

### INVESTIGATION: The Pythagorean Theorem

**Directions:** Use the steps below to lead you through the investigation. *After each step, be sure to click in the blank white area of your screen.* Fill in the Table 1 and answer the questions at the end.



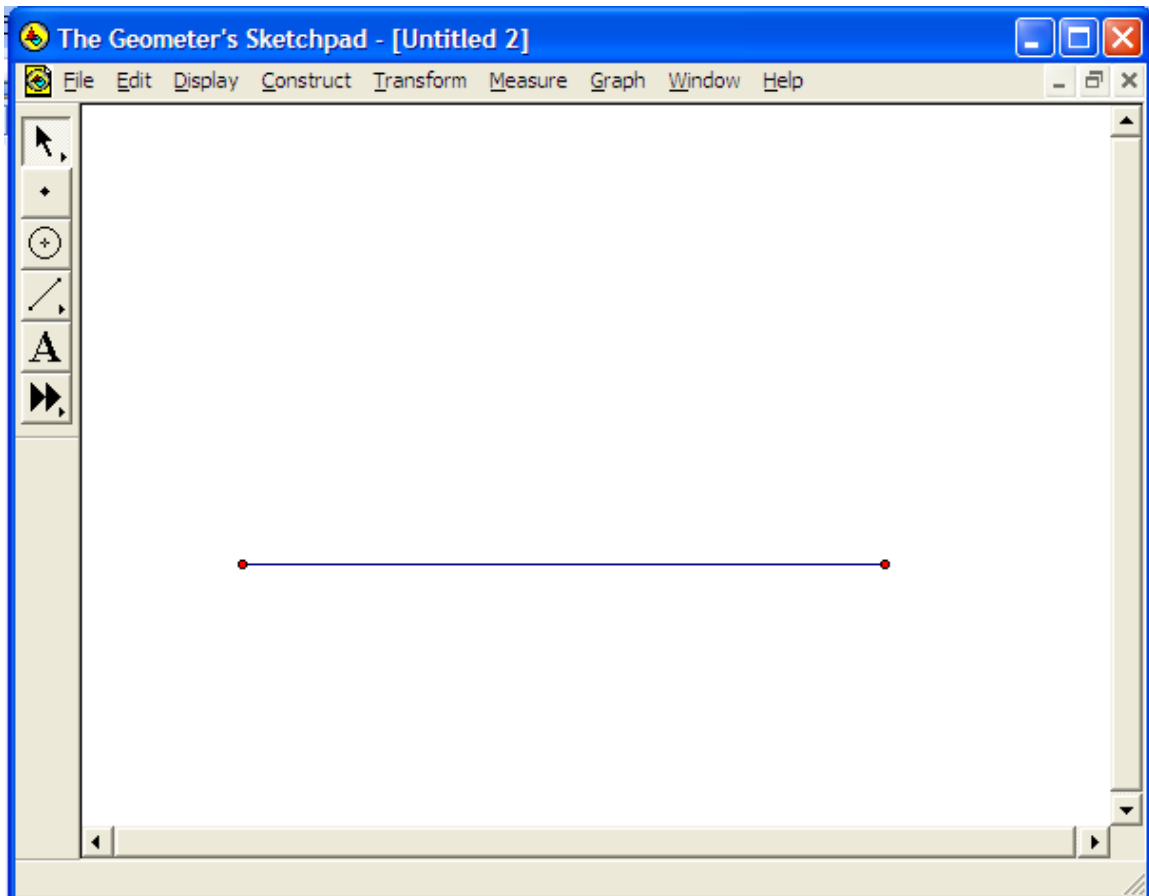
Selection Tool



Segment Tool

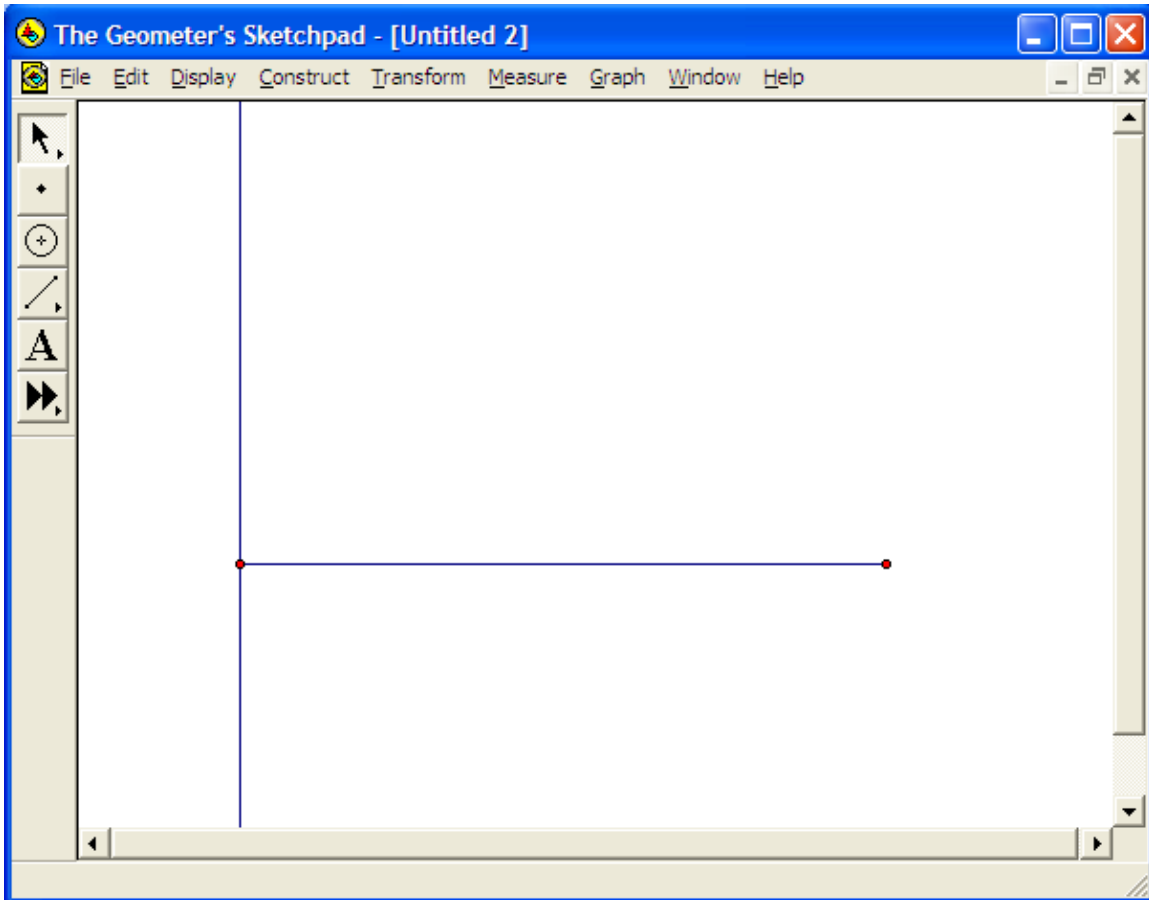
#### Sketch

*Step 1:* Select the **segment tool** on the left side of your screen. Draw a segment (Click once to create the first endpoint, move mouse to increase length segment length, click again to create second endpoint). Your screen should look similar to this (NOTE: your line does not need to be perfectly horizontal):



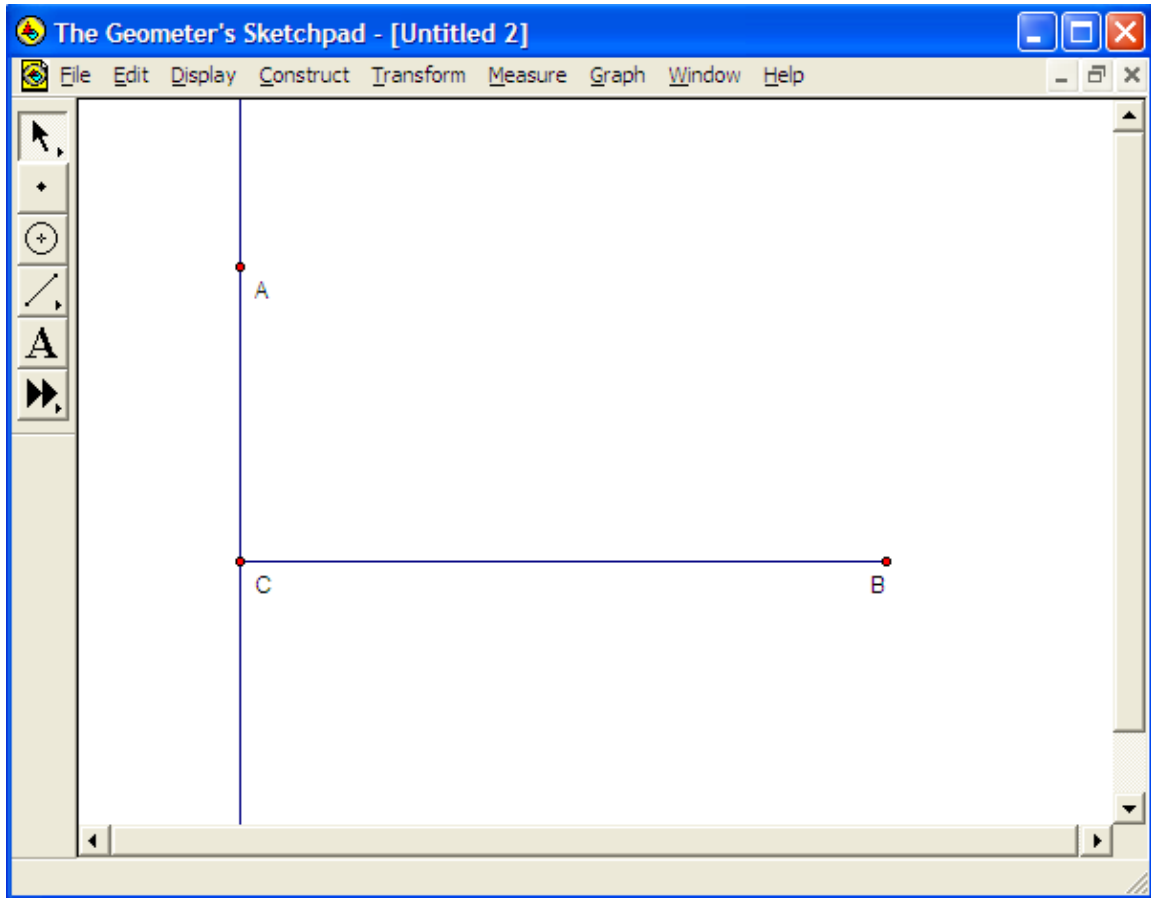
*Step 2:* Choose the **selection** tool on the left side of the screen. Now on the segment you just drew, click the segment and one of the end points of the segment. Both a line and point should now be selected.

*Step 3:* Go to the **Construct** menu at the top of your screen. Click on **Perpendicular Line**. *Geometer's Sketchpad* will draw a new line that is perpendicular to your line segment and passes through the point you chose. Your screen should now look similar to this:



*Step 4:* Now click on the perpendicular line you just created in step 3 (the entire line will be highlighted once selected). Go to the **Construct** menu and click on **Point on Perpendicular Line**. This will create a point on the line you created in step 3. You can click and drag the point to where you would like it on the perpendicular line. (Hint: *Sketchpad* may create a new point over top of the point that is already on the perpendicular line. Just click on it and drag to where you like.)

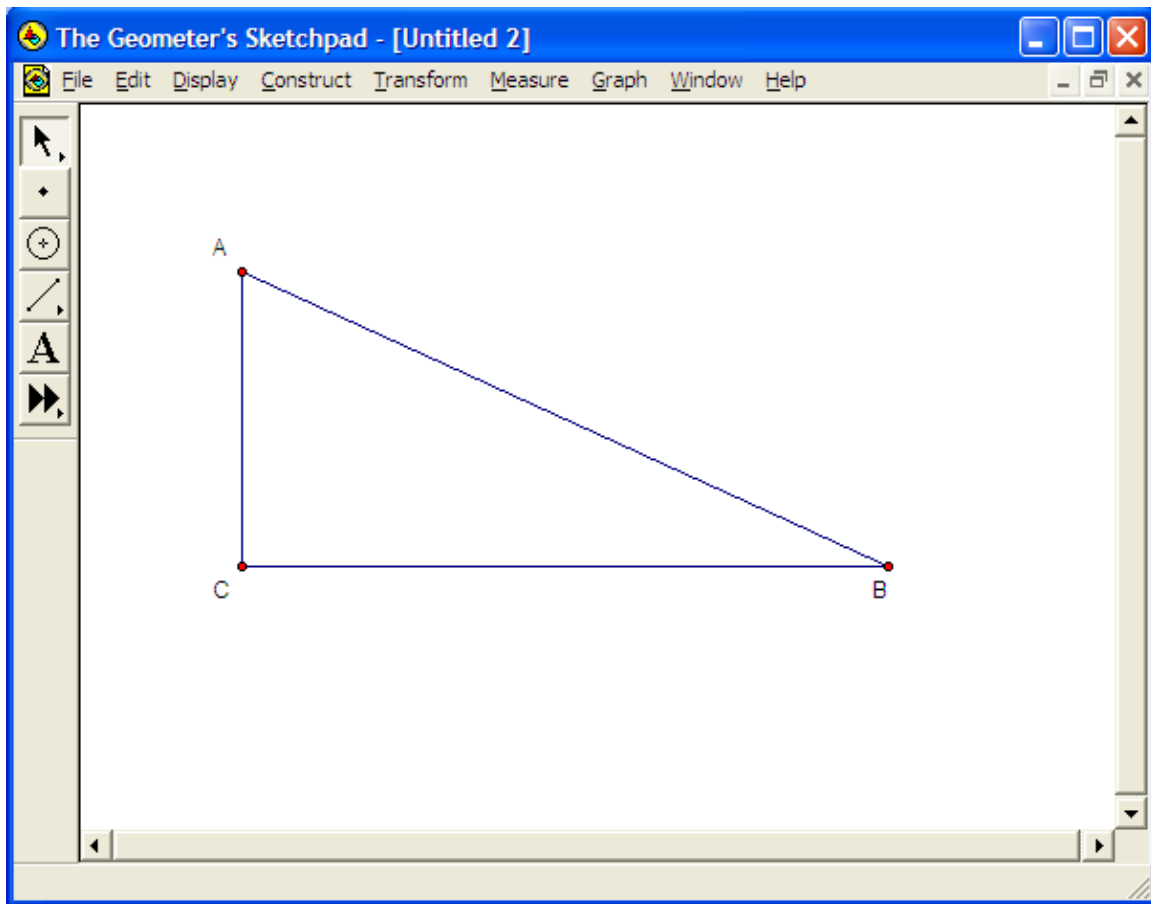
*Step 5:* Select all three points. Go to the **Display** menu at the top of the screen and click on **Show Labels**. Your points should now be labeled A, B, and C. If necessary, double click on the labels to rename them so that they are the same as the below diagram:



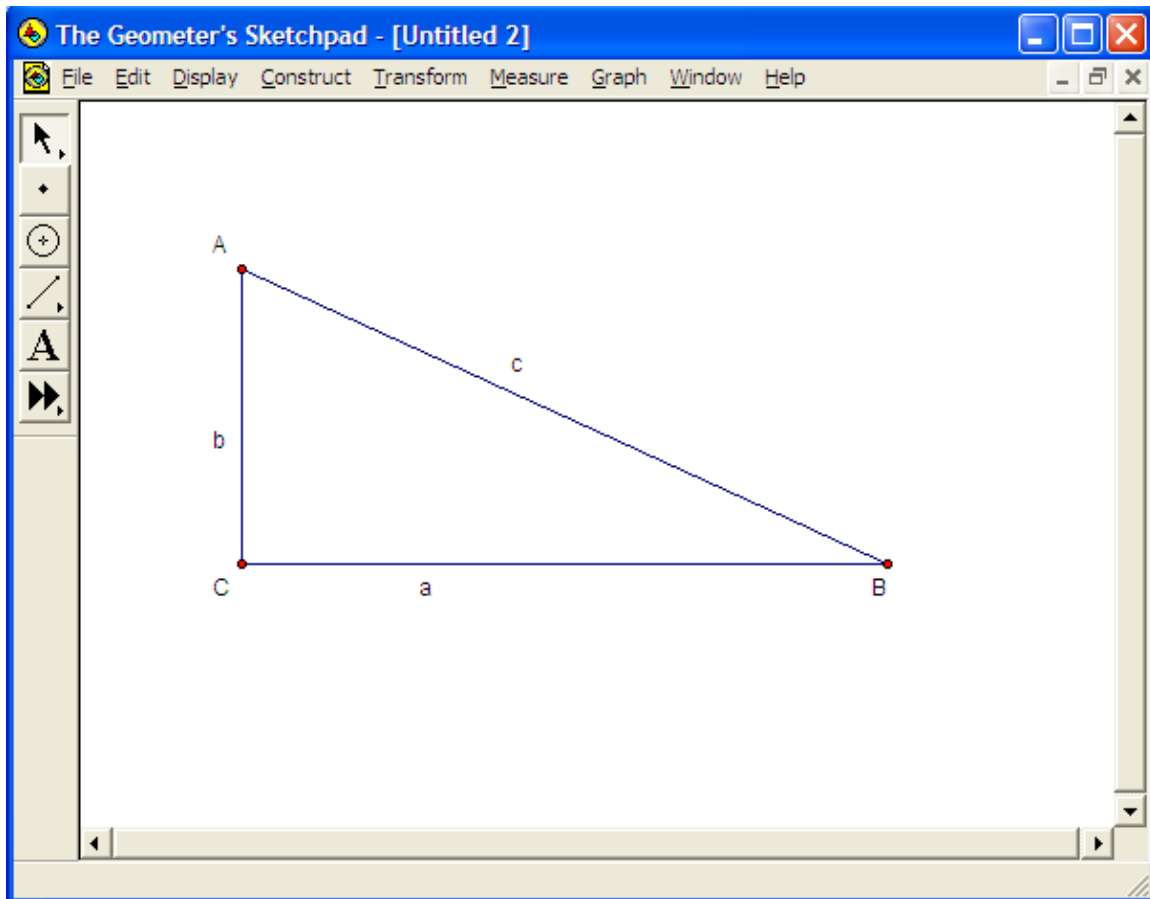
*Step 6:* Now select point A and point B. Go to the **Construct** menu and click **Segment**. *Sketchpad* will draw a segment connecting points A and B.

*Step 7:* Click on the perpendicular line that you drew in step 3. Go to the **Display** menu and click on **Hide Perpendicular Line**. *Sketchpad* will “hide” or remove the perpendicular line from your screen.

(more Step 7) Now repeat step 6 for points A and C, constructing a segment that connects points A and C. You have now successfully constructed a right triangle ABC and your screen should now look similar to this:

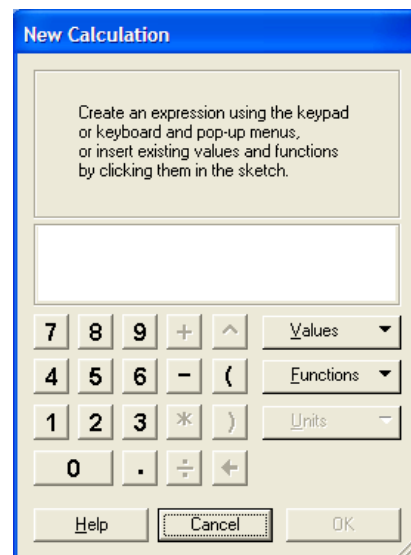


*Step 8:* Highlight the segment that connects points B and C. Go to the **Display** menu at the top of your screen and click on **Label Segment**. In the box that appears, label the segment 'a' and click the **OK** button. Make sure to click in the white area of your screen to de-select the segment you just labeled. Repeat these steps, labeling the segment that connects points A and B as segment 'c', and the segment that connects A and C as segment 'b'. Once the labels are in place you can click on them and move them where you would like them. Your screen should now look similar to this:



*Step 9:* We are now going to use *Geometer's Sketchpad* to measure the length of each side of the triangle. Click on segment *a*. Go to the **Measure** menu and click on **Length**. The length of segment *a* will now appear on your screen. Repeat these steps for segments *b* and *c*. Again, you can click on the lengths and move them where you would like them. Record the lengths of each segment in TABLE 1 of this worksheet.

*Step 10:* Click on the measurement of segment *a*. Go to the **Measure** menu and select **Calculate**. The box pictured to the right will appear on your screen. Click on the **Values** button, select '*a*', then click on the ^ button (the exponent symbol in this case). Now click on the '2' button. Click on the OK button. *Sketchpad* will now have calculated and displayed the value of  $a^2$  on your screen. Repeat this step for segments *b* and *c*. Once you have the values for  $a^2$ ,  $b^2$ , and  $c^2$  displayed on your screen,



record their values in TABLE 1.

*Step 11:* Now select the calculation for  $a^2$  and  $b^2$ . Go to the **Measure** menu and select **Calculate**. Click on the **Values** button, select ' $a^2$ '. Click the + button. Now click on the **Values** button and select ' $b^2$ ' and click OK. Now *Sketchpad* will have calculated and displayed the value of  $a^2 + b^2$ . Record this value in TABLE 1.

*Step 12:* Now click on one of the vertices of the triangle and drag it so that the size of the triangle changes. The measurements on your screen will also change. Use this method once on each of the vertices, creating new measurements for  $a$ ,  $b$ , and  $c$  as well as  $a^2$ ,  $b^2$ , and  $c^2$ . Record the measurements for each new triangle in TABLE 1.

**Investigation:**

Click on one of the vertices of the triangle and drag it so that the size of the triangle changes. The measurements on your screen will also change. Use this method once on each of the vertices, creating new measurements for  $a$ ,  $b$ , and  $c$  as well as  $a^2$ ,  $b^2$ , and  $c^2$ . Record the measurements for each new triangle in TABLE 1.

**TABLE 1**

Length of a	Length of b	Length of c	$a^2$	$b^2$	$c^2$	$a^2 + b^2$

In your own words, what is the relationship that you found for the sides of each of the right triangles you constructed and measured?

Discuss the relationship you discovered with your partner. Notice that your partner's measurements are most likely different than yours. Did they still find the same relationship? Express the relationship as an algebraic formula.

*Please attach a copy of the completed sketches of one of your right triangles.*

**Explore More**

Use *Geometer's Sketchpad* to construct a non-right triangle, i.e. a triangle with no right angles. Does the relationship that you discovered for right triangles hold for all triangles?