**Activity 2.3.7 Altitudes and Medians**

Two special segments of a triangle are the **medians** and the **altitudes**. This activity will help you to discover where the altitudes and medians are located in a triangle and how to construct them. Coordinate geometry will be used to show the relationship between altitudes and medians in different types of triangles.

**Median (**of a triangle**) –** A segment whose endpoints are a vertex and the midpoint of the side opposite the vertex.

**Altitude** (of a triangle) – A perpendicular segment from a vertex to the line containing the side opposite the vertex.

1. Plot the vertices of $△ABC$ and connect them to form a triangle.

$A\left(0,2\right), B\left(2,6\right), C(8,2)$

a. What type of triangle did you create, isosceles or scalene? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Find the coordinate of the midpoint of side $\overbar{AC }$

of the triangle. ( \_\_\_ , \_\_\_ ).

Name that point *M*.

Now connect point *B* to point *M* with a straightedge.

$c. \overbar{BM }$is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $ △ABC$.

Now use your straightedge and create a segment

from point *B* that is perpendicular to $\overleftrightarrow{AC}$

d. The coordinates of the point where the segment

intersects this line are ( \_\_\_ , \_\_\_ ).

Name this point *L*.

e. $\overbar{BL}$ is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $△ABC$.

What do you notice about the median and the altitude of $△ABC$:

f. Which is longer?

g. Are they in the same position?

h. Are they inside or outside of the triangle?

2. Plot the vertices of $△PQR$ and connect them to form a triangle.

$P\left(-5, 3\right), Q\left(1, -2\right), R(5, -2)$

a. What type of triangle did you create, isosceles or scalene? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



b. Find the coordinate of the midpoint of side $\overbar{QR}$

of the triangle. ( \_\_\_ , \_\_\_ ).

Name that point *M*.

Now connect point P to point M with a straightedge.

$c. \overbar{PM} $is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $ △ABC$.

Now use your straightedge and create a segment

from point *P* that is perpendicular to $\overleftrightarrow{QR}$.

d. The coordinates of the point where the segment

intersects this line are ( \_\_\_ , \_\_\_ ).

Name this point *L*.

e. $\overbar{PL}$ is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $△PQR$.

What do you notice about the median and the altitude of $△PQR$:

f. Which is longer?

g. Are they in the same position?

h. Are they inside or outside of the triangle?

3. Plot the vertices of $△TUV $ and connect them to form a triangle.

$T\left(-2, 8\right), U\left(-4, -3\right), V\left(4,1\right) $

a. What type of triangle did you create, isosceles or scalene? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Recall the midpoint formula

**Midpoint =** $\left(\frac{x\_{1}+x\_{2}}{2},\frac{y\_{1}+y\_{2}}{2}\right)$

b. Use this formula to find the midpoint of $\overbar{UV}$:

( \_\_\_\_ , \_\_\_\_\_ ) Name this point *M*.

Now connect point T to point M with a straightedge.

c. $\overbar{TM }$is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $ △TUV$.

In order to find a perpendicular line from *T* to $\overbar{UV}$,$ $

we must find the slope of $\overbar{UV}$.

d. Slope of $\overbar{UV}$ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Recall that slopes of perpendicular lines are opposite reciprocals of each other.

e. The opposite reciprocal of slope $\overbar{UV}$ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now start at point *T* using rise and run and the opposite reciprocal slope to find a point that is on a line perpendicular to $\overbar{UV}$.

Using your straightedge, connect the two points to create a segment from point T that is perpendicular to $\overleftrightarrow{UV}$. Name the point L, where this perpendicular line intersects$ \overleftrightarrow{UV}$.

f. What are the coordinates of *L*? \_\_\_\_\_\_\_\_

g. $\overbar{TL}$is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $△TUV$.

What do you notice about the median and the altitude of $△TUV$?

h. Which is longer?

i. Are they in the same position?

j. Are they inside or outside of the triangle?

4. Plot the vertices of $△DEF$ and connect them to form a triangle.

$D\left(1, 6\right), E\left(-3, -3\right), F(5, -3)$

a. What type of triangle did you create, isosceles or scalene? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Find the coordinate of the midpoint of side $\overbar{EF}$

of the triangle. ( \_\_\_ , \_\_\_ ).

Name that point M.

Now connect point D to point M with a straightedge.

c. $DM$ is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $△DEF$.

Now use your straightedge and create a segment

from point D that is perpendicular to the

line containing $\overbar{EF}$ .

d. The coordinates of the point where the segment intersects this line are ( \_\_\_ , \_\_\_ ).

Name this point *L*

e. $DL$ is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $△DEF$.

What do you notice about the median and the altitude to side $\overbar{EF}$ of $△TUV$:

f. Which is longer?

g. Are they in the same position?

h. Are they inside or outside of the triangle?

5. Plot the vertices of $△GHI $and connect them to form a triangle.

$G\left(2, -1\right), H\left(-3, 2\right), I(7, 2)$

a. How can you tell that this is an isosceles triangle?

b. Which side is the base?

c. Which angle is the vertex angle?

d. Find the coordinate of the midpoint of the base

of the triangle. ( \_\_\_ , \_\_\_ ).

Name that point *M*.

Now connect point *G* to point *M* with a straightedge.

e. $\overbar{GM}$ is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of $ △GHI$.

f. Is $\overbar{GM}$ perpendicular to the base? \_\_\_\_\_\_

g. GM is also an \_\_\_\_\_\_\_\_\_\_\_ of $△GHI$

h. Use the midpoint formula to find the midpoint of $\overbar{HG}$: (\_\_\_,\_\_\_). Call that point *N*.

i. $\overbar{HG}$ is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the isosceles triangle.

j. Draw segment $\overbar{IN}$. $\overbar{IN}$ is a median of $△GHI$. Is it also an altitude?\_\_\_\_\_ Explain

**6. Conclusions**

**a.** After completing the activity, we can see that in scalene triangles, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are distinct line segments.

b. In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ triangles, the altitude and median drawn from the vertex angle to the base coincide.

c. A(n) \_\_\_\_\_\_\_\_\_\_\_\_ of a triangle is always inside the triangle, but a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_ may be inside or outside.

d. In a scalene triangle, when an altitude and a median are drawn from the same vertex, which one is longer? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_