Lesson 1-3: Segments, Rays, Parallel Lines and Planes

Can you recall what the building blocks of geometry are?

We have been learning about the basic building blocks of Euclidean geometry.
Who can recall what they are?

- Point
- Line
- and Plane

Recall how they build on each other?

- The point was the basic building block.
- The line was the next and was made of two points.
- The Plane is made of 3 noncollinear points (or another way of looking at it is at least two different lines).

Today we will continue by adding a few more building blocks and discovering some interesting properties of the building blocks we have.

A new building block…

Who recalls the definition of a line?

- A straight arrangement of points that extends **forever** in two directions.
- The key attribute there is it "extends forever in two directions."
- But what if we considered just a part of the line, between two points on the line?

Definition

Segment:

- Consists of two points and all the points **between** them that lie on the line containing the two points.
- Like a line, has length but no thickness (it is part of a line)
- Named by the two end points with a bar over the top: $\overline{AB}$

Now, what if we jumped on a line and looked down it in one of the directions?

Definition

Ray:

- Ray AB is the part of line *AB* that contains point *A* and all the points on $\overleftrightarrow{AB}$ that are on the same side of point *A* as point *B*.
- Named by the endpoint and one other point on the ray (endpoint always 1st): $\overrightarrow{AB}$
- It is important to remember that a ray implies direction: $\overrightarrow{AB} \neq \overrightarrow{BA}$ they go in opposite directions (infinitely) and hence contain different points.
- Yes they can overlap … here is what 2 overlapping rays could look like on a line:

Green: overlap; green/blue: $\overrightarrow{AB}$; green/red: $\overrightarrow{BA}$.

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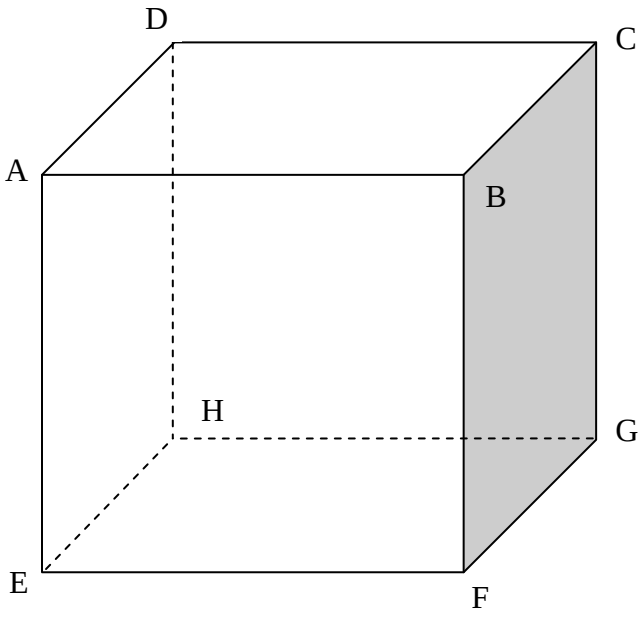
Opposite rays:

- Two collinear rays that share the **same** endpoint.
- Together they form a line … opposite rays **always** form a line.

Blue: $\overrightarrow{AB}$; Red: $\overrightarrow{AC}$; Together: line $\overleftrightarrow{CB}$

Now, consider the following cube:



- Name two lines that intersect:
  - There are many, one example is $\overleftrightarrow{AB}$ and $\overleftrightarrow{BF}$ (they intersect at point B).

- Name two lines that will never intersect:
  - Again, there are many, one example is $\overleftrightarrow{AB}$ and $\overleftrightarrow{DC}$.
  - Another example would be $\overleftrightarrow{AB}$ and $\overleftrightarrow{CG}$.

- Now, consider the two sets of non-intersecting lines we just named:
  - $\overleftrightarrow{AB}$ and $\overleftrightarrow{DC}$
  - $\overleftrightarrow{AB}$ and $\overleftrightarrow{CG}$
- Both sets name non-intersecting lines … but something is different between the two sets. What is it?

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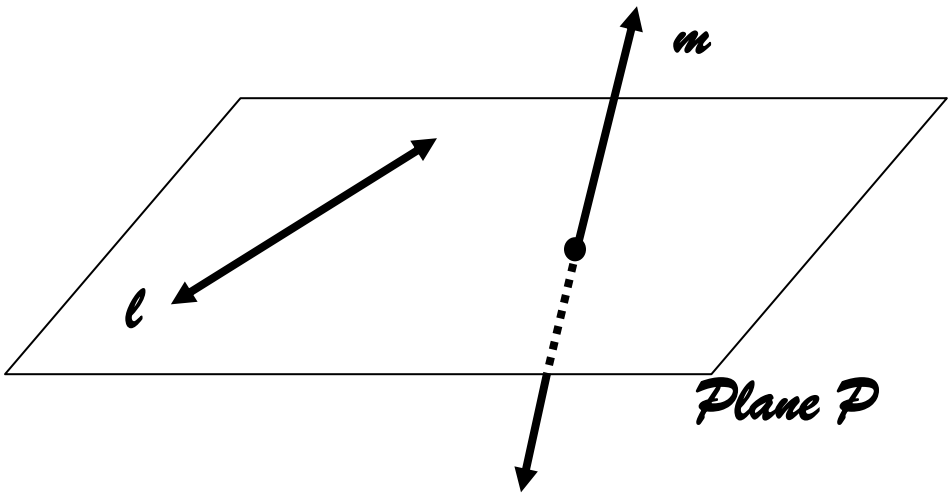
Definition

Parallel lines:

- **Coplanar** lines that do not intersect.
- The parallel line relationship is represented by the symbol ||
- If line AB is parallel to line FG then $\overleftrightarrow{AB} \parallel \overleftrightarrow{FG}$

Skew lines:

- ***Noncoplanar*** lines that do not intersect.
- There is no symbol to represent the skew line relationship.
- Here is a picture that shows a skew line relationship relative to a single plane:



- Here we see line ***l*** which is coplanar with plane ***P***.
- We also see line ***m*** which passes through plane ***P***…it is Noncoplanar with plane ***P***.
- Line ***l*** and line ***m*** do not intersect.
- Line ***l*** and line ***m*** are not coplanar (do not lie in the same plane).
- Line ***l*** and line ***m*** are skew lines.

A very important side note:

- Remember, you need to get used to understanding drawings like this.
- It is a 3-D representation on a 2-D surface.
- Think of plane ***P*** lying flat with line ***l*** on it (and hence lying flat).
- Line ***m*** is going up and down through plane ***P***. It doesn't lie in the plane.
- The dashed part of line ***m*** shows the part of line ***m*** that is obscured by the plane.
- Also, remember the plane shown above goes infinitely in each direction…we are drawing it as a quadrilateral so we can visualize it.

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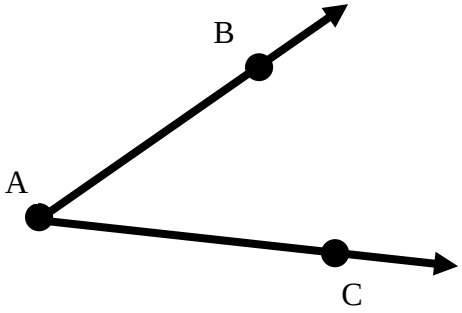
Definition

Parallel planes:

- Planes that (surprise, surprise) do not (drum roll please) … intersect.
- Saw that coming didn't you…
- In the diagram of the cube above (where we talked about parallel lines), plane AEH and plane BCG are parallel.
- Can you find a few others?

Finally, consider the following:



Name all of the segments and rays formed:

- ray $\overrightarrow{AB}$
- ray $\overrightarrow{AC}$
- segment $\overrightarrow{AB}$ (or can also be called $\overline{BA}$**)**
- segment $\overrightarrow{AC}$ (or can also be called $\overline{CA}$**)**

Assign homework

p. 19 1-49 odd, 58, 60
p. 23 1-10