**Geometer’s Sketchpad**

***Concurrent Lines, Medians, and Altitudes***

Lines that intersect in one point are called ***concurrent*** lines. The point at which they intersect is called the ***point of concurrency***.

**Construction 5.3.1: Circumceter**

1. Construct . Make the sides of the triangle Thick by selecting the whole triangle and change the line thickness under the [Display] menu.
2. Construct the midpoint of each side and the perpendicular bisectors of each side.   
   Make these lines thin (go to the [Display] menu again).

What do you notice about these three lines?

1. Construct a point *C* the intersection of the perpendicular bisectors.  
   This point is called the ***circumcenter***.
2. Select *C* and *P* and measure the distance *CP*. Do the same to measure the distances *CQ* and *CR.*
3. With the circle tool, construct a circle from the center *C* to one of the vertices.  
   This is called a ***circumscribed circle.***
4. Now drag the points *P*, *Q*, and *R* and observe the circle and the point *C*.  
   (To make things interesting, try animating *P, Q,* and *R*)

**Theorem 5-6**: **Perpendicular bisector Concurrency**

The Perpendicular bisectors of a triangle are concurrent at a point equidistant from the vertices.

***Example***

*Find the coordinates of the*

*Circumcenter of these two triangles:*

**Construction 5.3.2: Incenter**

1. Construct . Make the sides of the triangle Thick (like you did above)
2. Construct the angle bisectors of each angle and make them thin.

What do you notice about these three rays?

1. Construct a point *I* at the intersection of the angle bisectors.  
   This point is called the ***incenter***
2. Select and *I* and measure the distance between them.
3. Select and *I* and measure the distance between them.
4. Select and *I* and measure the distance between them.

What do you notice about these distances when you change the triangle?

1. Construct a line perpendicular to through point *I*. Select the line and make it a different color than the angle bisectors. Construct a point *T* at the intersection of and this new line.
2. Draw a circle from *I* to *T* . This is an ***Inscribed Circle.***

**Theorem 5-7: Angle Bisector Concurrency**

The bisectors of the angles of a triangle are concurrent at a point equidistant from the sides.



**Construction 5.3.3: Centroid**

**Definition:**  A ***median*** of a triangle is a line segment that connects a midpoint to the opposite vertex.   
 is a median in the triangle to the right.



1. Construct . Make the sides of the triangle Thick (like you did above)
2. Construct all three midpoints and label them points as shown in the picture to the right.
3. Now construct all three medians of the triangle.  
   What do you notice about these three line segments?
4. Construct a point at their intersection and label it point .
5. Select points and and measure the distance between them.
6. Select points and and measure the distance between them.
7. Move the vertices of the triangle and compare the lengths and .  
   How do the lengths and compare?  
     
   Complete this equation by filling in a number in the blank:

**Theorem 5-8: Centroid**

The medians of a triangle are concurrent at the **centroid** that is the distance from each vertex to the midpoint of the opposite side.