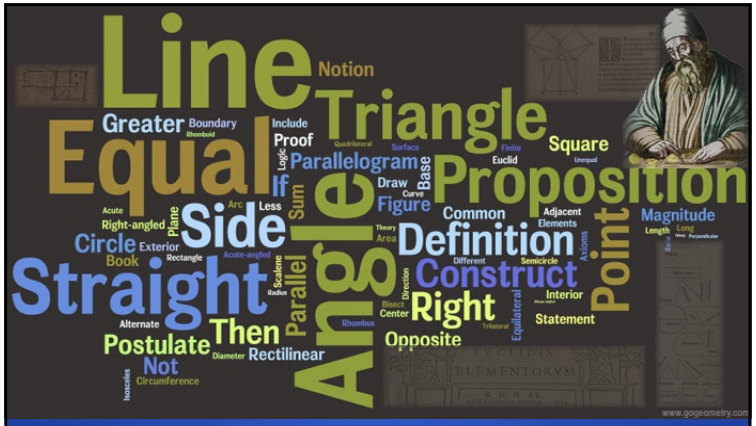


Warm-up#2: What would cause a person to begin studying what we now know as Geometry? Also, tell me what you already know about Geometry.

1-1 Understanding Points, Lines, and Planes

Standards and Objectives

CC.9-12.G.CO.1—[Holt 1-1; CPM Appendix A]
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.

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

Apply basic facts about points, lines, and planes in order to sketch and draw various figures.

1-1 Understanding Points, Lines, and Planes

Vocabulary

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

1-1 Understanding Points, Lines, and Planes

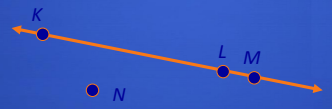
The most basic figures in geometry are undefined terms, which cannot be defined by using other figures. The undefined terms *point*, *line*, and *plane* are the building blocks of geometry.

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 **line** is a straight path that has no thickness and extends forever.	A lowercase letter or two points on the line line ℓ, $\overleftrightarrow{XY}$ or $\overleftrightarrow{YX}$	*X* *Y* ℓ
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*	*A* *C* *B* $\mathcal{R}$

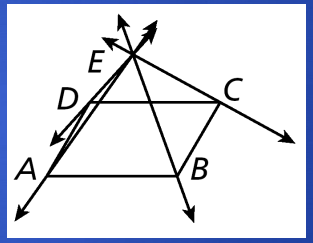
1-1 Understanding Points, Lines, and Planes

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



1-1 Understanding Points, Lines, and Planes

Example 1: Naming Points, Lines, and Planes



A. Name four coplanar points.

A, B, C, D

B. Name three lines.

Possible answer: $\overleftrightarrow{AE}$, $\overleftrightarrow{BE}$, $\overleftrightarrow{CE}$

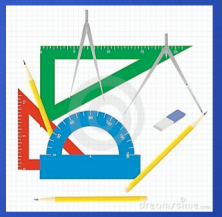
1-1 Understanding Points, Lines, and Planes

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 $\overline{BA}$	A B
An **endpoint** is a point at one end of a segment or the starting point of a *ray*.	A capital letter *C* and *D*	C 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 $\overrightarrow{RS}$	R S S R
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 $\overrightarrow{EG}$	F E G

1-1 Understanding Points, Lines, and Planes

Warm Up #2: What do you think the difference is between sketch, draw, and construct, geometrically speaking?



Smart Quote: "Much may be done in those little shreds and patches of time which every day produces, and which many men throw away." --Charles Caleb Colton,British cleric and writer

1-1 Understanding Points, Lines, and Planes

Example 2: Drawing Segments and Rays

Draw and label each of the following.

A. a segment with endpoints *M* and *N*.

B. opposite rays with a common endpoint *T*.

C. How many lines can you draw through any two points? Make a conjecture and a drawing to illustrate it.

1-1 Understanding Points, Lines, and Planes

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

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.	

1-1 Understanding Points, Lines, and Planes

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.

1-1 Understanding Points, Lines, and Planes

Example 4: Representing Intersections

How many points of intersection are formed by two lines? Explain. (you may need a drawing or visual aide for help)

What is formed by the intersection of two planes? Explain. (you may need a drawing or visual aide for help)

Postulates — **Intersection of Lines and Planes**

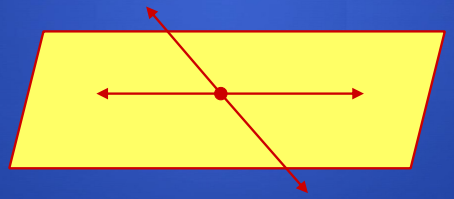
1-1-4	If two lines intersect, then they intersect in exactly one point.
1-1-5	If two planes intersect, then they intersect in exactly one line.

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.

1-1 Understanding Points, Lines, and Planes

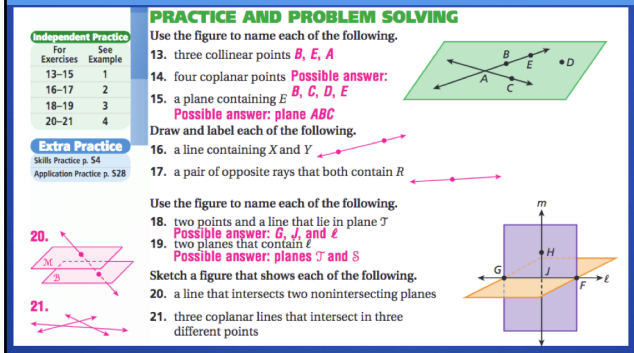
Check It Out! Example 4

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



1-1 Understanding Points, Lines, and Planes

HW #1: Holt 1-1 #14-30 even, 39-46 all



PRACTICE AND PROBLEM SOLVING

Independent Practice

For Exercises	See Example
13–15	1
16–17	2
18–19	3
20–21	4

Extra Practice
Skills Practice p. S4
Application Practice p. S28

Use the figure to name each of the following.
13. three collinear points *B, E, A*
14. four coplanar points Possible answer: *B, C, D, E*
15. a plane containing *E* Possible answer: plane *ABC*

Draw and label each of the following.
16. a line containing *X* and *Y*
17. a pair of opposite rays that both contain *R*

Use the figure to name each of the following.
18. two points and a line that lie in plane $\mathcal{T}$ Possible answer: *G, J,* and ℓ
19. two planes that contain ℓ Possible answer: planes $\mathcal{T}$ and $\mathcal{S}$

Sketch a figure that shows each of the following.
20. a line that intersects two nonintersecting planes
21. three coplanar lines that intersect in three different points

20.

21.

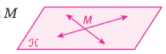
1-1 Understanding Points, Lines, and Planes

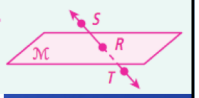
HW #1: Holt 1-1 #14-30 even, 39-46 all

22. This problem will prepare you for the Multi-Step Test Prep on page 34. Name an object at the archaeological site shown that is represented by each of the following.
   a. a point
   b. a segment
   c. a plane

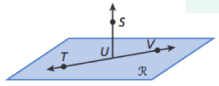
22. Possible answers:
a. tip of a stake
b. string
c. grid formed by string

Draw each of the following.
23. plane $\mathcal{H}$ containing two lines that intersect at *M*
24. $\overleftrightarrow{ST}$ intersecting plane $\mathcal{M}$ at *R*



24. 

Use the figure to name each of the following.
25. the intersection of $\overleftrightarrow{TV}$ and $\overleftrightarrow{US}$ *U*
26. the intersection of $\overleftrightarrow{US}$ and plane $\mathcal{R}$ *U*
27. the intersection of $\overline{TU}$ and $\overline{UV}$ *U*



1-1 Understanding Points, Lines, and Planes

HW #1: Holt 1-1 #14-30 even, 39-46 all

Write the postulate that justifies each statement.

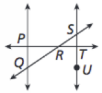
28. The line connecting two dots on a sheet of paper lies on the same sheet of paper as the dots.
29. If two ants are walking in straight lines but in different directions, their paths cannot cross more than once. **If 2 lines intersect, then they intersect in exactly 1 pt.**
30. **Critical Thinking** Is it possible to draw three points that are noncoplanar? Explain.

S	A	N
28. If 2 pts. lie in a plane, then the line containing those pts. lies in the plane.	**30. It is not possible. By Post. 1-1-2, any 3 noncollinear pts. are contained in a unique plane. If the 3 pts. are collinear, they are contained in infinitely many planes. In either case, the 3 pts. will be coplanar.**	

1-1 Understanding Points, Lines, and Planes

HW #1: Holt 1-1 #14-30 even, 39-46 all

39. Which of the following is a set of noncollinear points?



Ⓐ *P, R, T* Ⓒ *P, Q, R*
Ⓑ *Q, R, S* Ⓓ *S, T, U*

40. What is the greatest number of intersection points four coplanar lines can have?

Ⓕ 6 Ⓗ 2
Ⓖ 4 Ⓙ 0

41. Two flat walls meet in the corner of a classroom. Which postulate best describes this situation?

Ⓐ Through any three noncollinear points there is exactly one plane.
Ⓑ If two points lie in a plane, then the line containing them lies in the plane.
Ⓒ If two lines intersect, then they intersect in exactly one point.
Ⓓ If two planes intersect, then they intersect in exactly one line.

42. Gridded Response What is the greatest number of planes determined by four noncollinear points? 4

1-1 Understanding Points, Lines, and Planes

HW #1: Holt 1-1 #14-30 even, 39-46 all

CHALLENGE AND EXTEND

Use the table for Exercises 43–45.

Figure			
Number of Points	2	3	4
Maximum Number of Segments	1	3	

43. What is the maximum number of segments determined by 4 points? 6

44. Multi-Step Extend the table. What is the maximum number of segments determined by 10 points? 45

$\frac{n(n-1)}{2}$ **45.** Write a formula for the maximum number of segments determined by n points.

46. Critical Thinking Explain how rescue teams could use two of the postulates from this lesson to locate a distress signal.

46. Rescue teams can use the principles of Post. 1-1-1 and Post. 1-1-4. A distress signal is received by 2 rescue teams. By Post. 1-1-1, 2 pts. determine a line. So 2 lines are created by the 3 pts., the locations of the rescue teams and the distress signal. By Post. 1-1-4, the intersection of the 2 lines will be the location of the distress signal.