Lesson 1-5: Basic Constructions

Back to the beginning…

Do you remember where we get the name "Euclidean geometry"? It comes from the name of the man who first laid out in a logical and supported (proven) manner all the geometric ideas that had been floating around. His books, the Elements, were the very first geometry text book.

How did he figure all this out? Well, basically he drew pictures of geometric shapes and objects and manipulated them to help understand their properties and relationships. The first three postulates he develops focus on constructing the basic geometric entities.

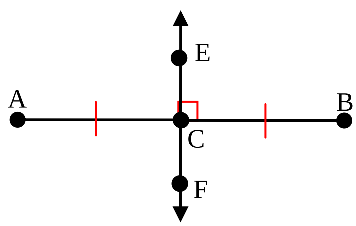
Today we are going to do some drawing. We are going to learn how to construct some of the basic, fundamental geometric relationships using just a compass and straight edge. I think you will be surprised how much you can do with those simple tools.

Why are we doing this? First, all of us learn in different ways. For some of us, just hearing something is enough. Others of us need to manipulate things with our hands in order to get our heads around something. Neither way is right, neither is wrong; it is just the way God made us as individuals. So, doing these constructions is yet another way of processing what we're learning.

Secondly, as you are forced to figure out how to construct something with these simple tools, you will be thinking about the geometric objects and relationships at a much deeper level. You will gain new understanding!

First, some segment basics…

Consider the following diagram…what information can you glean from it?



1. What is the measure of $\angle ECB$? The little red square tells us it is a right angle which we know has a measure of 90.
2. By the Segment Addition Postulate we can say that $AB = AC + CB$.
3. How does $\overleftrightarrow{EF}$ intersect $\overline{AB}$? Since it $\overleftrightarrow{EF}$ intersects $\overline{AB}$ at a right angle, we can say $\overleftrightarrow{EF}$ is **perpendicular** to $\overline{AB}$. The symbol for perpendicular is $\perp$ so $\overleftrightarrow{EF} \perp \overline{AB}$.
4. What can we say about the lengths of $\overline{AC}$ & $\overline{CB}$? The little red tick marks tell us they are congruent ($\overline{AC} \cong \overline{CB}$) hence their lengths are equal ($AC = CB$).
5. What is point C? It is the midpoint.
6. Since $\overleftrightarrow{EF}$ intersects $\overline{AB}$ at the midpoint, $\overleftrightarrow{EF}$ **bisects** $\overline{AB}$.
7. Hence $\overleftrightarrow{EF}$ is the **perpendicular bisector** of $\overline{AB}$.

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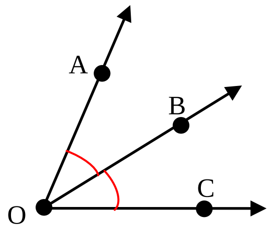
Angle basics…

Now consider the following diagram…what information can you glean from it?

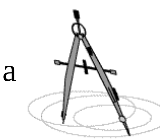


1. First name all the angles: $\angle AOB, \angle BOC, \& \angle AOC$
2. From the Angle Addition Postulate we can say $m\angle AOC = \angle AOB + \angle BOC$.
3. The red arcs inside the two angles mean they are congruent: $\angle AOB \cong \angle BOC$ and hence $m\angle AOB = m\angle BOC$.
4. Since the two interior and congruent angles share the side formed by the ray $\overrightarrow{OB}$ we can say that $\overrightarrow{OB}$ **bisects** $\angle AOC$.

Our tools

We will be working with three tools when doing constructions. They are:

1. Compass: the device that allows you to mark off arcs and also to set a desired length.



2. Straight-edge: ah…yeah. You can draw a straight line. Moving on…

3. Protractor: the device that lets you measure or mark off angles at desired degree measures.

Using just a compass and a straight-edge we can construct the following things:

1. A congruent segment (to a given segment)
2. A congruent angle (to a given angle)
3. A perpendicular bisector of a given segment
4. An angle bisector (of a given angle).

Give it a go. See if you can figure out how to do each of those.

Now, I know exactly what you are going to want to do: use a marked measuring device (such as a ruler or the protractor) to measure and copy. For these exercises, you can't do that; you can only use a compass (spreading it apart…) and a straight-edge (draw a straight line). That's it. The "Basic Constructions Cookbook" will get you going if you can't figure these out on your own. But, struggle with it a bit. If you can figure it out on your own, you will end up with a much deeper understanding of these geometric concepts.

Homework

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