

## Interior &amp; Exterior Angles of a Triangle

Time required  
40 minutes

ID: 8771

## Activity Overview

*In this activity, students will measure interior and exterior angles of a triangle and make conjectures about their relationships.*

## Topic: Triangles &amp; Congruence

- *Use inductive reasoning to conjecture a theorem about the total measures of a triangle's interior angles.*
- *Prove that the sum of the measures of the interior angles of a triangle is  $180^\circ$ .*
- *Prove that the sum of the measures of the exterior angles of a triangle is  $360^\circ$ .*

## Teacher Preparation and Notes

- *This activity is designed to be used in a high school or middle school geometry classroom.*
- *The sum of the measures of the three interior angles of a triangle is  $180^\circ$ .*
- *The sum of the measures of the two remote interior angles of a triangle is equal to the measure of the exterior angle.*
- *An exterior angle is supplementary to its adjacent interior angle.*
- *The sum of the measures of three exterior angles of a triangle is  $360^\circ$ .*
- *This activity is designed to be **student-centered** with the teacher acting as a facilitator while students work cooperatively. Use the following pages as a framework as to how the activity will progress.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of TI-Navigator is not needed for completing this activity.*
- **To download the student TI-Nspire document (.tns file) and student worksheet, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter "8771" in the quick search box.**

## Associated Materials

- *IntExtAngles\_Student.doc*
- *IntExtAngles.tns*

## Suggested Related Activities

*To download any activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the quick search box.*



- *Transversals (TI-Nspire technology) — 10991*
- *Angles in Polygons (TI-Nspire technology) — 9055*
- *Remote Interior Angles (TI-Nspire technology) — 10230*

**Problem 1 – Interior angles of a triangle**

On page 1.3, students will construct a triangle (**MENU > Shapes > Triangle**) and label the vertices *A*, *B*, and *C*.

**Note:** If the vertices are not labeled at the same time that they are created, they may be labeled using the **Text** tool (**MENU > Actions > Text**).

Students should measure the three interior angles of the triangle using the **Angle** tool (**MENU > Measurement > Angle**).

**Note:** To measure an angle, press  (or **enter**) three times to select the vertices of the angle and then press  (or **enter**) again to anchor the measurement.

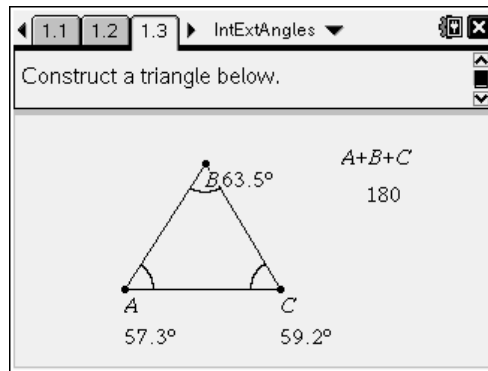
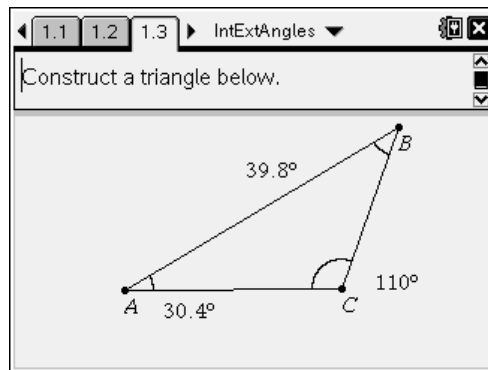
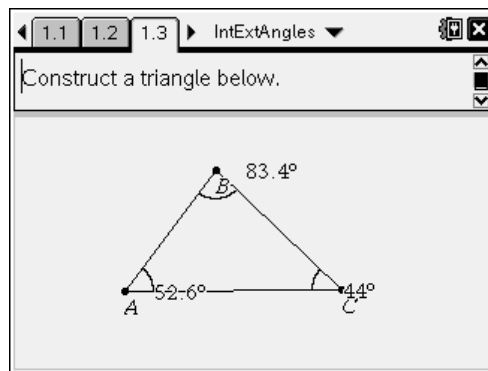
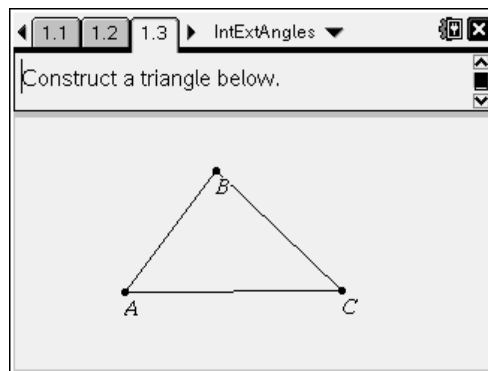
This data should be recorded in the first row of the chart on the student worksheet.

Students should then drag a vertex of the triangle to change the angle measures. Have them try to create different types of triangles (acute, obtuse, right). After recording two more sets of data in the chart on their worksheet, students should make a conjecture about the three interior angles.

Instruct students to use the **Text** tool to display the expression ***A+B+C*** on the screen.

Then have them use the **Calculate** tool (**MENU > Actions > Calculate**) to find the sum of the three interior angles of the triangle.


Next, have them drag a vertex and observe the results. Ask: *Do the results support your conjecture?*



**TI-Nspire Navigator Opportunity: Screen Capture**  
**See Note 1 at the end of this lesson.**

**Problem 2 – One exterior angle of a triangle**

On page 2.2, students will construct a line through the two lower vertices of the triangle (A and C) using the **Line** tool (**MENU > Points & Lines > Line**).

**Note:** To be certain that the line passes through a vertex, make sure the vertex point is flashing before pressing  (or **enter**).

Have students create a new point on the line to the right of the triangle using the **Point On** tool. Label it **D**.

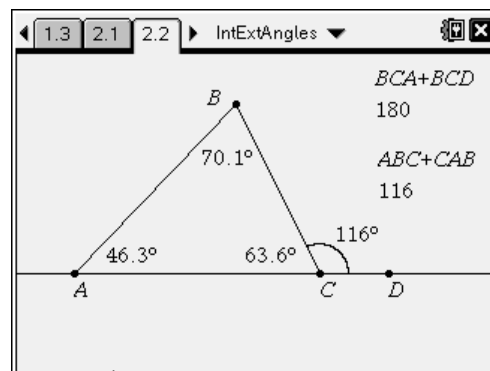
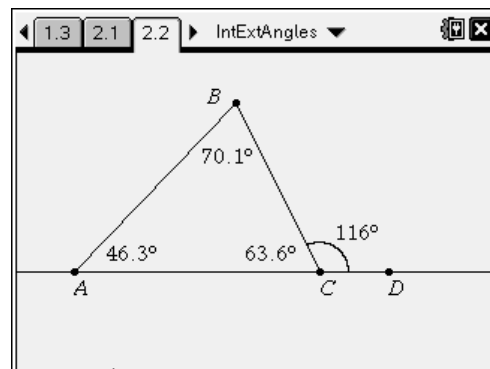
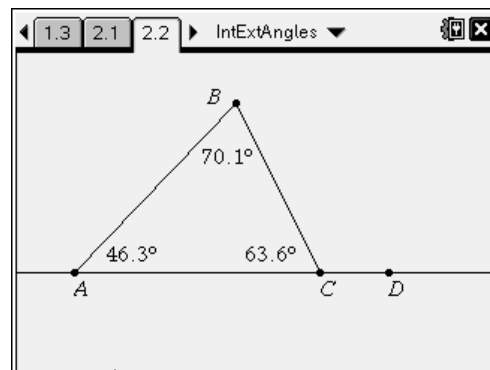
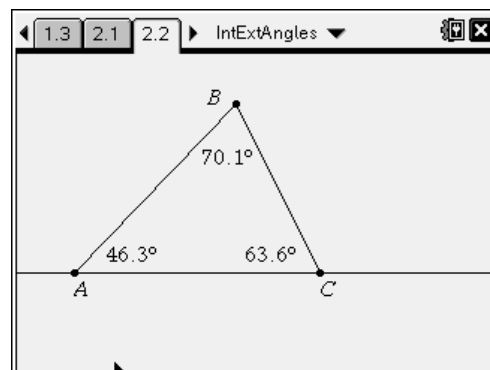
Direct students to measure the exterior angle  $\angle BCD$  using the **Angle** tool, and record this measure, along with the measures of the interior angles, in the chart on the student worksheet.

Next, students should drag a vertex of the triangle to change the angle measures, and add two more sets of data to the chart.

Students should make some observations about the exterior angle and its relationship to the other angles displayed in the chart.

Have them make calculations as needed to test their conjectures. If desired, prompt students to calculate the sums of pairs of angles in the chart.

Once again, students should drag a vertex and observe the results. Ask: *Do the results support your conjectures?*

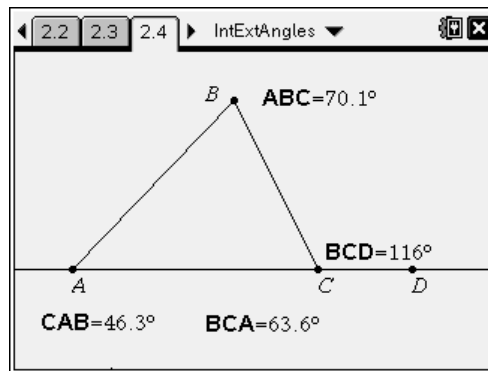


**TI-Nspire Navigator Opportunity: Quick Poll**

**See Note 2 at the end of this lesson.**

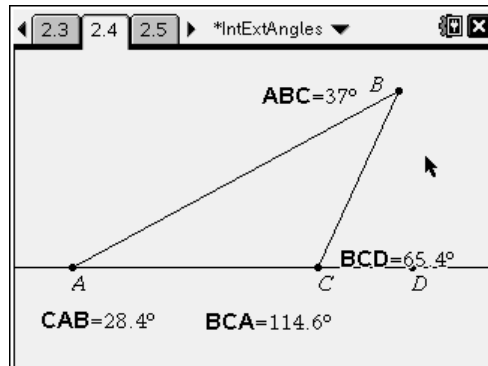
Advance to page 2.4 where the construction is replicated. The *Lists & Spreadsheet* application on page 2.5 is set up to capture the angle measurements displayed on page 2.4.

On page 2.5, have students press  $\text{ctrl} + \text{.}$  to capture and view the first set of data.



Returning to page 2.4, tell students to drag a vertex of the triangle to change the angle measures, and press  $\text{ctrl} + \text{.}$  to capture another set of data.

They should continue dragging a vertex and pressing  $\text{ctrl} + \text{.}$  until they have collected at least five data sets. (There is no need for students to return to page 2.5 during this process.)



On page 2.5, students will inspect the collected data. The formula in Column E calculates the sum of the two remote interior angles ( $\angle ABC$  and  $\angle CAB$ ). Press  $\text{ctrl} + \text{R}$  to execute the formula. Ask students to compare the resulting values to those in other columns of the spreadsheet. They should observe that Columns D and E contain the same values.

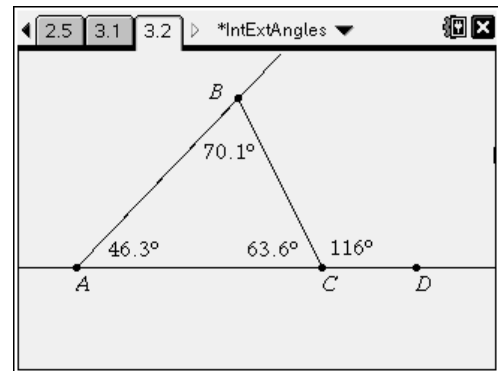
	A	B	C	D	E
	labc	lbca	lcab	lbcd	rem
	=capture	=capture	=capture	=capture	=labc+
1	70.07	63.64	46.3	116.4	116.4
2	69.46	67.05	43.49	112.9	112.9
3	64.08	77.31	38.61	102.7	102.7
4	51.95	95.66	32.39	84.34	84.34
5	49.41	99.21	31.38	80.79	80.79

The formula in Column F finds the sum of the exterior angle and its adjacent interior angle ( $\angle BCD$  and  $\angle BCA$ ). Ask: *How can this result be interpreted?* (The angles are supplementary.)

	a	C	D	E	F	G
	a	lcab	lbcd	rem	adj	.
	=capture	=capture	=capture	=labc+	=lbcd+	
1	3.64	46.3	116.4	116.4	180.	
2	7.05	43.49	112.9	112.9	180.	
3	7.31	38.61	102.7	102.7	180.	
4	5.66	32.39	84.34	84.34	180.	
5	9.21	31.38	80.79	80.79	180.	

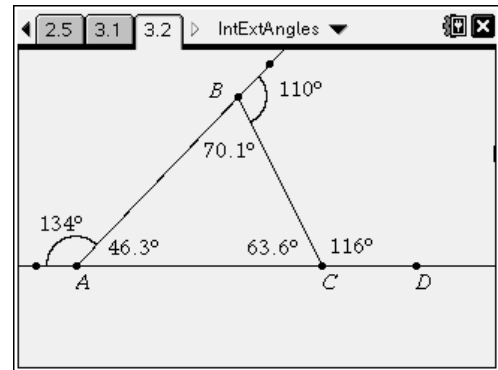
**Problem 3 – Three exterior angles of a triangle**

On page 3.2, students will construct a ray (MENU > Points & Lines > Ray) from point A through point B as shown.



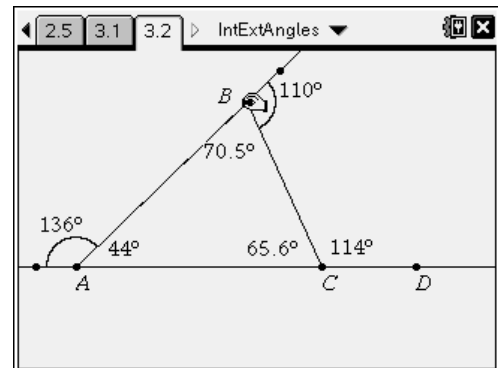
Next, they should measure one exterior angle at each vertex.

**Note:** It is not necessary to create an additional point on the line before measuring the angle.



Have them record the measures of the three exterior angles into the chart on the student worksheet.

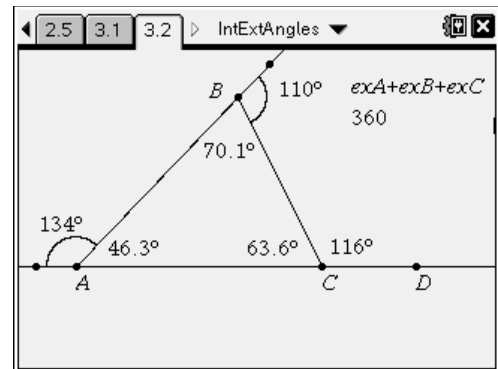
Then they can drag a vertex of the triangle and record more data into the chart.



Instruct students to make a conjecture about the three exterior angles.

Then have them calculate the sum of the three exterior angles.

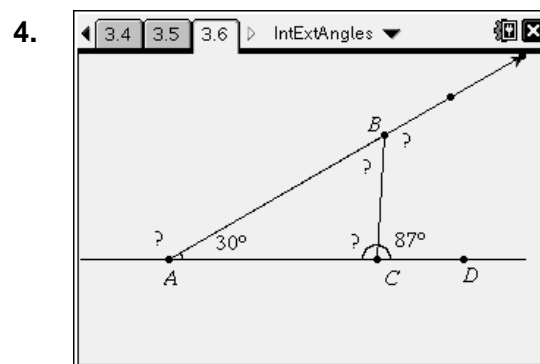
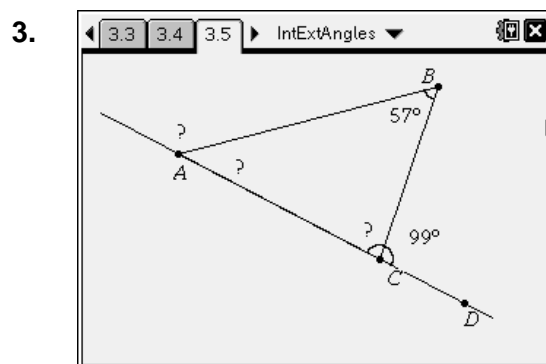
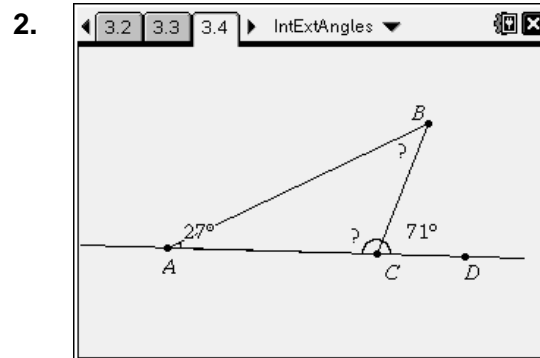
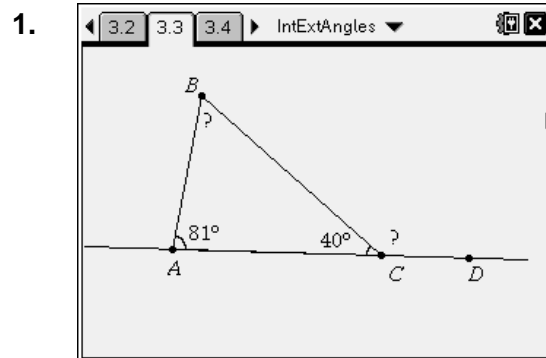
Tell students to drag a vertex and observe the results. Ask: *Do the results support your conjectures?*



**TI-Nspire Navigator Opportunity: Screen Capture or Live Presenter**  
**See Note 3 at the end of this lesson.**

**Additional Problems**

Ask students to find the missing angle measures in each of the diagrams below.



**Solutions**

1.  $\angle B = 59^\circ$ ,  $\angle BCD = 140^\circ$
2.  $\angle B = 44^\circ$ ,  $\angle BCA = 109^\circ$
3.  $\angle BCA = 81^\circ$ , int  $\angle A = 42^\circ$ , ext  $\angle A = 138^\circ$
4.  $\angle BCA = 93^\circ$ , ext  $\angle A = 150^\circ$ ,  $\angle ABC = 57^\circ$ , ext  $\angle B = 123^\circ$

**TI-Nspire Navigator Opportunities**

**Note 1**

**Problem 1, Screen Capture**

Use Screen Capture to ensure that students all selected the correct Text box and variables for their calculation. This will ensure they are able to see the correct sum of the interior angles.

**Note 2**

**Problem 2, Quick Poll**

Ask students to submit the sum of  $\angle ABC$  and  $\angle CAB$  and the exterior angle measurement. All students should enter the same two numbers. Otherwise, they have made a mistake in their construction.

**Note 3****Problem 3, Screen Capture or Live Presenter**

As the class is discussing the results of the sum of the exterior angles, have different students move vertices around in the construction. This will show that regardless of the shape of the construction, the exterior angles always sum to  $360^\circ$ .