

## Understand Points, Lines, and Planes

Geometry is the study of points, lines, and planes and their relationships. Everything we see contains elements of geometry.

A point is the basic unit of geometry. The shoreline in the painting represents part of a line. A line is a series of points that extends without end in two directions.

### Definition 1: Point

A point has no size

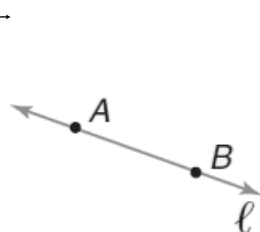
Points are named using capital letters



Points A and B

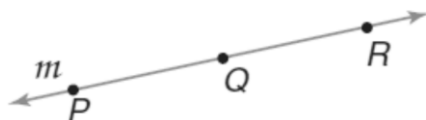
### Definition 2: Line

- A line is made up of an infinite number of points
- The arrows show that the line extends without end in both directions
- A line can be named with a single lowercase script letter or by two points on the line
- The symbol for a line is  $\ell$



Line AB or  $\overline{AB}$

**Example 1:** Refer to the diagram to answer the following questions



1) Name two points on line  $m$ .

Two points are point  $P$  and point  $Q$ .

2) Give three names for the line.

Any two points on the line or the script letter can be used to name it.

Three names are  $\overline{PQ}$ ,  $\overline{PR}$ , and line  $m$ .

Three points may lie on the same line, as in Example 1. **These points are collinear.** Points that do not lie on the same line are noncollinear.

Rays and line segments are parts of lines. A ray has a definite starting point and extends without end in one direction. The sun's rays represent a ray.

### Definition 3: Ray

The starting point of a ray is called the endpoint

A ray is named using the endpoint first, then another point on the ray

The symbol is  $\overrightarrow{\quad}$



The rays are  $\overrightarrow{DF}$  and  $\overrightarrow{CA}$

A line segment has a definite beginning and end.

### Definition 4: Line Segment

A line segment is part of a line containing two endpoints and all points between them

A line segment is named using its endpoints

The symbol for segment BL is  $\overline{\quad}$



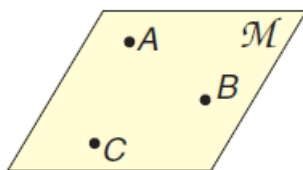
Segment BL or  $\overline{BL}$

A plane is a flat surface that extends without end in all directions.

### Definition 5: Plane

For any three noncollinear points, there is only one plane that contains all three points

A plane can be named with a single uppercase script letter or by three noncollinear points



Plane ABC or plane M

Points that lie in the same plane are coplanar. Points that do *not* lie in the same plane are noncoplanar.

Postulate 1

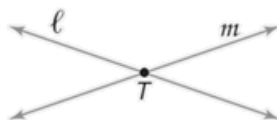
Two points determine a unique line



There is only one line that contains points P and Q

Postulate 2

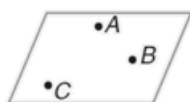
If two distinct lines intersect, then their intersection is a point



Lines l and m intersect at T

Postulate 3

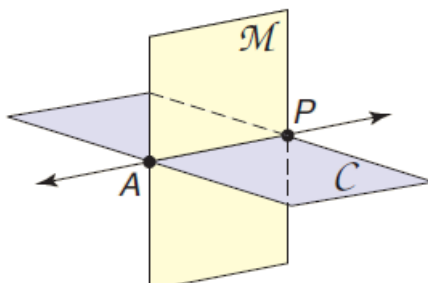
Three noncollinear points determine a unique plane



There is one and only one plane that contains points A, B, and C

Postulate 4

If two distinct planes intersect, then their intersection is a line



Plane M and plane C intersect in line AP