



### Math Objectives

- In this activity, students will make a conjecture about the sum of the measures of the interior angles of a triangle and prove the Triangle Sum Theorem.

### Vocabulary

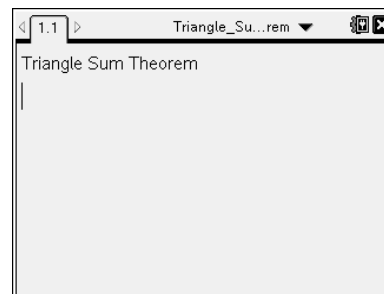
- adjacent angles
- interior angles

### About the Lesson

- The time varies for this activity depending on whether the .tns file is provided or created by the students.
- Send the file *Triangle\_Sum\_Theorem.tns* to student handheld devices. If you are planning for students to create the file, take time to follow the directions prior to helping the students.
- Students should have knowledge of alternate interior angles, congruent angles, straight angles, and adjacent angles.
- This activity is designed to be student-centered, with you acting as a facilitator while students work cooperatively. The student worksheet is intended to guide students through the activity and provide a place to record their answers.
- The .tns files come in several different forms. You can use them in several ways.
  - You can build the entire file and give it to students along with the student lesson. This would include creating a slider using the directions in the appropriate file.
  - You can give students a partially created file with a triangle and slider in place along with the student lesson in which they will need to create a parallel line and measure angles.
  - You can have students build the entire file using the create instructions and the directions for the slider in the appendix.

### TI-Nspire™ Navigator™ System

- Use Screen Capture to observe students' work as they proceed through the activity.
- Use Live Presenter to have a student illustrate how he/she used a certain tool.



### TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

### Tech Tips:

- Make sure the font size on your TI-Nspire handheld is set to Medium.
- You can hide the function entry line by pressing **ctrl** **G**.

### Lesson Materials:

*Create Instructions*  
Triangle\_Sum\_Theorem\_Create.pdf

*Student Activity*  
Triangle\_Sum\_Theorem\_Student.pdf  
Triangle\_Sum\_Theorem\_Student.doc

*TI-Nspire document*  
Triangle\_Sum\_Theorem.tns  
Triangle\_Sum\_Theorem\_Teacher.tns

Visit [www.mathnspired.com](http://www.mathnspired.com) for lesson updates and tech tip videos.



**Discussion Points and Possible Answers**

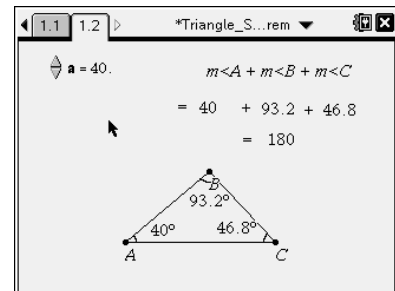
**Tech Tip:** If students experience difficulty dragging a point, check to make sure that they have moved the arrow until it becomes a hand (☞). Press (ctrl) to grab the point and close the hand (☞).

**Teacher Tip:** You may choose to have students construct part of this activity.

**Move to page 1.2.**

1. a. What happens when you click the  $\Delta$  and the  $\nabla$  on the slider?

**Sample Answer:** The measures of all the angles change. Points  $A$  and  $C$  do not move. Point  $B$  moves. (It rotates around point  $A$ .)



- b. Grab and move point  $B$ . What do you notice?

**Answer:** The measure of  $\angle A$  does not change, but the measures of  $\angle B$  and  $\angle C$  do. Point  $B$  moves along line  $\overline{AB}$ .

**Teacher Tip:** By fixing  $\angle A$ , the three angles will always sum to  $180^\circ$ . If you do not fix  $\angle A$ , but instead use the Measurement tool to measure all three angles ( $\angle A$ ,  $\angle B$ , and  $\angle C$ ), you will introduce rounding errors. In some cases, the sum will be 179 and in others 181. If your class is advanced, you might want to ask them when and how this might happen and why the activity is designed using a slider.

- c. What do you observe about the sum of the angles in the triangle?

**Answer:** The sum of the angles seems to always be  $180^\circ$ .



2. Use the slider to change the measure of  $\angle A$  to  $90^\circ$ .
- a. What do you observe about the measures of  $\angle B$  and  $\angle C$ ?

**Answer:** The measures of  $\angle B$  and  $\angle C$  sum to  $90^\circ$ .

- b. Change the measure of  $\angle A$  to  $30^\circ$ . Make a prediction about the measures of  $\angle B$  and  $\angle C$ .

**Answer:** The measures of  $\angle B$  and  $\angle C$  sum to  $150^\circ$ .

3. a. If the measure of  $\angle A$  is  $180^\circ$ , make a conjecture about the measures of  $\angle B$  and  $\angle C$ . Explain your reasoning.

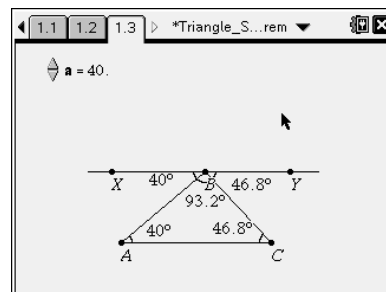
**Answer:** The measures of  $\angle B$  and  $\angle C$  will be zero. There will be no triangle because an angle of  $180^\circ$  is a straight angle.

- b. Use the slider to change the measure of  $\angle A$  to  $180^\circ$ . Justify your conjecture.

**Answer:** When the measure of  $\angle A$  is  $180^\circ$ , points  $A$ ,  $B$ , and  $C$  are collinear, forming a straight angle.

**Move to page 1.3.**

On page 1.3,  $\overline{XY}$  was constructed so that  $\overline{XY} \parallel \overline{AC}$ . Use the slider to change the measure of  $\angle A$ .



**Teacher Tip:** You may have students create the parallel line and measure the angles for the following problems. Directions for creating the parallel line are in the file [Triangle\\_Sum\\_Theorem\\_Create.pdf](#).

4. Which angles are always congruent and why?

**Answer:**  $\angle XBA \cong \angle A$  and  $\angle YBC \cong \angle C$

The angles are always congruent because each pair is a set of alternate interior angles formed by the two parallel lines with one of the sides of the triangle ( $AB$  or  $BC$ ) as a transversal.



5. Describe the relationship among the three angles associated with vertex  $B$ .

**Answer:**  $\angle XBA$ ,  $\angle ABC$ , and  $\angle CBY$  are adjacent angles that form a straight angle; therefore,  $m\angle XBA + m\angle ABC + m\angle CBY = 180$ .

The Triangle Sum Theorem states that the sum of the measures of the interior angles of a triangle is  $180^\circ$ .

6. Use your reasoning in questions 4 and 5 to prove the Triangle Sum Theorem.

**Answer:**  $\angle XBA$ ,  $\angle ABC$ , and  $\angle CBY$  are adjacent angles that form a straight angle; therefore,  $m\angle XBA + m\angle ABC + m\angle CBY = 180$ .  $\angle XBA \cong \angle BAC$  and  $\angle CBY \cong \angle BCA$  because they are pairs of alternate interior angles formed by parallel lines  $XY$  and  $AC$  cut by the transversals  $AB$  and  $CB$ . Substituting into the statement above about straight angles, you have  $m\angle BAC + m\angle ABC + m\angle BCA = 180$ , which is the Triangle Sum Theorem that states the sum of the interior angles of a triangle is  $180^\circ$ .

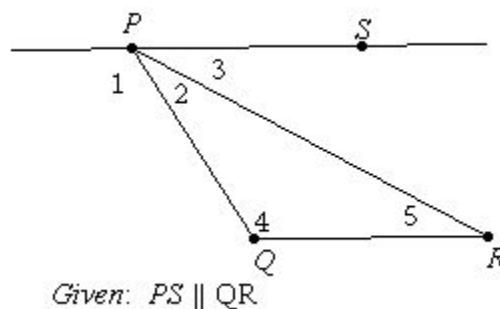
### Wrap Up

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

- The sum of the measures of the interior angles.
- Prove the Triangle Sum Theorem.

### Assessment

In the figure below,  $m\angle 1 = 110$  and  $m\angle 5 = 30$ . Find the measure of each of the remaining numbered angles.



**Answers:**  $m\angle 2 = 40$ ,  $m\angle 3 = 30$ ,  $m\angle 4 = 110$