The Euler Line and Its Ratios
ID: 11518

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 find 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 Cabri Jr. on the TI-84.*
- *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.*
- *Before beginning this activity, make sure that all students have the Cabri Jr. application and the Cabri Jr. files Euler.8xv and Eulerrat.8xv loaded on their TI-84 calculators.*
- ***To download the teacher and student worksheet, go to education.ti.com/exchange and enter "11518" in the quick search box.***

Associated Materials
- *GeoWeek10_Euler_worksheet_TI84.doc*
- *Euler.8xv*
- *Eulerrat.8xv*

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

In *Euler.8xv*, students are given acute △*ABC*. They are
asked to construct the centroid, circumcenter, incenter,
and the orthocenter and label them *C*, *R*, *I*, and *T*,
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

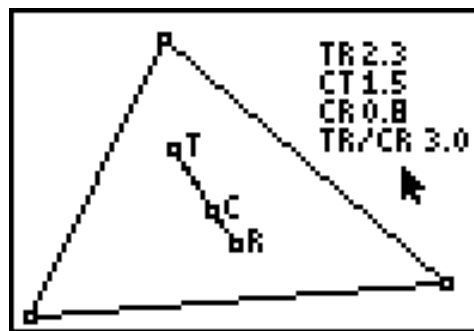- Orthocenter is the point of concurrency of the altitudes.
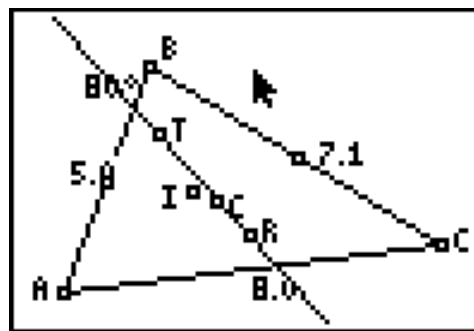
Students should hide the lines that they used to construct the centers (select GRAPH
> Hide/Show > Object and click on objects to hide them).

Students will construct the line between points *T* and *R*. This line is the Euler Line.
After constructing this line, the 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. Students are given △*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 (WINDOW **> Segment**). Then, students will
find the length of $\overline{TR}$, $\overline{CR}$, and $\overline{CT}$ using the **Distance
& Length** tool (**MENU > Measure > D.&Length**).
Students will then need to calculate the ratio of *TR* to
CR using the **Calculate** tool (press GRAPH and select **Calculate**). Students will need to move
their cursor to *TR* until it is underlined, then press ENTER, then press ÷, then move their cursor
to *CR* until it is underlined, then press ENTER. You are then given the ratio of *TR* to *CR,* a
measurement that you can place anywhere on the screen by pressing ENTER.

Students will be asked several questions regarding the ratios of the Euler Line. 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