

Properties of Triangles

Time required
45 minutes

Activity Overview

In this activity, students explore different type of triangles and find the interior and exterior angle sum to form a paragraph proof.

Concepts

- *Types of triangles, exterior and interior triangle sums, measuring angles, and paragraph proof.*

Teacher Preparation

This investigation offers opportunities for review and consolidation of key concepts related to triangles. As such, care should be taken to provide ample time for ALL students to engage actively with the requirements of the task, allowing some who may have missed aspects of earlier work the opportunity to build new and deeper understanding.

- *This activity can serve to consolidate earlier work on triangles. It offers a suitable introduction to utilizing previous concepts to investigate the properties of the interior and exterior angle sum in triangles.*
- *Begin by discussing different types of triangles.*
- *Refer to the screenshots on page 5 for a preview of the student .tns file.*

Classroom Management

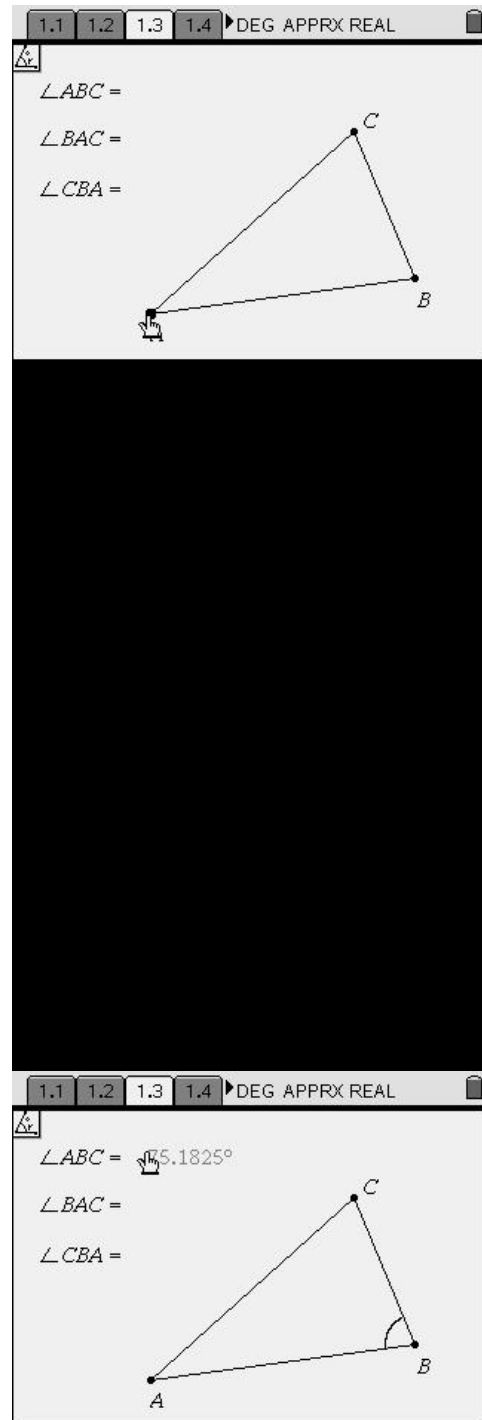
- *This activity is intended to be **teacher led**. You should seat your students in pairs so they can work cooperatively on their handhelds. Use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds, although the majority of the ideas and concepts are only presented in **this** document; be sure to cover all the material necessary for students' total comprehension.*
- *Students can either record their answers on the handheld or you may wish to have the class record their answers on a separate sheet of paper. Another option is to just use the questions posed to engage a class discussion.*

TI-Nspire[™] Applications

Calculator, Graphs & Geometry, Notes

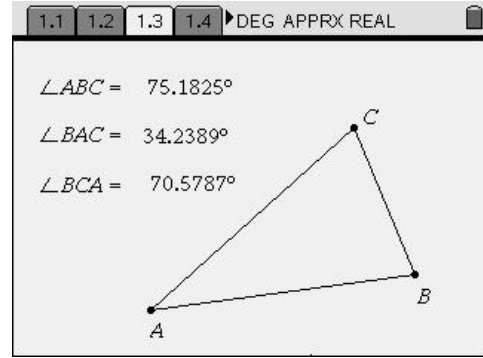
Step 1: Students are to go to page 1.2, where they are instructed to measure each angle by choosing the Measure Angle tool from the Measurement menu.

Make note that to measure the angle at vertex B, for example ($\angle ABC$), they just click on each of the letters in the order of the angle name. The students should continue to measure the other two angles.



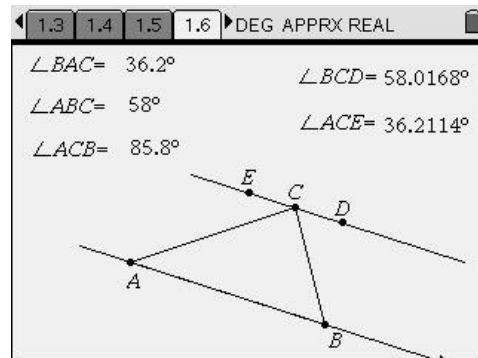
Step 2: Once they have all the angles measured, they should escape out of that tool and then grab the vertices and move $\triangle ABC$ to the various shapes as discussed in class before. Students should observe the angle measurements as they move the vertices around.

You have the option here to have the students measure the lengths of the sides of the triangle to get a better understanding of the different types of triangles. If you choose to measure the lengths, the tool is located in the Measurement menu.



Step 3: On the page 1.6, students will see a similar triangle with a line constructed parallel to the base of the triangle. The base side of the triangle has an auxiliary line placed on it.

They are to measure the two angles $\angle BCD$ and $\angle ACE$ the same way they did on page 1.2 and place the measurements next to the names.



Step 4: Students should again grab various vertices and observe the relationships between the five angles. This would be a good place for a class discussion regarding alternate interior angles.

1.5 1.6 1.7 1.8 DEG APPRX REAL

Question

Finish the statement: When parallel lines are cut by a transversal...

Answer ▾

Step 5: This is a leading question to get students to be thinking and understanding that these three angles form a linear pair.

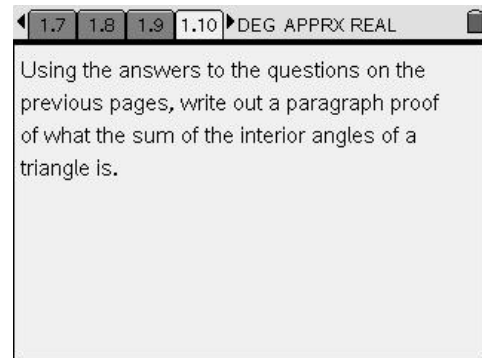
1.6 1.7 1.8 1.9 DEG APPRX REAL

Question

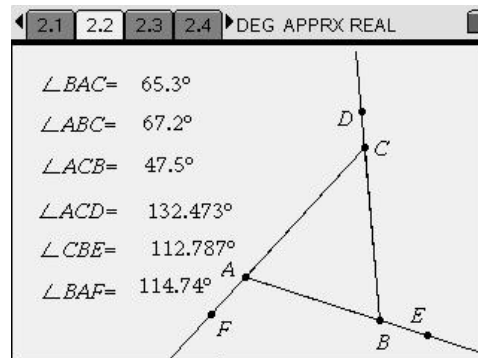
What does the sum of $\angle ACE$, $\angle ACB$ and $\angle BCD$ imply?

Answer ▾

Step 6: If students are not familiar with proof at this time, this would be a good place to work as a class on a paragraph proof.



Step 7: Students are to go to page 2.1, where they will see $\triangle ABC$ with each side of the triangle extended with a ray. Students are to measure each of the exterior angles and place these measurements by each angle name.



Step 8: As before, the students are to grab the vertices and make observations about the relationship between the interior and exterior angles. On page 2.4, the students are to look at the interior angle and its corresponding exterior and conclude that they form a linear pair.

Step 9: As with page 1.10, students are to write a paragraph proof about the sum of the exterior angles. Depending on where your students are with proof, it is up to your discretion as to how you want work through this. You may want them to tackle it themselves since you did the first one together in class.

Extension

Students can use the techniques learned in this activity to study properties of various quadrilaterals.

Sample Paragraph Proofs:

Page 1.10: We know that $\angle BAC \cong \angle ACE$ and $\angle ABC \cong \angle BCD$ because parallel lines cut by a transversal the alternate interior angles are congruent. Also, $\angle ACE + \angle ACB + \angle BCD = 180^\circ$ as they form a line then $\angle BAC + \angle ACB + \angle ABC = 180^\circ$ by substitution. Therefore, interior angle sum in $\triangle ABC$ is 180° .

Page 2.5: We know that $\angle BAF + \angle BAC = 180^\circ$, $\angle ACD + \angle ACB = 180^\circ$, and $\angle CBE + \angle ABC = 180^\circ$ because they all form linear pairs. If we add all the angles together, they equal 540° but since the interior angles equal 180° , then $540^\circ - 180^\circ = 360^\circ$. So the exterior angle sum of a triangle is 360° .

Properties of Triangles –

(Student)TI-Nspire File: *GeoActXX_PropertiesTriangle_EN.tns*

1.1 1.2 1.3 1.4 ▸ DEG APPRX REAL

Properties of Triangles

Interior and Exterior Angles

1.1 1.2 1.3 1.4 ▸ DEG APPRX REAL

Grab each of the vertices with the **grab** tool and move them around.

Question

What do you notice about the measurements of the angles?

Answer

1.1 1.2 1.3 1.4 ▸ DEG APPRX REAL

On the next page, you will see $\triangle ABC$. Measure each angle by choosing the *Measure Angle* tool from the *Measurement* menu.

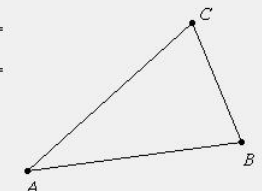
To measure the angle at vertex B, for example ($\angle ABC$), just click on each of the letters in the order of the angle name.

1.2 1.3 1.4 1.5 ▸ DEG APPRX REAL

On the next page, you will see a similar triangle with a line constructed parallel to the base side of the triangle. The base side of the triangle has an auxiliary line placed on it. Measure the two angles $\angle BCD$ and $\angle ACE$ the same way you did on page 1.2 and place the measurements next to the names.

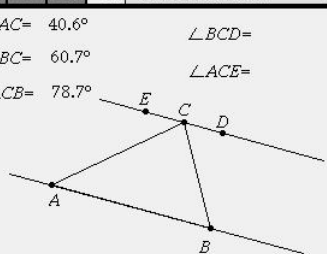
1.1 1.2 1.3 1.4 ▸ DEG APPRX REAL

$\angle ABC =$
 $\angle BAC =$
 $\angle BCA =$



1.3 1.4 1.5 1.6 ▸ DEG APPRX REAL

$\angle BAC = 40.6^\circ$ $\angle BCD =$
 $\angle ABC = 60.7^\circ$ $\angle ACE =$
 $\angle ACB = 78.7^\circ$



1.4 1.5 1.6 1.7 ▸ DEG APPRX REAL

Question

What do you notice about the five angles on the screen?

Answer

1.5 1.6 1.7 1.8 ▸ DEG APPRX REAL

Question

Finish the statement: When parallel lines are cut by a transversal...

Answer

1.6 1.7 1.8 1.9 ▸ DEG APPRX REAL

Question

What does the sum of $\angle ACE$, $\angle ACB$ and $\angle BCD$ imply?

Answer

1.7 1.8 1.9 1.10 ▸ DEG APPRX REAL

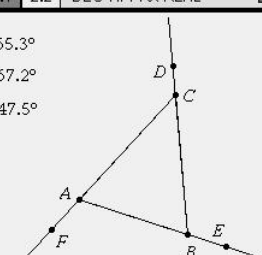
Using the answers to the questions on the previous pages, write out a paragraph proof of what the sum of the interior angles of a triangle is.

1.8 1.9 1.10 2.1 ▸ DEG APPRX REAL

On the next page, you will see $\triangle ABC$ on the page with the measurements for the three angles already done. Each side of the triangle has been extended with a ray. Measure each of the exterior angles of the triangle and place the angle measurements by each angle name.

1.9 1.10 2.1 2.2 ▸ DEG APPRX REAL

$\angle BAC = 65.3^\circ$
 $\angle ABC = 67.2^\circ$
 $\angle ACB = 47.5^\circ$
 $\angle ACD =$
 $\angle CBE =$
 $\angle BAF =$



1.10 2.1 2.2 2.3 ▸ DEG APPRX REAL

Grab each of the vertices with the **grab** tool and move them around.

Question

What do you notice about the measurements of the interior and exterior angles?

Answer

2.1 2.2 2.3 2.4 ▸ DEG APPRX REAL

Question

What does the interior angle and its corresponding exterior angle form?

Answer

2.2 2.3 2.4 2.5 ▸ DEG APPRX REAL

Using the answers to the questions on the previous pages, write out a paragraph proof of what the sum of the exterior angles of a triangle is.