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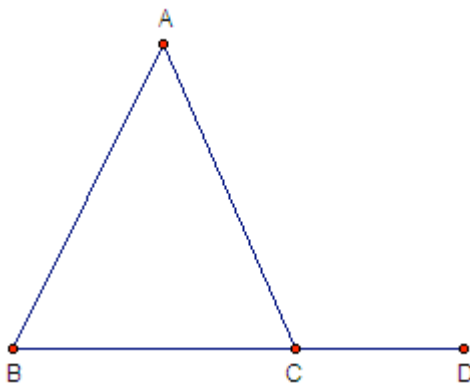
SEU 323

October 18, 2005

GEOMETER'S SKETCHPAD INVESTIGATION

Exterior Angles and Opposite Interior Angles of a Triangle

In this investigation you will discover the relationship between the measure of an exterior angle of a triangle and each of the two nonadjacent interior angles. An exterior angle is an angle that is formed outside of a triangle by one side of the triangle and the extension of an adjacent side. The triangle you will create will be similar to the triangle below. Angle ACD is the exterior angle.



Follow the instructions in each step to complete the investigation.

Let's get started!

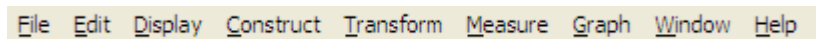
1. Open the Geometer's Sketchpad program on your computer. You will get a blank "sketchpad" which is labeled as "Untitled 1" at the top left. This is where you

will create your drawing and do your work. You can make the sketchpad larger by dragging the right lower corner with the mouse pointer.

2. The drawing “tools” you will use are located in a vertical toolbar on the upper left hand side of the sketchpad. Some of the tools have alternate choices in addition to what is displayed. If necessary you can access them. Using the mouse you can click on the tool you want to use. The toolbar looks like this:



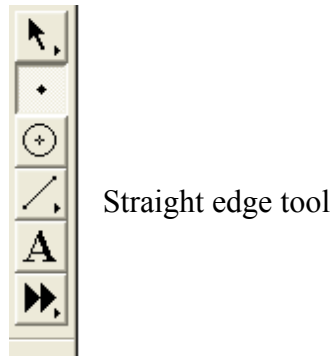
3. The “menu bar” is located across the top of the sketchpad. Each has a drop-down list. You will be using commands from this menu-bar. The menu-bar looks like this:



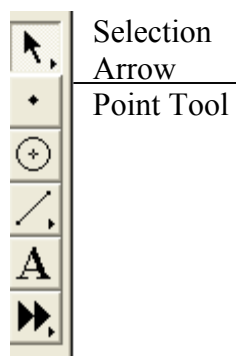
Let's sketch!

You will now draw, or “construct”, a triangle.

1. Click on the straight edge tool on the toolbar using the mouse. Using the mouse, draw a line segment in the blank sketch area similar in length to the above example. This is the straight edge tool:



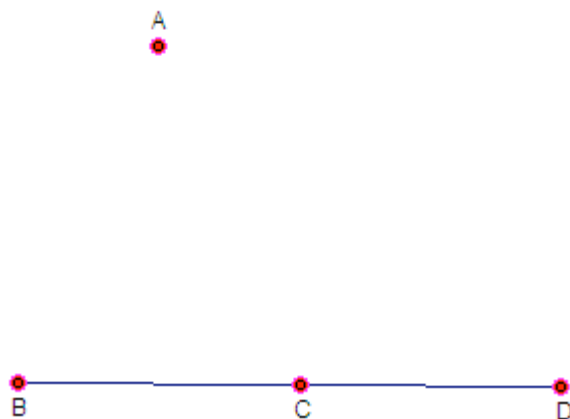
2. Next click on the point tool on the toolbar and place a point on the segment you drew. This will ensure that the three points on the bottom of the triangle are collinear. Still using the point tool, place a point above the line segment to represent the top vertex of the triangle. The point tool is the second button from the top:



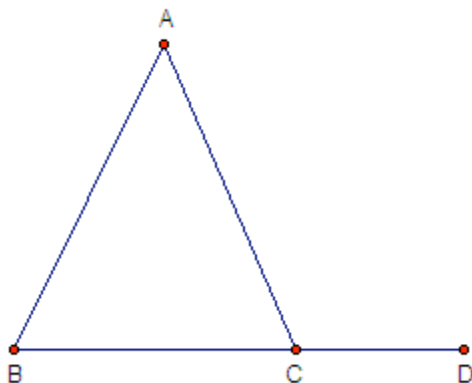
3. You will now label the points which represent the vertices of the triangle and the exterior angle. Click on the selection arrow on the toolbar. It is the top button on the toolbar and is used to select and “drag” objects on the

sketchpad. After selecting the arrow, click on each of the four points; when the selection arrow is right on the point, the arrow will turn horizontal. The points will then highlight as a halo surrounds them. This means they are “selected” and they are the points which will be acted upon with then next command you execute. The points will be labeled alphabetically according to the order in which you select them. Please select them in an order so that your triangle is labeled the same way that the triangle in the introduction is labeled.

4. Go to the menu bar and click on “Display”; from the drop-down list click on “Show labels.” After you see the letters label each point, click in a blank area of the sketchpad so that no parts are highlighted. You can move the labels by putting the cursor on the letter and when a hand appears, click on the letter and its position can be changed. You only have to do this if the letter is not in a good spot; that is, the letter might be right over the point or on the line segment. Your sketch should look similar to this:



- Next you will construct the sides of the triangle. Using the mouse, once again click on the “selection arrow” on the toolbar. You will use it to select the two points you want to “connect” to construct a side. Select Points A and B. Do you remember how to select the points? If not, refer to Step 3 to refresh your memory!
- Using the menu-bar, click on the “Construct” command and you will get a drop-down list. Click on “Segment” in that list. The two points you selected will now be connected by a line segment. The segment you just constructed will be highlighted. Click in a blank area of your screen so the segment will no longer be highlighted.
- Construct the remaining side in the same manner. You should now have a triangle on your sketchpad similar to the following:



8. You will now do a “drag test” to make sure the triangle is “all connected.” Using the selection arrow from the toolbar, click on any one of the points and “move” or “drag” with the mouse. The triangle should “move around” all in one piece. If it does not, you’ll need to “undo” your work and try again! To “undo”, choose “Edit” from the menu-bar and select “Undo.” You can “undo all” in one step if you hold down the Shift key while choosing Undo. If your triangle has “got it all together,” you’re ready to move on!

Let’s investigate!

Now it’s time to investigate the relationship between measures of the exterior angle and the nonadjacent interior angles of the triangle we constructed.

1. First make sure that all objects are “deselected” or not highlighted. Do you remember how to deselect? Check Step 6 in the previous section to refresh your memory!
2. To investigate a relationship between measures, you need to get some measurements. The first angle we will measure is the exterior angle, angle ACD. Using the selection arrow tool, select the three points A, C, D which make up the angle. The vertex of the angle, point C, must be the second point you select so that the correct angle is measured. Go to the menu bar, choose “Measure,” then choose “Angle” from the drop down box. The angle measure will appear in the upper left of the sketch area. Record the measure in the chart in Column 1.

	Measurement 1	Measurement 2	Measurement 3
Angle ACD	116.01°	121.72°	88.07°
Angle CBA	61.88°	97.18°	40.40°
Angle BAC	54.13°	24.54°	47.67°

- Measure the two angles which are not adjacent, but opposite to angle ACD. Use the same method described in Step 2. Record the measures in the chart.
- Now you can change the angle measurements by “dragging” the triangle around. Make sure all parts of the triangle are deselected. Using the Selection Arrow tool, click on one of the vertices and move the mouse in order to drag the triangle. The angle measurements will change; you can watch the measurements change in the upper left of the sketch area!
- When you stop dragging the point, record the measurements in the chart in Column 2.
- Drag the triangle one more time! Record the measurements one more time!

Please answer the following questions:

- In Column 1 of the chart, is the measure of the exterior angle equal to, smaller than, or bigger than angle CBA?

The measure of angle ACD is bigger than angle CBA.

- In Column 1, is the measure of the exterior angle equal to, smaller than ,or bigger than angle BAC?

The measure of angle ACD is bigger than angle BAC.

3. In Column 2, is the measure of angle ACD equal to, smaller than, or bigger than angle CBA?

Angle ACD is bigger than angle CBA.

4. In Column 2, is the measure of angle ACD equal to, smaller than, or bigger than angle BAC?

Angle ACD is bigger than angle BAC.

5. In Column 3, what is the relationship between the measures of the angles?

Angle ACD is bigger than the opposite interior angles.

6. From the information you have gathered, what can you conclude about the relationship between an exterior angle of a triangle and the opposite interior angles? More formally asked, what is your conjecture?

The measure of an exterior angle of a triangle is bigger than the measure of either opposite interior angle.



