The Euler Line and Its Ratios
ID: 11519

Time Required
45 minutes

Activity Overview
In this activity, students will explore the Euler Line of a triangle. Students will discover that the centroid, circumcenter, and orthocenter are collinear. Students will also discover that if the triangle is isosceles, then the centroid, circumcenter, incenter, and orthocenter are all collinear. Students will also look at ratios involved in the Euler line.

Topic: Triangles & Their Centers
- *Circumcenter*
- *Orthocenter*
- *Incenter*
- *Centroid*

Teacher Preparation and Notes
- *This activity was written to be explored with the TI-Nspire. This is a 30–45 minute activity, depending on how fast students will be able to construct the centroid, circumcenter, incenter, and orthocenter of the original triangle.*
- *To follow this activity, students will need to know how to change between pages, construct triangles, grab and move points, measure lengths, and construct segments.*
- *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 "11519" in the quick search box.***

Associated Materials
- *GeoWeek10_Euler_Worksheet_TINspire.doc*
- *GeoWeek10_Euler.tns*
- *GeoWeek10_Euler_Soln.tns*

Suggested Related Activities
To download any activity listed, go to <u>education.ti.com/exchange</u> and enter the number in the quick search box.
- *The Euler Line (TI-84 Plus) — 8186*
- *Mystery Point! (TI-Nspire technology) — 9062*
- *Secrets in the Triangle (TI-Nspire technology) — 9231*

Problem 1 – Exploring the Euler Line

On page 1.3, students are given acute $\triangle ABC$. They are asked to construct the centroid, circumcenter, incenter, and the orthocenter and label them *Ce, Ci, I,* and *O,* respectively. Students may need to be reminded of these definitions:

- Centroid is the point of concurrency of the medians

- Circumcenter is the point of concurrency of the perpendicular bisectors

- Incenter is the point of concurrency of the angle bisectors

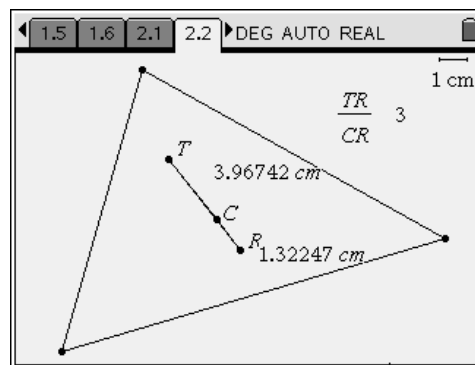- Orthocenter is the point of concurrency of the altitudes
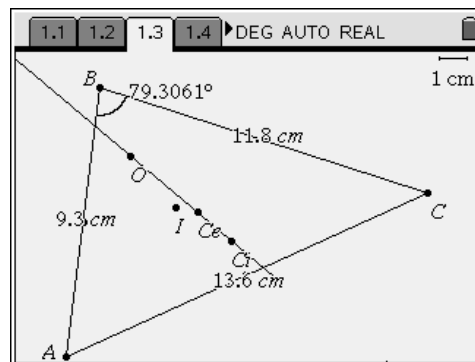
Students should hide the lines that they used to construct the centers (select **MENU > Actions > Hide/Show** and click on objects to hide them).

Students will construct the line between points *O* and *Ci*. This line is the Euler Line. After constructing this line, students will answer several questions on their handheld or accompanying worksheet.

Students will discover that an isosceles triangle guarantees that the incenter is on the Euler line. Students will also discover that a right triangle guarantees that the orthocenter and circumcenter are on the sides of a triangle.

Problem 2 – Exploring Ratios of the Euler Line

Students will investigate several ratios between segments on the Euler Line. On page 2.2, students are given $\triangle ABC$. The centroid, *C*, the circumcenter, *R*, and the orthocenter, *T*, are all provided for the students. Next, students should construct $\overline{TR}$, $\overline{CR}$, and $\overline{CT}$ using the **Segment** tool (**MENU > Points & Lines > Segment**). Then, students will find the length of $\overline{TR}$, $\overline{CR}$, and $\overline{CT}$ using the **Length** (**MENU > Measurement > Length**). Students will also need to use the **Calculate** tool (**MENU > Actions > Calculate**). The variables will be requested in alphabetical order. This may not be what students expect.

Students should find that the centroid is twice as far from the orthocenter as it is from the circumcenter.

Student Solutions

1. They are collinear and lie on the Euler Line.
2. Isosceles Triangle.
3. Right triangle
4. 3
5. Three times longer
6. 1:3
7. 1:2