Math Objectives

- Students will show why certain segments or lines in triangles are medians, angle bisectors, altitudes, or perpendicular bisectors.
- Students will interpret what properties these particular segments have.
- Students will attend to precision (CCSS Mathematical Practice).
- Students will use appropriate tools strategically (CCSS Mathematical Practice).

Vocabulary

- median
- angle bisector
- altitude
- perpendicular bisector

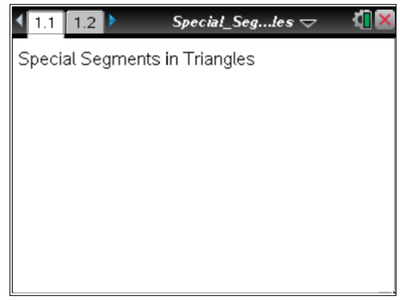
About the Lesson

In this activity, students will investigate special segments from a given vertex in a triangle and the perpendicular bisector of the base of the triangle. They will identify relationships among the special segments and the angles that they form.

If you want students to create the figure, give each student a copy of the handout Special_Segments_in_Triangles_Create.pdf. This will explain clearly how to create the necessary figure.

TI-Nspire™ Navigator™ System

- Use Class Capture to monitor progress.
- Use Quick Poll to assess progress.



TI-Nspire™ Technology Skills:

- Open a document
- Move from one page to another
- Measure lengths
- Measure angles

Tech Tips:

- Make sure the font size on your TI-Nspire handheld is set to Medium.

Lesson Files:

Create Instructions
Special_Segments_in_Triangles_Create.pdf

Student Activity
Special_Segments_in_Triangles_Student.pdf
Special_Segments_in_Triangles_Student.doc

TI-Nspire document
Special_Segments_in_Triangles.tns

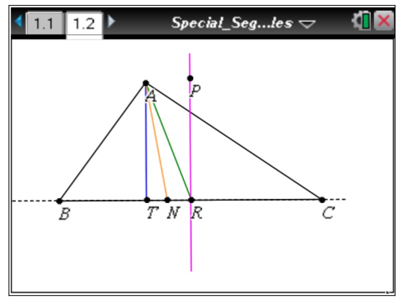
Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

You have decided whether or not students will create the figure.
Have students open the document: *Special_Segments_in_Triangles.tns*

TI-Nspire Navigator Opportunity: *Class Capture*
See Note 1 at the end of this lesson. Use this only if you elected to have students create the figure.

Move to page 1.2.



To measure the length of a segment, press **Menu > Measurement > Length.** Press [click] on each endpoint of the segment. Then press [click] again to place the measurement. Press [esc] to exit the **Measurement** tool.

1. a. Identify the median. Find and state the appropriate measurement(s) to support your answer.

   Sample answer: $\overline{AR}$ is the median because the length of $\overline{BR}$ is equal to the length of $\overline{RC}$.

   b. Will your answer change if you move the vertices of the triangle?

   Sample answer: No. $\overline{AR}$ will always be the median of this triangle because it was constructed that way. The length of $\overline{BR}$ will always be the same as the length of $\overline{RC}$.

To measure an angle, press **Menu > Measurement > Angle.**
Press [click] on three points of the angle, always selecting the vertex of the angle second.
Press [esc] to exit the **Measurement** tool.

Teacher Tip: You may want to demonstrate how to measure the length of a segment and how to measure an angle with TI-Nspire.

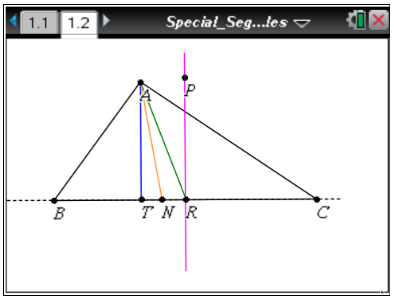
2. a. Identify the angle bisector. Find and state the appropriate measurement(s) to support your answer.

   Sample answer: $\overline{AN}$ is the angle bisector of $\angle BAC$ because the measure of $\angle BAN$ is equal to the measure of $\angle CAN$.

b. Will your answer change if you move the vertices of the triangle?

Sample answer: No. $\overline{AN}$ will always be the angle bisector because $\overline{AN}$ was constructed to separate $\overline{BAC}$ into two congruent adjacent angles.

3. a. Identify the altitude. Find and state the appropriate measurement(s) to support your answer.



Sample answer: $\overline{AT}$ is the altitude of the triangle because the measure of $\angle BTA$ is 90°. An altitude of a triangle is a segment that is drawn from the vertex of a triangle that is perpendicular to the opposite side (or the line containing the opposite side).

Tech Tip: The altitude was constructed perpendicular from point A to the line that contains $\overline{BC}$. If the altitude is constructed perpendicular from point A to $\overline{BC}$, then it is not displayed when $\angle B$ or $\angle C$ is obtuse.

b. Will your answer change if you move the vertices of the triangle?

Sample answer: No. $\overline{AT}$ will always be the altitude of this triangle because $\overline{AT}$ was constructed to be perpendicular to its opposite side, $\overline{BC}$.

4. a. Identify the perpendicular bisector. Find and state the appropriate measurement(s) to support your answer.

Sample answer: $\overline{PR}$ is the perpendicular bisector of $\overline{BC}$, for two reasons: the measure of $\angle PRC = 90°$, which makes it a right angle. Also, the length of $\overline{BR}$ is equal to the length of $\overline{RC}$. A bisector separates a segment into two segments of equal length. $\overline{PR} \perp \overline{BC}$ and $\overline{PR}$ bisects $\overline{BC}$.

b. Will your answer change if you move the vertices of the triangle?

Sample answer: Since $\overline{PR}$ was constructed to be the perpendicular bisector of $\overline{BC}$, it will remain the perpendicular bisector no matter where the vertices are.

5. Which two segments are parallel? How do you know that they are parallel?

Sample answer: $\overline{AT}$ and $\overline{PR}$ are parallel. One explanation: $\angle BTA$ and $\angle BRP$ are congruent corresponding angles because they each measure 90º. Also, $\overline{AT}$ and $\overline{PR}$ are both perpendicular to the same line, so they are parallel to each other.

6. Name a pair of congruent angles. How do you know that they are congruent?

Sample answer: $\angle BAN$ and $\angle CAN$ are congruent because $\overline{AN}$ was constructed to bisect $\angle BAC$. $\angle BTA \cong \angle CTA$ because they are both right angles. Also, $\angle ATC \cong \angle PRC$ because they are corresponding angles for the two parallel segments. Other answers are possible.

TI-Nspire Navigator Opportunity: *Quick Poll* **See Note 2 at the end of this lesson.**

Drag one of the vertices until ΔABC is a right triangle.

7. a. How do you know that ΔABC is a right triangle? Explain.

   Sample answer: When point *B* is moved until it coincides with point *T*, a right triangle is formed. Due to the construction, it is a right triangle. ($\overline{AT} \perp \overline{BC}$, which forms a right angle at *T*.)

   b. What are the measures of the acute angles in the right triangle that you formed?

   Sample answer: Answers will vary. However, discuss that the sum of the angles' measures should be 90º.

Move one of the vertices until all four of the special segments coincide.

8. a. Describe the kind of triangle that you formed and explain your reasoning.

   Sample answer: ΔABC is an isosceles triangle because $\Delta ANB \cong \Delta ANC$ by ASA. The angle bisector makes $\angle BAN \cong \angle CAN$. $\overline{AN}$ is congruent to itself. And the perpendicular segments make $\angle ATB \cong \angle ATC$ because they are both right angles. Since side *AB* corresponds to side *AC*, $\overline{AB} \cong \overline{AC}$, and that makes ΔABC an isosceles triangle.

   b. Describe the characteristics of ΔABC that you formed.

   Sample answer: Each pair of corresponding sides and angles is congruent, namely $\angle B \cong \angle C$, the base angles of the isosceles triangle.

Move point A.

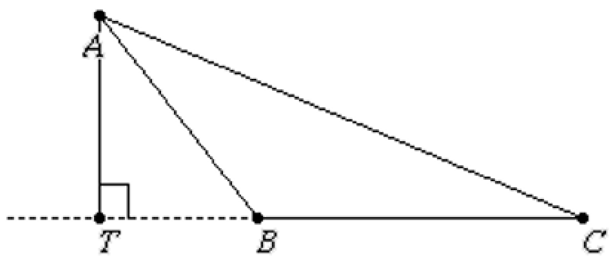
9. a. Which of the special segments is not always inside the triangle? Explain when one of the segments is not inside the triangle.

Sample answer: The altitude, $\overline{AT}$, will not always be inside the triangle. When either $\angle B$ or $\angle C$ is obtuse, the altitude from point *A* will be outside the triangle.

See the figure below.

b. Draw a figure to support your reasoning in part a.

Sample answer: Other figures possible, but the figure must be an obtuse triangle.



TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 3 at the end of this lesson.

Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

- How the construction of special segments can be used to make conjectures about geometric relationships.
- What attributes are necessary to identify special segments.

Assessment

Construct a figure similar to the one on page 1.2. Ask students to identify the four special segments and to explain how they determined the type of each segment.

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Note 1 (Use only if students were asked to create the figure.)
Question 1, *Class Capture*: As students create the figure, use Class Capture to periodically check students' progress. Assist or encourage students as needed.

Note 2
Question 6, *Quick Poll*: For question 6, verbally ask students which angles are congruent. Have them submit their responses using an Open Response Quick Poll.

Note 3
Question 9, *Quick Poll*: For question 9, verbally ask students which of the four special segments is not always inside the triangle. Have students submit their responses using an Open Response Quick Poll.
Note: To save time, ask them to type only the first three letters of the name of the type of segment (for example, alt, per, ang, or med).