

Hey, Ortho! What's Your Altitude?

ID: 11483

Time Required
45 minutes

Activity Overview

In this activity, students will explore the altitudes of a triangle. Students will discover that the altitude can be inside, outside, or a side of the triangle. Students will discover that the altitudes are concurrent. The point of concurrency is the orthocenter. Students should discover the relationship between the type of triangle and the location of the point of concurrency. Students will discover properties of the orthocenter in equilateral triangles.

Topic: Triangles & Their Centers

- *Altitudes of a Triangle*
- *Orthocenter*

Teacher Preparation and Notes

- *This activity was written to be explored with the Cabri Jr. on the TI-84.*
- *Before beginning this activity, make sure that all students have the Cabri Jr. application, and the Cabri Jr. files Acute.8xv, Obtuse.8xv, Right.8xv, Triangle.8xv, Equilate.8xv, and Medial2.8xv loaded onto their TI-84 calculators.*
- ***To download the teacher and student worksheet, go to education.ti.com/exchange and enter "11483" in the quick search box.***

Associated Materials

- *GeoWeek09_Altitudes_worksheet_TI84.doc*
- *Acute.8xv*
- *Obtuse.8xv*
- *Right.8xv*
- *Triangle.8xv*
- *Equilate.8xv*
- *Medial2.8xv*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

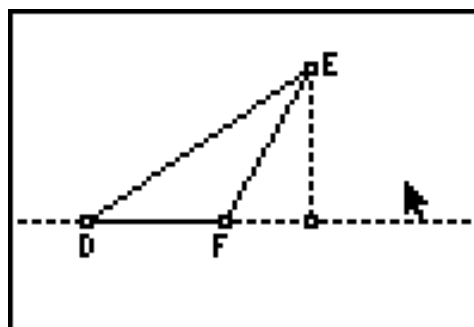
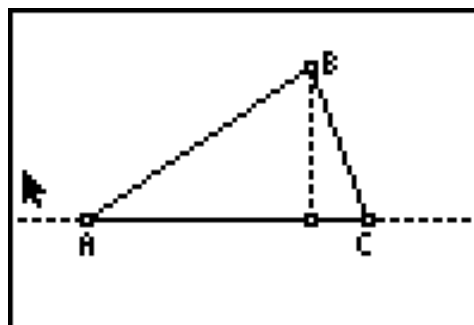
- *Centroid and Orthocenter (TI-84 Plus) — 4618*
- *Exploring the Orthocenter of a Triangle (TI-84 Plus) — 6863*
- *The Orthocenter of a Triangle (TI-89) — 4597*

Problem 1 – Exploring the Altitude of a Triangle

Students should define the altitude of a triangle using their textbooks or other source on their worksheet.

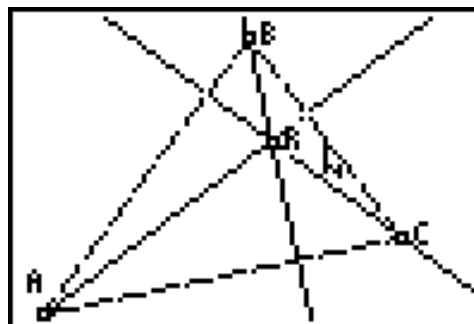
In files *ACUTE*, *OBTUSE*, and *RIGHT*, students are to create the altitude of an acute triangle, obtuse triangle, and right triangle, respectively. Students will need to construct the perpendicular line to a line through a point (press **ZOOM** and select **Perp.**).

To show the altitude of the triangle, students will need to find the intersection point of the perpendicular line and the line that extends from the base of the triangle. Students will then need to create a segment from the opposite vertex to the intersection point.

**Problem 2 – Exploring the Orthocenter**

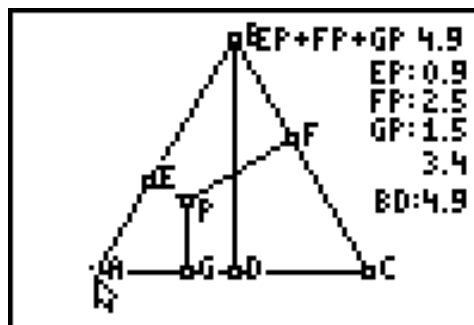
In file *TRIANGLE*, students are given $\triangle ABC$. They should construct the altitude of each vertex of the triangle. Students should realize that they are concurrent. Explain to students that the point of concurrency is called the orthocenter of the triangle.

Students should discover a few facts about the orthocenter. If a triangle is an acute triangle, then the orthocenter is inside of the triangle. If a triangle is a right triangle, then the orthocenter is on a side of the triangle. If a triangle is an obtuse triangle, then the orthocenter is outside of the triangle.



Problem 3 – Exploring the Altitude of an Equilateral Triangle

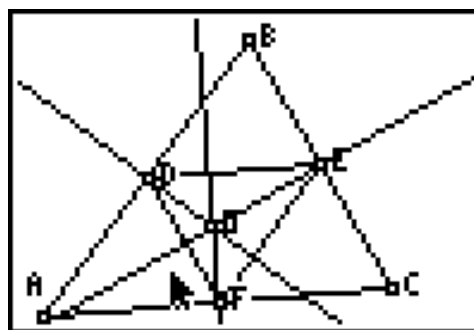
Students will need to find the distance from point P to the 3 sides of the triangle and the altitude BD in the file *EQUILATE*. The **Distance & Length** tool is found in the **GRAPH** menu (press **GRAPH** and select **Measure > D.&Length**). Once students make their calculation, they can move it to the right of the appropriate label (EP , for instance). Students will then need to calculate the sum of $EP + FP + GP$ using the **Calculate** tool (press **GRAPH** and select **Calculate**). Students will need to move their cursor to EP until it is underlined, then press **ENTER**, then press **+**, then move their cursor to FP until it is underlined, then press **ENTER**. A measurement that you can place anywhere on the screen is given. Place the measurement by pressing **ENTER**. Repeat this process for $EP + FP$ that was just created and GP to get the sum $EP + FP + GP$.



Students should discover that the sum of the distances from all three sides to point P and the length of the altitude BD are equal. Make sure that students see that this only works for an equilateral triangle.

Problem 4 – Exploring the Orthocenter of a Medial Triangle

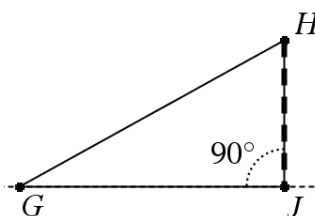
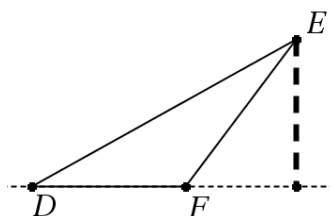
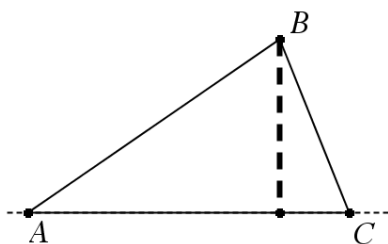
In the file *MEDIAL2*, students are given a triangle, its medial triangle, and the orthocenter of the medial triangle. Students are to discover which point of the original $\triangle ABC$ is the orthocenter of the medial triangle. Choices should include the centroid, circumcenter, incenter, and orthocenter.



Students should discover that the orthocenter of the medial triangle is the circumcenter of the original triangle.

Solutions to Student Worksheet

1. An altitude of a triangle is a perpendicular segment from a vertex to the line containing the side opposite that vertex.
- 2.



3.
 - a. inside
 - b. outside
 - c. a side of
4. They are concurrent
5. Right Triangle
6. Acute Triangle
7. Obtuse Triangle
- 8.

Position	1 st position	2 nd position	3 rd position	4 th position
<i>BD</i>	4.9	5.4	5.4	5.4
<i>EP+FP+GP</i>	4.9	5.4	5.4	5.4

9. They are equal
10. equal to the length of the altitude
11. circumcenter