines and Planes

A What are two other ways to name $\overleftrightarrow{QT}$?

B What are two other ways to name plane P?

C What are the names of three collinear points? What are the names of four coplanar points?

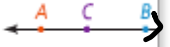


A geometric figure is a set of points.

Space is the set of all points in three dimensions.

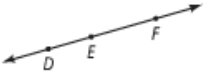
take note

Key Concept Defined Terms

Definition	How to Name It	Diagram
A **segment** is part of a line that consists of two endpoints and all points between them.	You can name a segment by its two endpoints, such as $\overline{AB}$ (read "segment AB") or $\overline{BA}$.	
A **ray** is part of a line that consists of one endpoint and all the points of the line on one side of the endpoint.	You can name a ray by its endpoint and another point on the ray, such as $\overrightarrow{AB}$ (read "ray AB"). The order of points indicates the ray's direction.	
Opposite rays are two rays that share the same endpoint and form a line.	You can name opposite rays by their shared endpoint and any other point on each ray, such as $\overrightarrow{CA}$ and $\overrightarrow{CB}$.	

Problem 2 Naming Segments and Rays

A What are the names of the segments in the figure at the right?



B What are the names of the rays in the figure?

C Which of the rays in part (B) are opposite rays?

A **postulate** or **axiom** is an accepted statement of fact. Postulates, like undefined terms, are basic building blocks of the logical system in geometry. You will use logical reasoning to prove general concepts in this book.

Take note

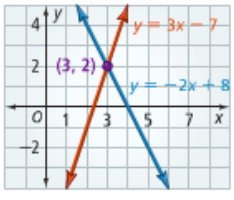
Postulate 1-1

Through any two points there is exactly one line.

Line t passes through points A and B. Line t is the only line that passes through both points.

When you have two or more geometric figures, their **intersection** is the set of points the figures have in common.

This is an example of an intersection that you should be familiar with from Algebra 1.

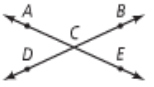


take note

Postulate 1-2

If two distinct lines intersect, then they intersect in exactly one point.

$\overleftrightarrow{AE}$ and $\overleftrightarrow{DB}$ intersect in point C.

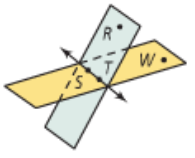


take note

Postulate 1-3

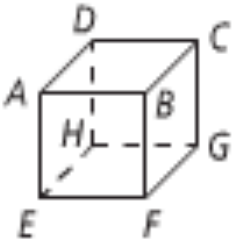
If two distinct planes intersect, then they intersect in exactly one line.

Plane RST and plane WST intersect in $\overleftrightarrow{ST}$.



Problem 3 Finding the Intersection of Two Pla

Each surface of the box at the right represents part of a plan
What is the intersection of plane *ADC* and plane *BFG*?



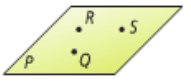
When you name a plane from a figure like the box in Problem 3, list the corner points in consecutive order. For example, plane *ADCB* and plane *ABCD* are also names for the plane on the top of the box. Plane *ACBD* is not.

take note

Postulate 1-4

Through any three noncollinear points there is exactly one plane.

Points Q, R, and S are noncollinear. Plane P is the only plane that contains them.

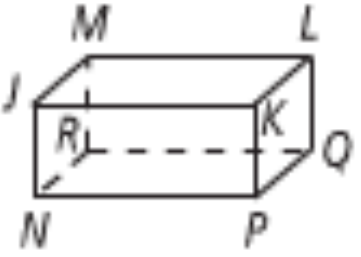


Problem 4 **Using Postulate 1-4**

Use the figure at the right.

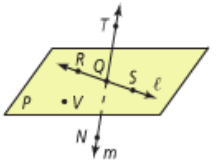
A What plane contains points N, P, and Q? Shade the plane.

B What plane contains points J, M, and Q? Shade the plane.



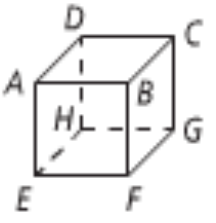
Lesson Review:

1. **a.** What are two other ways to name $\overleftrightarrow{RS}$?
   b. What are two more ways to name plane P?
   c. What are the names of three other collinear points?
   d. What are two points that are *not* coplanar with points R, S, and V?

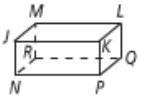
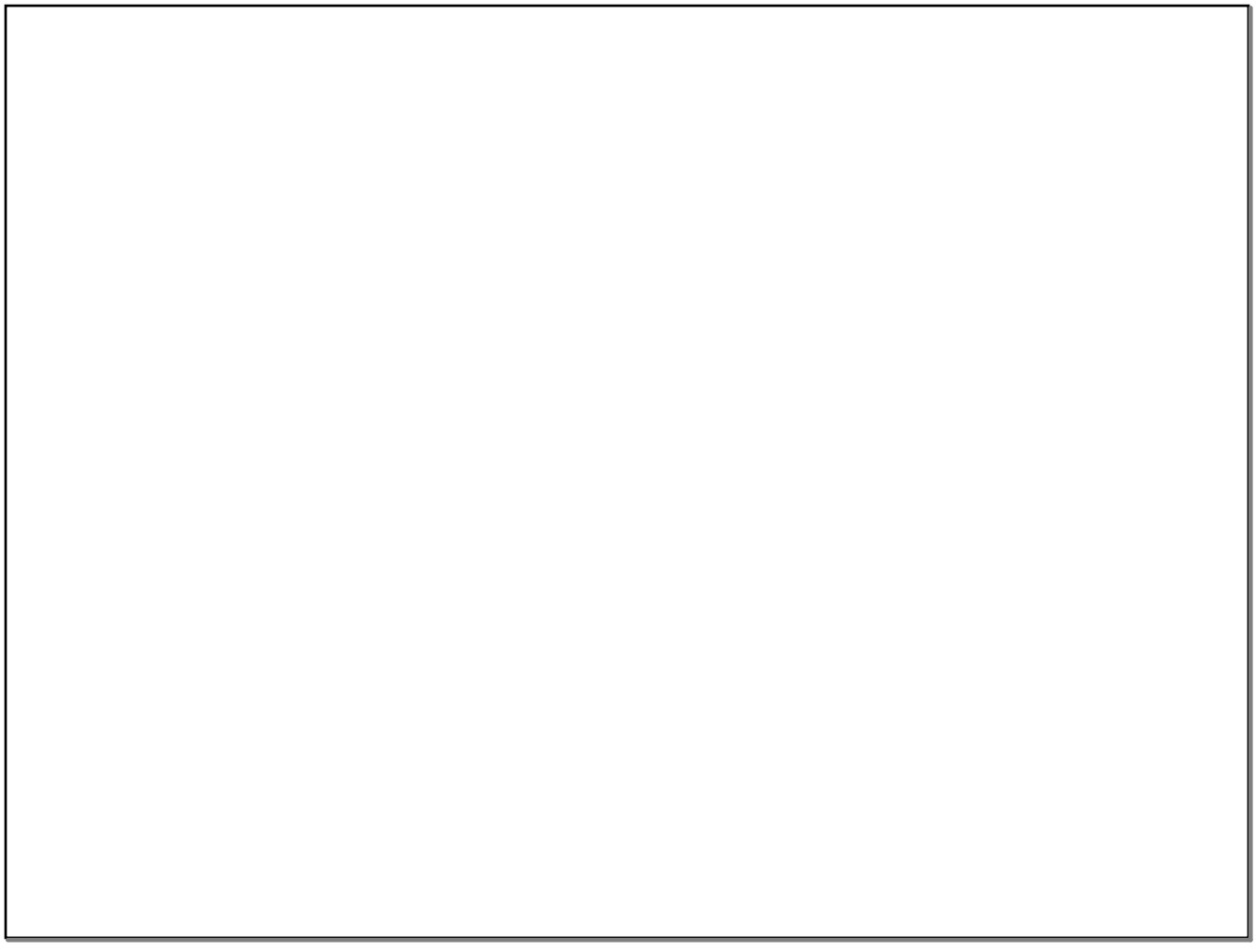


2. **Reasoning** $\overrightarrow{EF}$ and $\overrightarrow{FE}$ form a line. Are they opposite rays? Explain.

3. **a.** What are the names of two planes that intersect in $\overleftrightarrow{BF}$?
   b. Reasoning Why do you only need to find two common points to name the intersection of two distinct planes?



4. **a.** What plane contains points L, M, and N? Copy the figure in Problem 4 and shade the plane.
   b. Reasoning What is the name of a line that is coplanar with $\overrightarrow{JK}$ and $\overrightarrow{KL}$?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