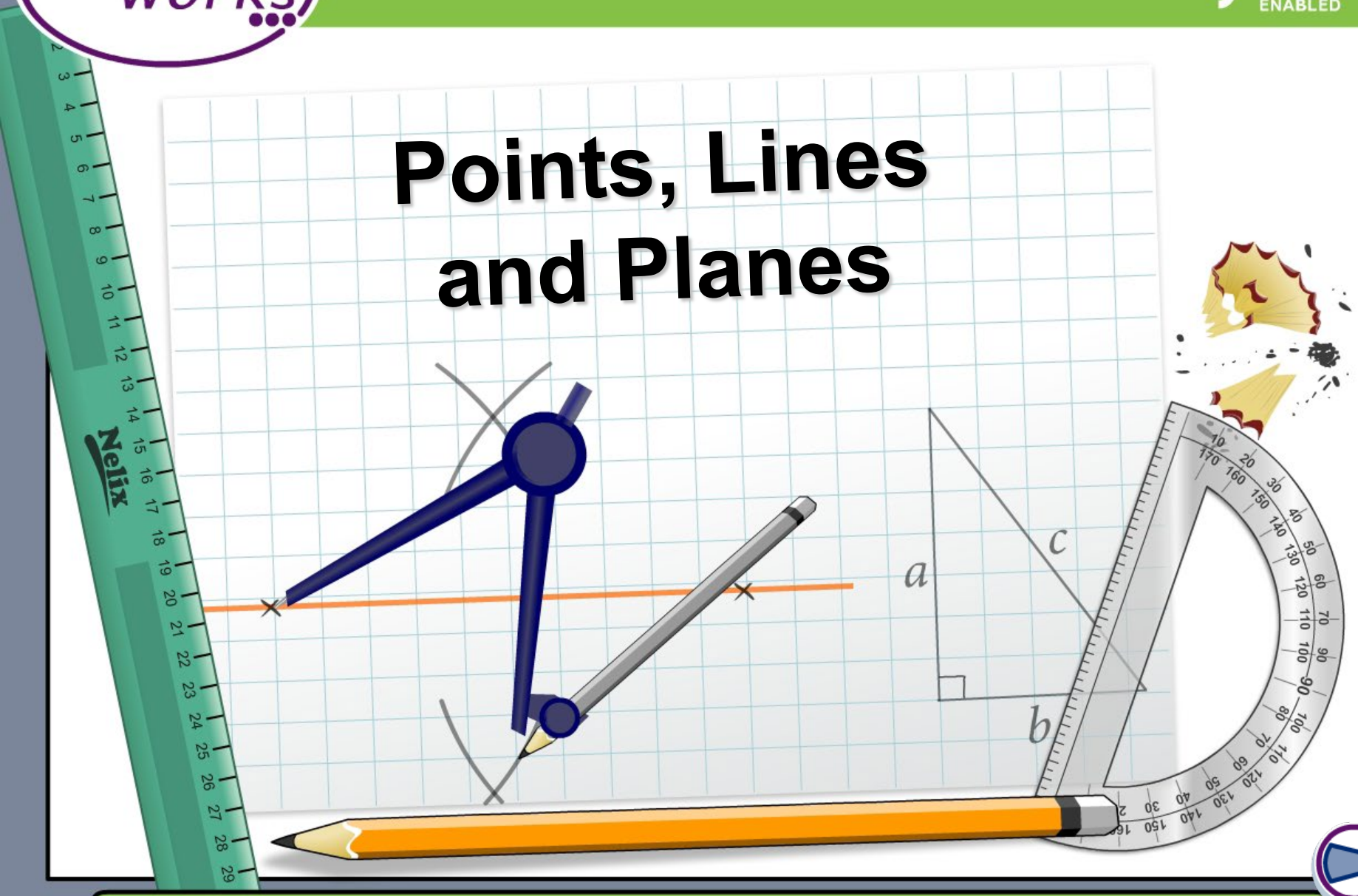
Points, Lines and Planes



Information

Common core icons

This icon indicates a slide where the Standards for Mathematical Practice are being developed. Details of these are given in the Notes field.

Slides containing examples of mathematical modeling are marked with this stamp.

This icon indicates an opportunity for discussion or group work.

The **Standards for Mathematical Practice** outlined in the Common Core State Standards for Mathematics describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

These are:

1) Make sense of problems and persevere in solving them.

2) Reason abstractly and quantitatively.

3) Construct viable arguments and critique the reasoning of others.

4) Model with mathematics.

5) Use appropriate tools strategically.

6) Attend to precision.

7) Look for and make use of structure.

8) Look for and express regularity in repeated reasoning.

This icon indicates that the slide contains activities created in Flash. These activities are not editable.

This icon indicates teacher's notes in the Notes field.

Points, lines and planes

Arrange characteristics and symbols to match the term

name	characteristics	symbol
plane		
point		
line		

There are three undefined terms in geometry – points, lines and planes – that form the basis of geometry.
Even though they are undefined, we still need to understand what is meant by them.

Press **start** to begin.

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S C

Points and lines

A **point** is a location in space. It is zero dimensional, meaning it has no height, width or length. A point is represented by a dot and named with a capital letter.

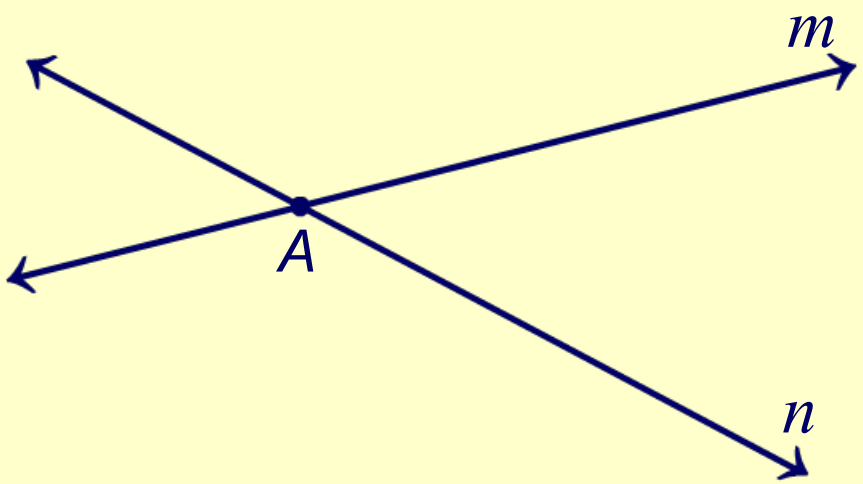
A **line** is set of points that follow a straight path infinitely in either direction. It has only one dimension, which means it has length, but no width or height. A line is represented by a straight line with an arrowhead at either end.

Lines can be named two ways:

- with a lower case letter h
- which can also be written $\overleftrightarrow{AB}$.

Intersecting lines

What do lines m and n have in common?



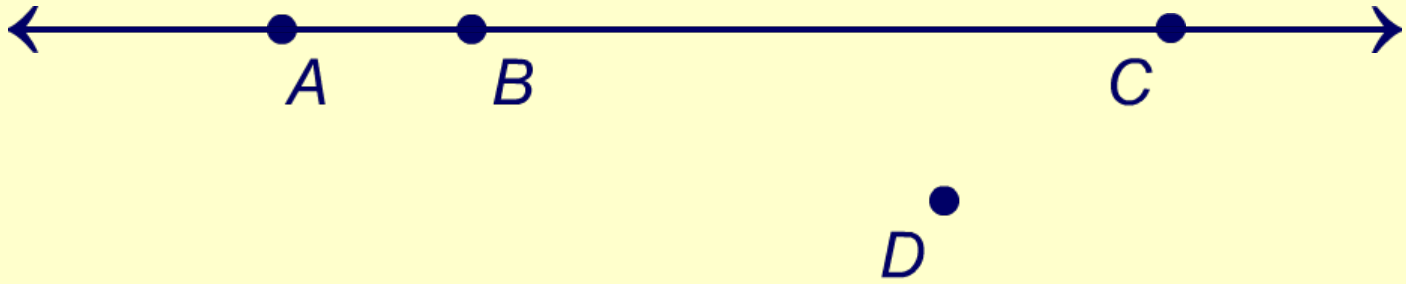
The lines share point A.

More mathematically, lines m and n **intersect** at point A.

If two lines intersect, they intersect at exactly one point.

Collinear lines

What do the points A, B and C have in common?



A, B and C all lie on the same line – they are **collinear**.

Is it possible to have two points that are noncollinear?

No, a line can always be drawn connecting two points.

Through any two points, there is exactly one line.

Lines in the coordinate plane

Lines can be graphed on a coordinate plane and the intersection defined by giving its coordinates.

What is the intersection of the functions $f(x) = -2x - 3$ and $g(x) = x$?

set equations equal to each other:

$$x = -2x - 3$$

solve for x:

$$3x = -3$$

$$x = -1$$

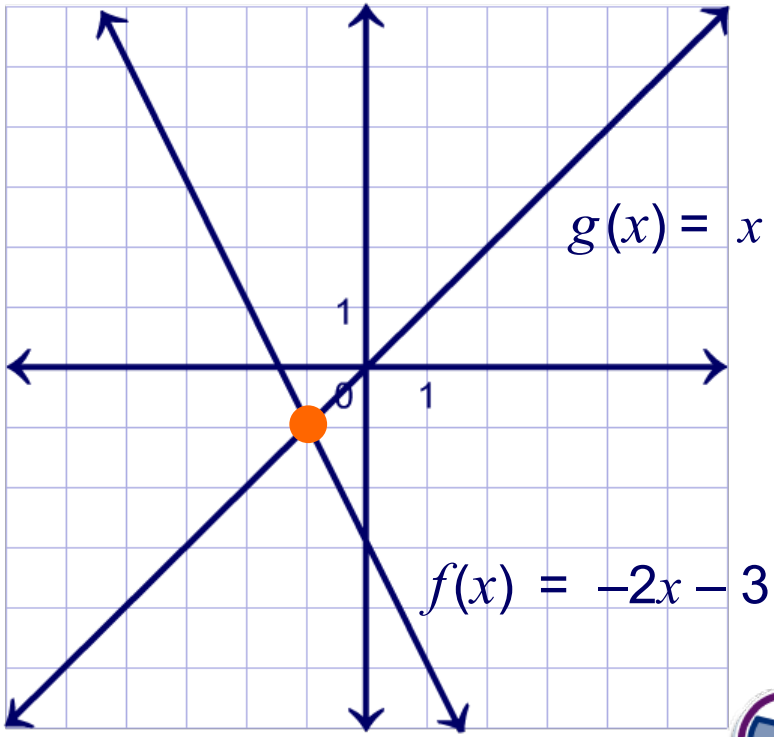
use x to find y:

$$f(x) = y$$

$$f(x) = -2(-1) - 3$$

$$f(x) = -1$$

They intersect at the point **(–1, –1)**.



All the points of a linear function are collinear.

Rays

A **ray** is a part of a line starting at a point, called the **endpoint** and extending infinitely in one direction.

A ray is named using two points and the ray symbol: the endpoint first and any other point along that ray, e.g., $\overrightarrow{RS}$.

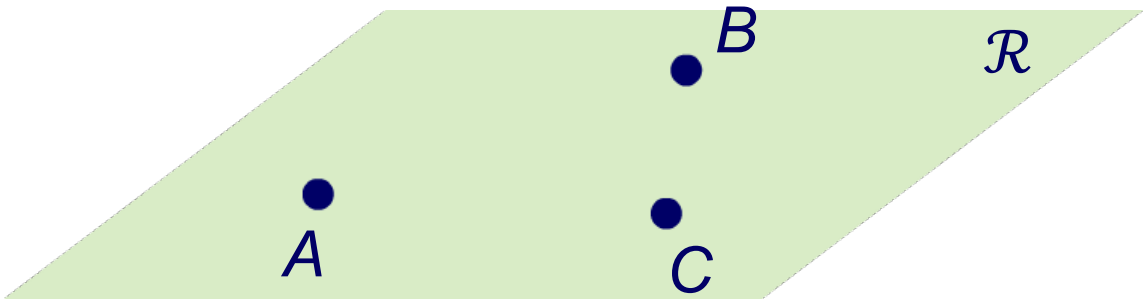
Opposite rays share an endpoint but extend in opposite directions so that they form a line.

Ray $\overrightarrow{XY}$ and $\overrightarrow{XZ}$ form a line and they are opposite rays.

Planes

A **plane** is a flat surface. It has two dimensions: length and width, but no height.

A plane extends infinitely in all directions. However, it is usually represented by a parallelogram.

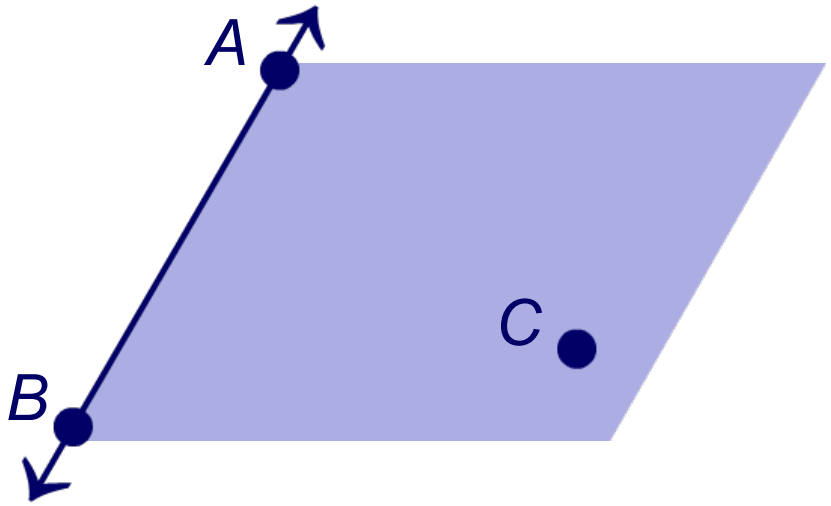


A plane is named with a capital script letter, or with any three noncollinear points that are on it, e.g., $\mathcal{R}$, or plane ABC.

Why must three noncollinear points by given in order to define a plane?

If only two points were given, it would define a line, which could lie in infinitely many planes.

Giving a third noncollinear point uniquely defines the plane.

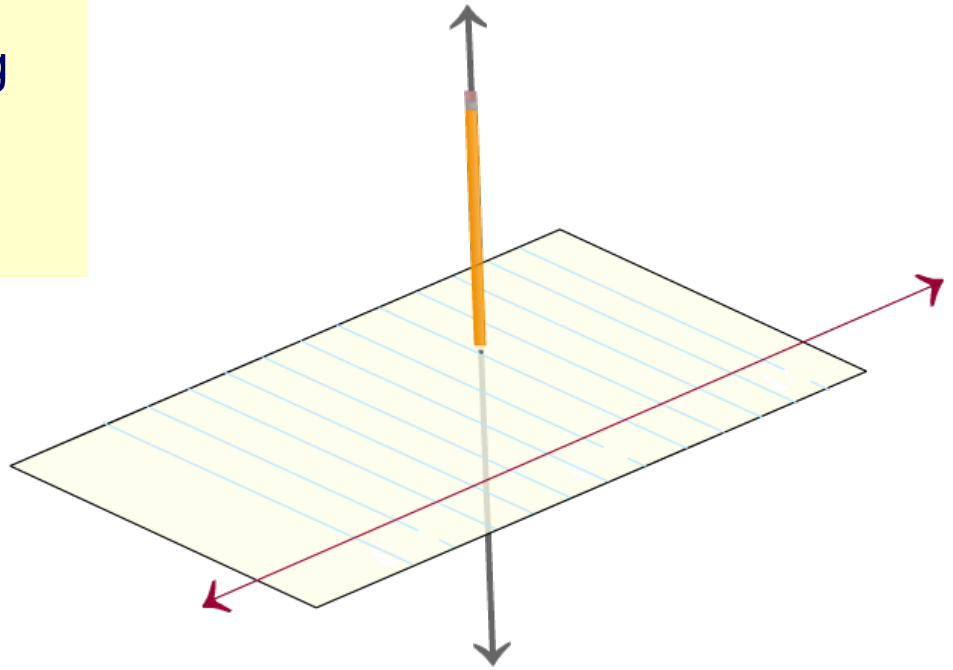


Coplanar

Geometrical objects are **coplanar** if they lie in the same plane.

Is it possible to have two lines that are noncoplanar?

Yes. Two nonintersecting lines. For example, one on a piece of paper and one going through the piece of paper, but not through the line.



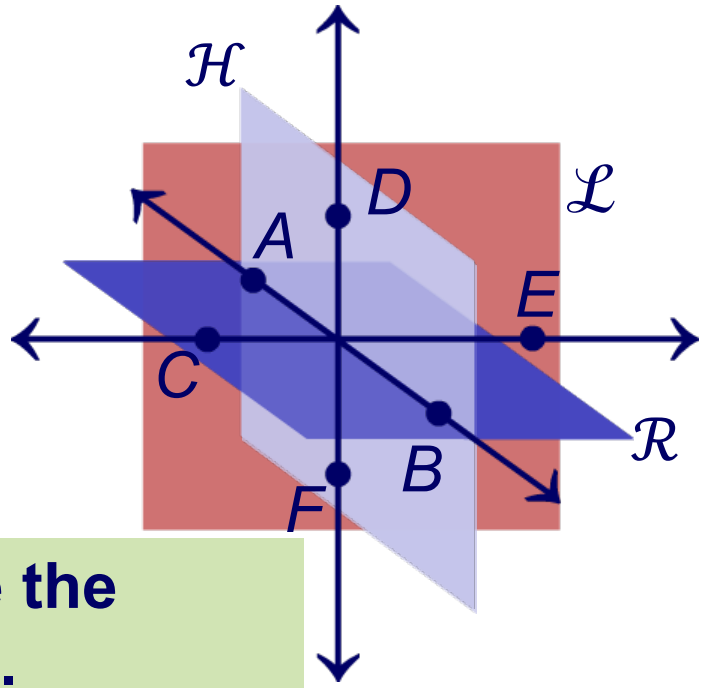
Lines and planes

If two planes intersect, they intersect at exactly one line.

Points A, B and C define plane $\mathcal{R}$.

Points A, B and D define plane $\mathcal{H}$.

Planes $\mathcal{R}$ and $\mathcal{H}$ intersect at $\overleftrightarrow{AB}$.



What points define plane $\mathcal{L}$? Define the intersections of planes $\mathcal{H}$, $\mathcal{R}$, and $\mathcal{L}$.

$\mathcal{L}$ is defined by any three of the points: C, D, E, and F.
$\mathcal{L}$ and $\mathcal{H}$ intersect at $\overleftrightarrow{DF}$.
$\mathcal{L}$ and $\mathcal{R}$ intersect at $\overleftrightarrow{CE}$.
They all intersect at the origin.

True or false?

Are these statements about lines and planes true or false?

1.	Three points cannot be collinear.	?
2.	The intersection of two planes forms a line.	?
3.	Collinear points are also coplanar.	?
4.	Intersecting lines are always in the same plane.	?
5.	Through any two points there are infinitely many lines.	?

true false

Suppose there is a enemy ship on the ocean. On the shore of the ocean, there is RADAR equipment for tracking the ship. How can you model:

1. the surface of the lake
2. the shore
3. the position of the boat at a given time
4. the position of the RADAR equipment
5. the path of the radio waves from the RADAR equipment to the boat

using points, lines and planes?

Press **start** to begin.

start