



Lesson Question

What are the basic tools of Euclidian geometry?



Lesson Goals

Analyze **undefined** terms and related postulates.

Characterize points, **lines**, and planes.

Characterize **distance** along a line.



Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

 C deductive reasoning

A. a statement that has been proven based on previous theorems, postulates, or axioms

 E postulate

B. points that lie on the same line

 A theorem

C. the process of utilizing facts, properties, definitions, and theorems to form a logical argument

 B collinear

D. contained within the same plane

 D coplanar

E. a statement accepted without proof; also known as an axiom



Definitions in Mathematics

Definitions in mathematics, and all sciences, require **precise language**.

There's a difference between **definitions** and descriptions.

Description	Definition
<ul style="list-style-type: none">• Run:<ul style="list-style-type: none">• To move quickly• To walk fast	<ul style="list-style-type: none">• Run:<ul style="list-style-type: none">• To go quickly by moving the legs more rapidly than at a walk and in such a manner that for an instant in each step all or both feet are off the ground

The kind of precise language used in a definition is what we need to use when we are defining words in geometry.

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Euclidean Geometry

POSTULATES AND THEOREMS

Euclid, who lived around 330 BCE, created a comprehensive study of geometry based on **deductive reasoning** using **postulates**, definitions, and **theorems**.

Postulate	Definition	Theorem
Mathematical statement taken as true but not proven (also called axiom)	Formal statement declaring the meaning of a word	Conditional statement containing a hypothesis and conclusion.

The difference between a theorem and a postulate is that we **prove** our theorems.

We prove our theorems by using definitions and by using **postulates** and possibly even other theorems.

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TOOLS FOR CONSTRUCTING GEOMETRIC FIGURES

Euclidean geometry is comprised of figures and diagrams that can all be constructed using just a **straightedge** and **compass**.

Straightedge:



Compass:



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Undefinable Notions

There are some concepts in Euclidean geometry that are considered undefinable, but are used to define other foundational objects. These are the point, line, and plane.

We think of a point as a **location** in space.

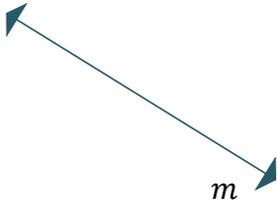
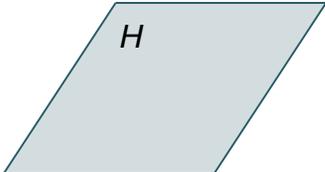
We think of **lines** as a series of points extending infinitely in two directions.

Think of a plane as something consisting of **infinitely** many lines and that has a length and width direction.

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Characteristics of Undefined Concepts: Examples

Point	Line	Plane
 <p>A point has 0 dimensions.</p>	 <p>A line has 1 dimension.</p>	 <p>A plane has 2 dimensions.</p>

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Characteristics of Undefined Concepts: Summary

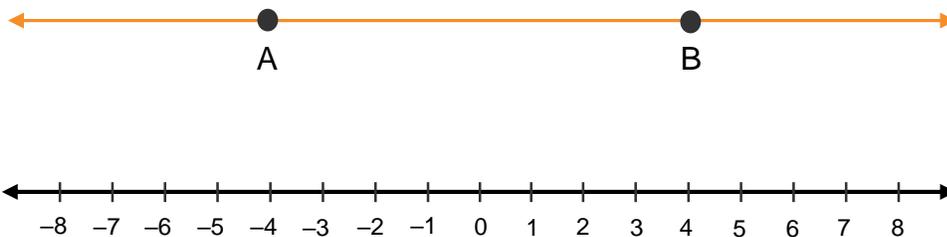
Point	Line	Plane
<ul style="list-style-type: none"> No dimensions Location on coordinate plane designated by an ordered pair (x, y) Identified with a single capital letter 	<ul style="list-style-type: none"> One-dimensional set of infinite points Has no beginning or end Identified with a lowercase italicized letter or two capital letters representing two points on the line 	<ul style="list-style-type: none"> Two-dimensional set of all points Flat or level surface Has no beginning or end Identified with a capital italicized letter

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Analyzing the Meaning of Distance

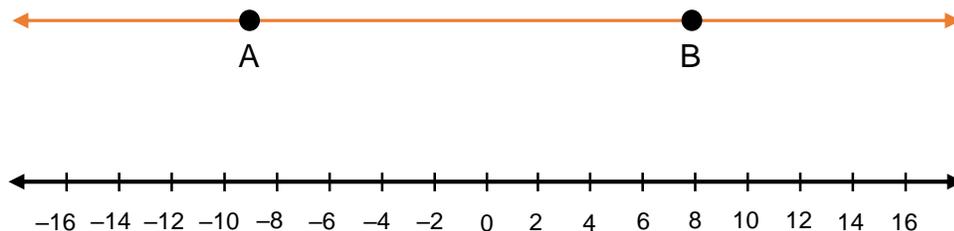
How can we define distance?



Using this number line, the distance between these two points is 8.

Analyzing the Meaning of Distance along a Line

How can we define distance along a line?



If you change the number line, the distance changes.

Distance is another undefined notion in Euclidean geometry.

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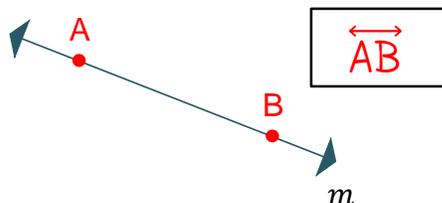
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Postulates for Undefined Notions

Point existence postulate for lines: A line contains at least **two** points.

- Points on the same line are **collinear**.

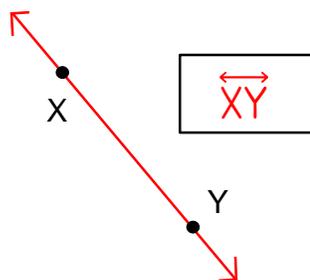
Draw two points on the line, and name the line using the points.



Unique line postulate: Through any two points there exists one and

only one line.

Connect the points to make a line. Then name the line using the points.



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Postulates for Undefinable Notions

Point existence postulate for planes: A plane contains at least

three

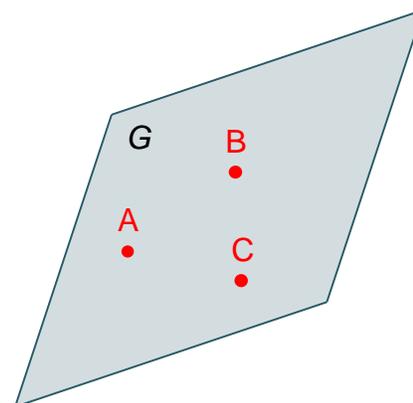
noncollinear points.

Objects that are on the same

plane are

coplanar

Draw coplanar points A, B, and C on the plane.

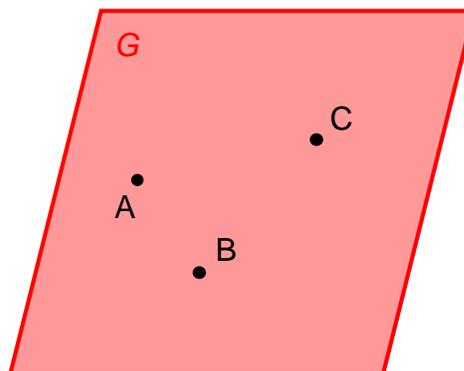


Unique plane postulate: Through any three noncollinear points there exists

one and only one

plane

Draw a shape that represents a plane containing the three points.

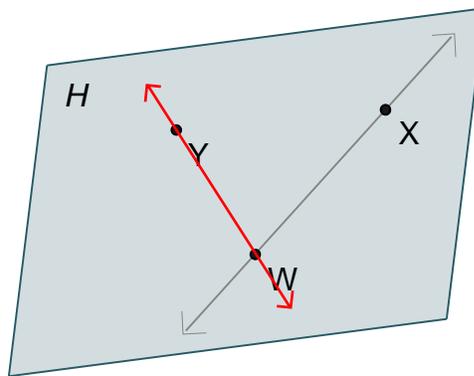


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Flat plane postulate: If two points are in a plane, then the **line** that contains those two points lies **entirely** in that plane.

Draw another line that lies entirely in the plane through points W and Y.



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Intersections of Geometric Figures

INTERSECTING LINES

If two **distinct** lines intersect, then they intersect at one and only one point.

Draw two lines that intersect and two lines that do not intersect.

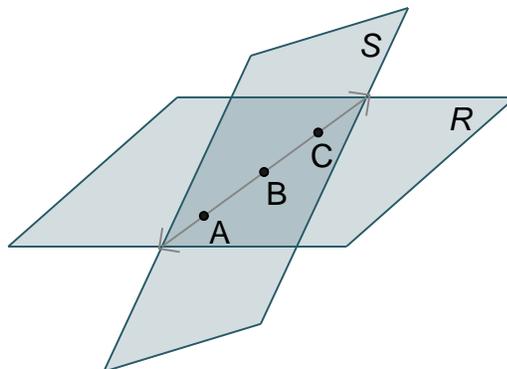
One intersection:	No intersection:

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INTERSECTING PLANES

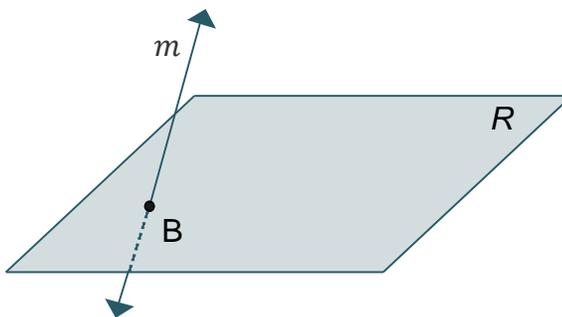
If two planes intersect, then their intersection is a .



Here, plane S and plane have an intersection that creates a line containing points A, B, and C.

LINES INTERSECTING PLANES

If a plane and a line intersect, they intersect at one .



Line m intersects plane R at point .

Summary

Euclidean Geometry



Lesson Question

What are the basic tools of Euclidean geometry?



Answer

(Sample answer) Euclidean geometry is based on constructions with a straightedge and compass and is built with deductive reasoning using undefined terms, postulates, precise definitions, and theorems.

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Review: Key Concepts

Geometry is built from deductive reasoning using postulates, precise definitions, and **theorems**.

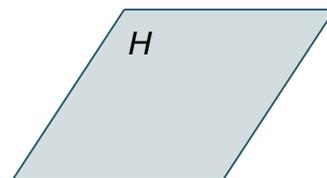
- The diagrams and figures that represent the postulates, definitions, and theorems are constructed with a straightedge and a **compass**.
- The foundational figures, which are also known as undefined concepts, are points, **lines**, and planes.



Point



Line



Plane



Summary

Euclidean Geometry

Use this space to write any questions or thoughts about this lesson.