Hey, Ortho! What's Your Altitude?

ID: 11484

Time Required
45 minutes

Activity Overview

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

Topic: Triangle & Their Centers

- *Altitudes of a Triangle*
- *Orthocenter*

Teacher Preparation and Notes

- *This activity was written to be explored with the TI-Nspire.*
- *The answers to all problems except Exercise 8 can be answered in the TI-Nspire document.*
- *This is an introductory activity in which students will need to know how to change between pages, construct triangles, grab and move points, measure lengths, and construct the perpendicular bisector.*
- *The multiple choice items are self-check, and students can check them by pressing* ctrl + ▲.
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "11484" in the quick search box.***

Associated Materials

- *HeyOrthoWhatsYourAltitude_Student.doc*
- *HeyOrthoWhatsYourAltitude.tns*
- *HeyOrthoWhatsYourAltitude_Soln.tns*

Suggested Related Activities

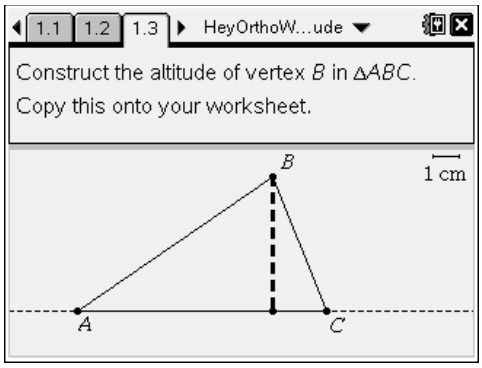
To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

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

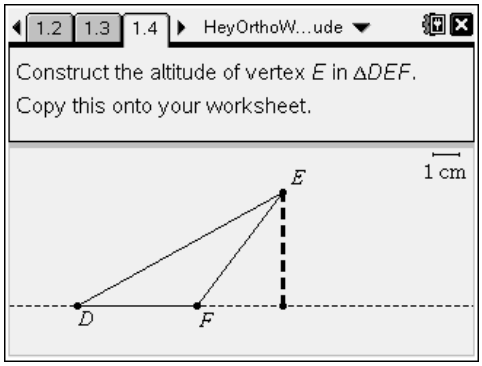
Problem 1 – Exploring the Altitude of a Triangle

On page 1.2, students should define the altitude of a triangle using their textbook or other source.

On page 1.3, 1.4, and 1.5, 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 (**MENU > Construction > Perpendicular**).



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.



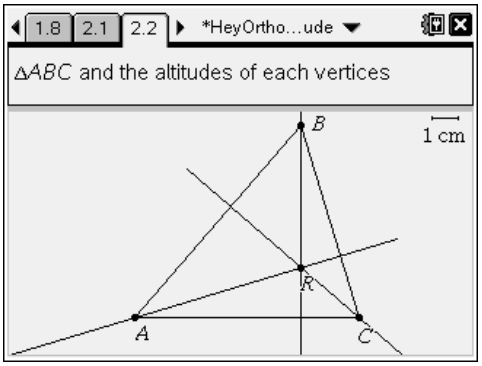
TI-Nspire Navigator Opportunity: *Screen Capture*

See Note 1 at the end of this lesson.

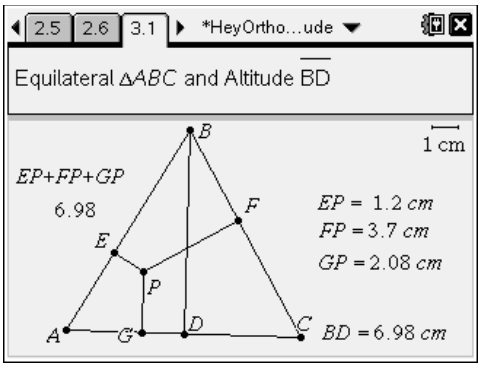
Problem 2 – Exploring the Orthocenter

On page 2.2, students are given △*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.



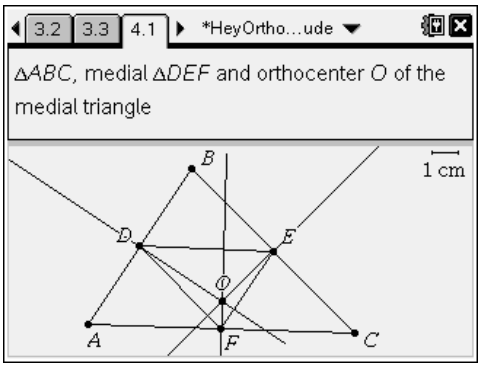
Problem 3 – Exploring the Altitude of an Equilateral Triangle



Students will need to find the distance from point *P* to the 3 sides of the triangle and the altitude *BD*. The **Length** tool is found in the Measurement menu (**MENU > Measurement > 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 (**MENU > Actions > Calculate**). Students will need to move their cursor to *EP* + *FP* + *GP* until it starts to blink, then press (enter). Next, move to the measurement for *EP* until it starts blinking and press (enter). Repeat this for *FP* and *GP*, then press (enter). Finally, you will have a measurement that you can place anywhere on the screen.

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



Students are given a triangle, its medial triangle, and the orthocenter of the medial triangle. Students are to discover which point of the original △*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.

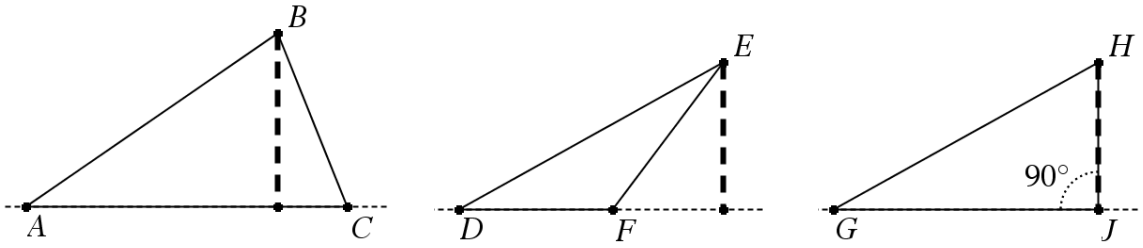
TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 2 at the end of this lesson.

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	1st position	2nd position	3rd position	4th position
BD	7.05	6.78	6.78	6.78
EP+FP+GP	7.05	6.78	6.78	6.78

9. They are equal.

10. equal to the length of the altitude

11. circumcenter

TI-Nspire Navigator Opportunities

Note 1
Problem 1, *Screen Capture*
This would be a good place to do a screen capture to verify students are able to use the **Perpendicular** tool to create altitudes for each triangle. Later in the activity, you may choose to take screen captures to verify students are able to complete the tasks.

Note 2
Problems 1- 4, *Quick Poll*
You may choose to use Quick Poll throughout the activity to assess student understanding. The worksheet questions can be used as a guide for possible questions to ask.