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Lesson 1

The Basic Building Blocks of Geometry

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Overview

- Geometry is the study of shapes, patterns, relationships, and measurements.
- There are many different kinds of shapes in geometry including trapezoids, cubes, circles, pentagons, and cones.
- Many shapes are made from basic building blocks including points, lines, line segments, rays, and angles.

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Points

- Points are location without substance. They have neither size nor dimension.
- Points are imperfectly represented on the page by a small dot.
- A capital letter is used to name a point as we see labeled below.

A•

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- You have seen points before in the *xy*-coordinate plane. They are represented by ordered pairs of numbers (*x*, *y*).
- Two intersecting lines intersect in a point.
- Points make up every geometric figure. For example, string a bunch of them together and you have a line.

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Lines

- When we talk about lines in geometry we are talking about *straight* lines that extend forever in both directions. They never end.
- Below is a picture of a line. When we draw a line we put arrows on the ends to signify that the line keeps going.

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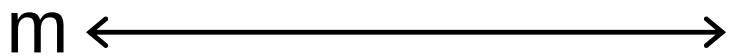
- There are two ways to name a line. One way is to use a lowercase letter (usually *l*, *m*, *n*, *p*, *q*, *r*, *s*, or *t*) as in the figure below.



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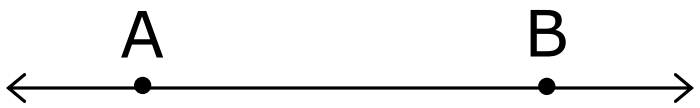
- Two points determine a line, right? Right. What we mean by this is that if you have two different points, there is one and only one line that passes through them.
- Because of this, another way to name a line is by using two points on the line.

Picture of Line	Name of Line
	$\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$

- So, to name a line by using two points, we write the two capital letters of the points next to each other and then draw a little line symbol over them.
- It doesn't matter which letter comes first.
- **Important:** the line symbol above the letters has arrows on both ends.

$$\overleftrightarrow{AB}$$

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Line Segments

- Line segments are *straight* and they have two endpoints.
- Line segments come in various lengths.
- Line segments are parts of lines.
- Below is a picture of a line segment. When we draw one, we usually use dots to emphasize the endpoints.

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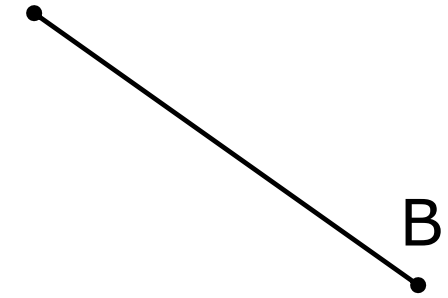
- There is only one way we will name line segments.
- We name them by using their endpoints.

Picture



Name

$\overline{AB}$ or $\overline{BA}$

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- When naming a line segment we draw a picture of a line segment (without arrows or dots on the ends) above the two capital letters denoting the endpoints.
- Note well the difference between the name of a line and the name of a line segment:

Line	Line Segment
$\overleftrightarrow{AB}$	$\overline{AB}$

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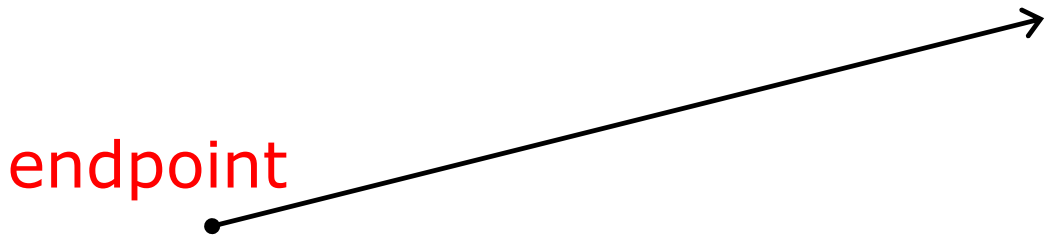
Rays

- A ray is straight and it has *one* endpoint.
- A ray extends forever in *one* direction.
- Imagine a line (not a line segment). If you break the line into two pieces, each piece will be a ray.
- Below is a picture of a ray. We draw an arrow on one end and a dot on the other end.



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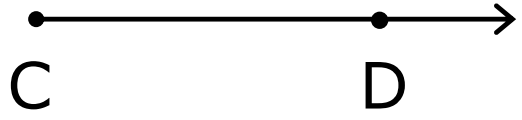
- We name a ray by using its endpoint and any other point on the ray.
- We *always* write the endpoint first, then the other point, and then we draw a picture of a ray above the letters.

Picture



Name

$\overrightarrow{CD}$

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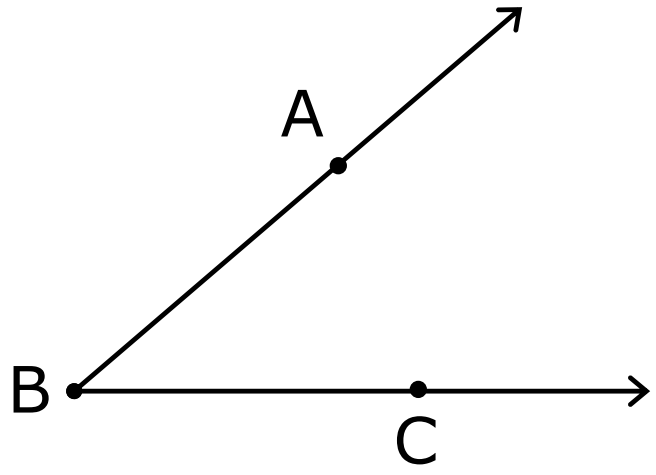
Angles

- An angle is what you get when you take two rays pointing in different directions and join them at their endpoints.
- The angle below is formed from the rays

$\overrightarrow{BA}$ and $\overrightarrow{BC}$.



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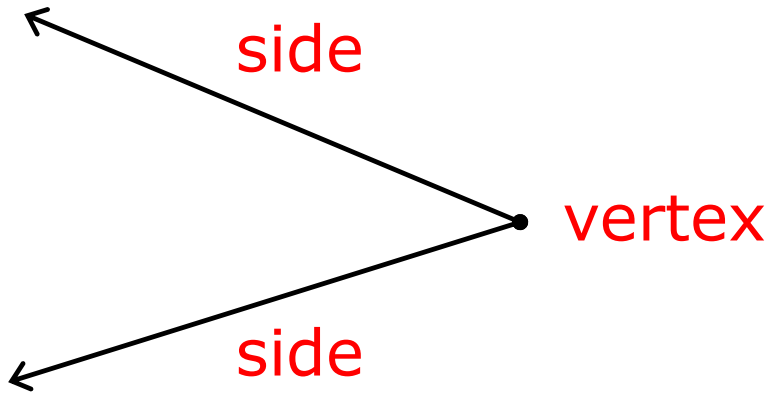
- The point where the two rays come together is called the **vertex** of the angle.
- Each ray is called a **side** of the angle.



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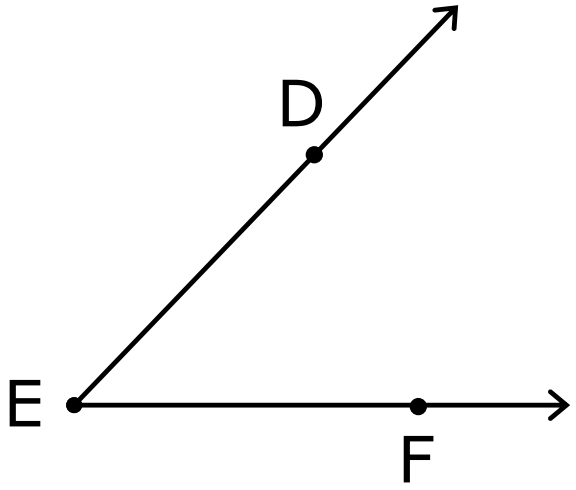
Naming an Angle
Three-Letter Method

- First, we write the angle symbol.
- Next, we write the name of a point on one side.
- Next, we write the name of the vertex.
- Finally, we write the name of a point on the other side.



Name

$\angle DEF$

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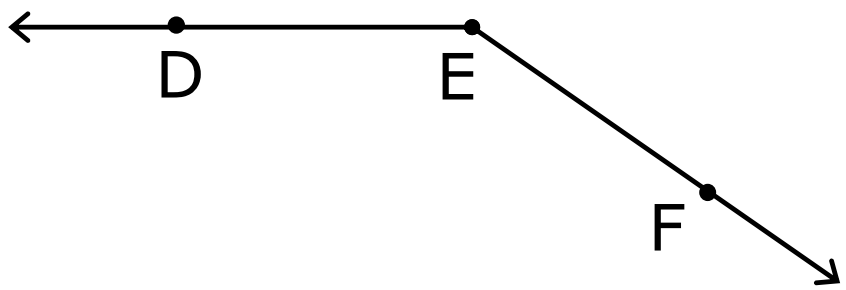
- Keep in mind that when naming an angle with three letters, the name of the vertex must come in the middle.
- The angle below has two different three-letter names. Do you know what they are?

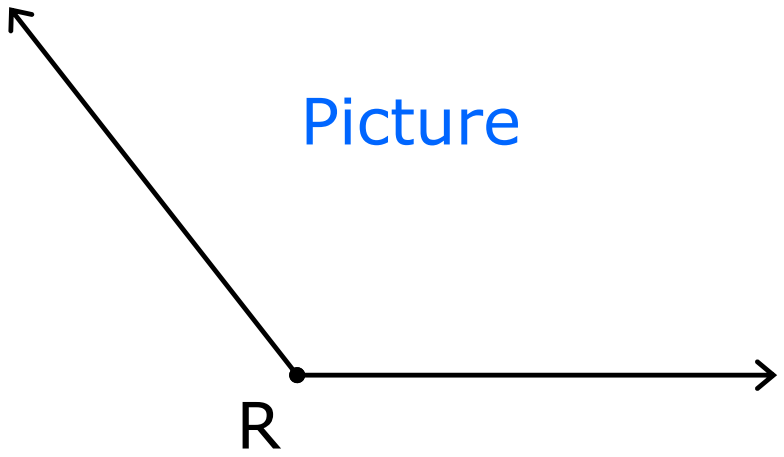


$\angle DEF$
and
$\angle FED$

Naming an Angle
One-Letter Method

- Sometimes it is ok to just use the vertex to name an angle.
- Only do this if there is no other angle in the diagram with the same vertex.

Picture



Name

$\angle R$

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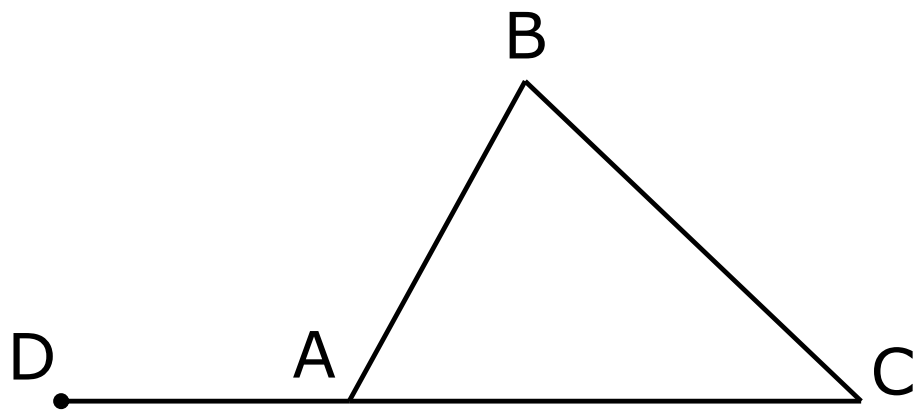
- In the diagram below, there is only one angle with vertex *B*. So, that angle could be called

$$\angle B \text{ or } \angle ABC \text{ or } \angle CBA$$

- There is more than one angle with vertex *A*, so it would not make sense to write $\angle A$.



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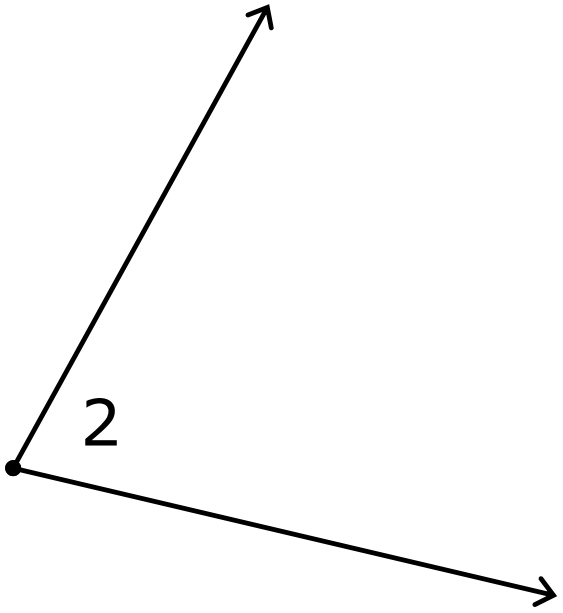
Naming an Angle Number Method

- A simple way to label and name an angle is to put a number in its opening and then use that number to name the angle.



Name

$\angle 2$

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Diagrams

- In geometry we draw pictures, called diagrams, depicting points, line segments, angles, etc.
- Various important points, lines, and angles are labeled in diagrams.
- We need to practice “reading” these diagrams carefully.

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Rules for Reading Diagrams

- Don’t assume diagrams are drawn to scale.
- Don’t assume things involving measurements (like one line segment looks shorter than another or a point appears to be exactly midway between two other points).
- If you see three points *A*, *B*, and *C* marked on a line, you may assume that there is indeed one line passing through them all.
- You may assume “betweenness” relationships. This means that if one point is drawn between two other points, you may assume it really is.

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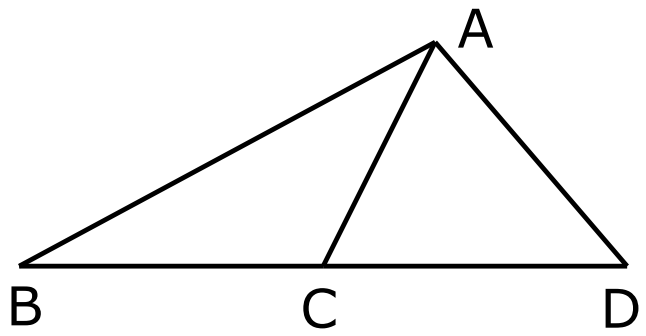
- In the diagram below, you may assume that *C* is between *B* and *D*. You may assume that one line is drawn through *B*, *C*, and *D*. You may **not** assume that line segment *AD* is shorter than line segment *AB*. You may **not** assume that *C* is exactly midway between *B* and *D*.



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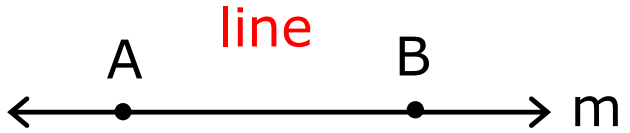
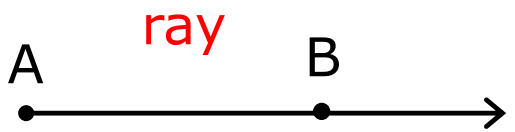
Summary

$\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$ or line m



$\overline{AB}$ or $\overline{BA}$

$\overrightarrow{AB}$ only



$\angle ABC$ or $\angle CBA$ or $\angle B$ or $\angle 1$