EXPLORATIONS

Activity 2

Surround and Be Found! Triangular Areas, That Is!

Objective

- To use Geoboard to find areas of triangles using the surrounding rectangle technique

Materials

- TI-73
- Student Activity pages (pp. 15 – 17)

In this activity you will

- Find the area of right triangles.
- Find the area of other triangles by surrounding them with rectangles and subtracting right-triangular areas.

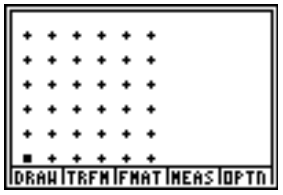
Introduction

How do you cut a sandwich in half? Some people cut their sandwich into two congruent right triangles. It is apparent even to small children that the sandwich is cut into two congruent (same size, same shape) halves. Therefore, we can use the idea that the area of one triangular part of a rectangle is equal to one-half of the whole. We will use this method to find the area of right triangles.

Investigation

This investigation will help you find the area of right triangles by surrounding them with rectangles.

1. From the main Geoboard menu, select **2:6x6**.



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2. To format the geoboard, select **FMAT** and make sure that the following settings are selected:

   LblsOn (Labels are on)
   AxesOff (Axes are off)
   CoordOff (Coordinates are off)
   Decimal (Measurement is in decimal form)

   To change a setting, press ◄ or ► to select, and then press ENTER to change the setting.

   Select **QUIT** to exit the FORMAT menu.

3. On this geoboard, construct a 2-unit by 3-unit rectangle.

   a. Starting at the lower left peg, move the cursor up one unit by pressing ▲.

   b. To start the rectangle, select **DRAW**, **ADD**.

   c. To complete the side, move the cursor three units to the right by pressing ► ► ► and select **ADD**.

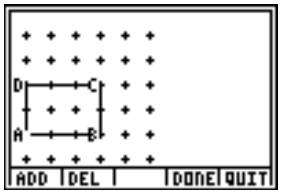
   d. To complete the next side, move the cursor up two units by pressing ▲ ▲ and selecting **ADD**.

   e. To complete the third side, press ◄ ◄ ◄ and select **ADD**.

   f. Press ▼ ▼ and select **DONE** to complete the rectangle.

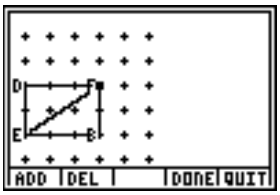
   Note: *When completing an object, the last point may be set by selecting* ***DONE****. For the last point in an object you may use* ***ADD, DONE,*** *but* ***ADD*** *is not necessary.*

   Your geoboard should look like the screen at the right.



4. The cursor should be on point A. Now draw segment AC. Select **ADD** ► ► ► ▲ ▲ **DONE**. Notice that A was renamed E and C was renamed F. What is the area of triangle EBF? How about triangle DEF? Since the diagonal splits the rectangle into two congruent right triangles, each triangle must have one-half of the area of the rectangle. The area of the rectangle is 6 square units, so each right triangle has an area of 3 square units.

   Your geoboard should look like the screen at the right.



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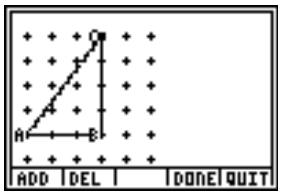
5. Clear the board by selecting **QUIT**, **OPTN**, **4:Erase Board**, **2:YES** . Draw a 3-unit by 4-unit right triangle.

Press ▲, and then select **DRAW**, **ADD** ▶ ▶ ▶ **ADD** ▲ ▲ ▲ ▲ **DONE**. You have just drawn triangle ABC. Can you visualize triangle ABC as half of a rectangle?

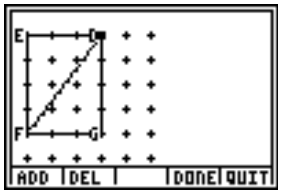
Your geoboard should look like the screen at the right.



6. Surround the triangle with a rectangle. The cursor should be on Point C. Select **ADD** ◀ ◀ ◀ **ADD** ▼ ▼ ▼ ▼ **ADD** ▶ ▶ ▶ **ADD** ▲ ▲ ▲ ▲ **DONE**. Again, points A, B, and C were renamed. What were they renamed?

A = _____ B = _____ C = _____

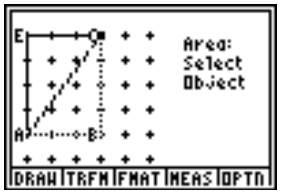
Your geoboard should look like the screen at the right.



7. Triangle DFG is surrounded by rectangle DEFG. We can now find the area of triangle DFG. Select **QUIT**, **MEAS**, **2:Area** ENTER.

Your geoboard should look like the screen at the right.

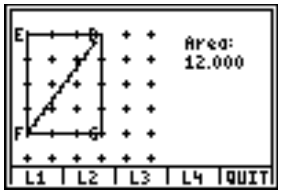
Notice that triangle DFG has changed to the original triangle ABC and is highlighted. Press ENTER to find the area of this highlighted triangle, which is 6 square units. Select **QUIT**. You return to a flashing cursor at point C.



8. Find the area of the surrounding rectangle. Since you are already in Measure mode, press ▲ to select (highlight) a different object that contains B and a corner point. The rectangle DEFG is now highlighted. To finds its area, press ENTER. The area of rectangle DEFG is 12 square units.

The geoboard should look like the screen at the right.

Notice that the area of the original triangle ABC is exactly one-half of the area of its surrounding rectangle DEFG.



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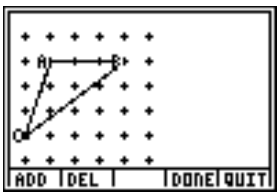
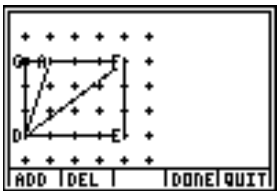
9. Clear the board by selecting **QUIT, OPTN, 4:Erase Board, 2:Yes.** Draw the obtuse triangle shown at the right.



10. Draw the surrounding rectangle DEFG as shown.

The geoboard should look like the screen at the right.



11. Develop a plan to find the area of the original obtuse triangle. First, find the area of rectangle DEFG. Then take away (or subtract) the areas of the two right triangles DEF and DAG.

12. Find the areas below. Note that triangle DEF and triangle DAG were never actually formed. These triangles need to be drawn in order to find their areas using the TI-73.

a. Rectangle DEFG has area _____ .

b. Triangle DEF becomes triangle HIJ and has area _____ .

c. Triangle DAG becomes triangle KLM and has area _____ .

d. The area of the original triangle ABC is _____ .

e. Area rectangle DEFG minus area triangle DEF minus area triangle DAG equals _____ .

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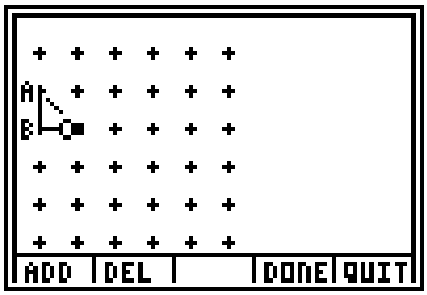
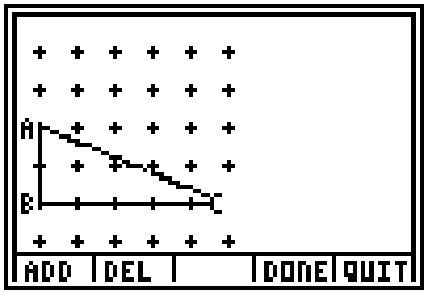
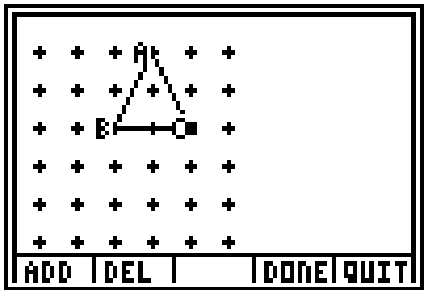
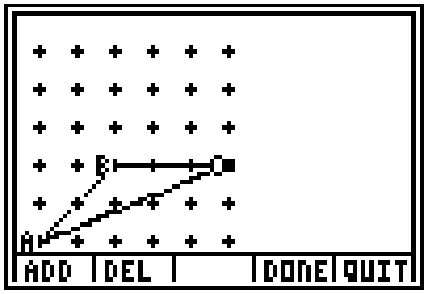
Student Activity

Name _____

Date _____

Activity 2: Surround and Be Found! Triangular Areas, That Is!

Find the area of each triangle using the surrounding rectangle method.

1. Area: _____ square units	
2. Area: _____ square units	
3. Area: _____ square units	
4. Area: _____ square units	

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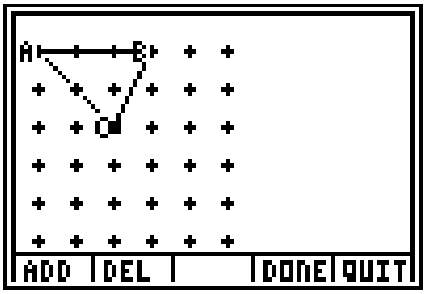
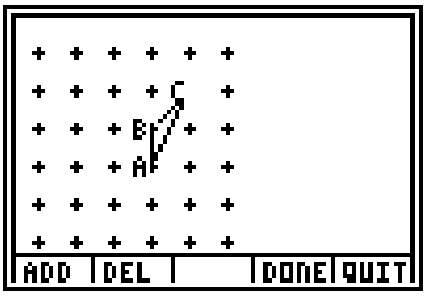
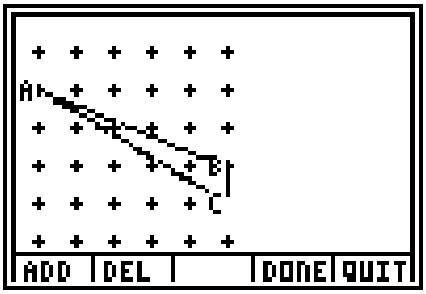
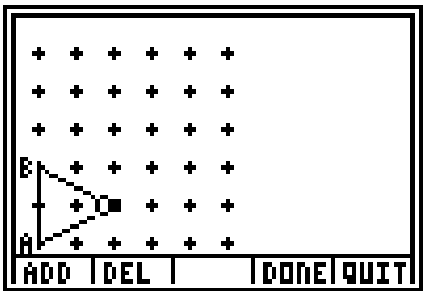
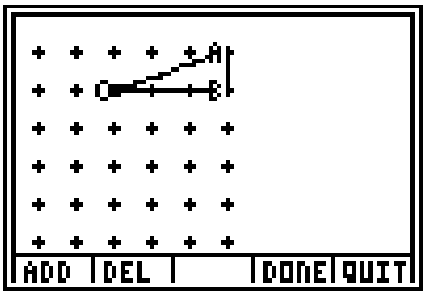
5. Area: _____ square units	
6. Area: _____ square units	
7. Area: _____ square units	
8. Area: _____ square units	
9. Area: _____ square units	

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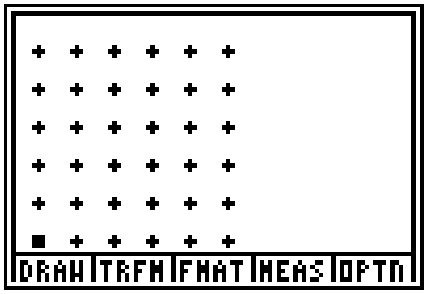
10. On the geoboard below, draw a triangle with the greatest area possible.



11. List any set of congruent triangles from the problems above.

_____

_____

_____

12. Use your geoboard to determine the number of square centimeters that a right-triangular pig pen would have if the distance between each steel fence post on the boundary is 90 cm. There are three fence posts placed horizontally and six fence posts placed vertically. Draw a picture and show your work.

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② The area is 2.5 square units 	② There are 2 congruent sides 
② The shape is a triangle 	② There are 2 congruent angles 
❷ There is 1 right angle 	❷ None of the sides is horizontal or vertical 

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Teacher Notes

Activity 2

Surround and Be Found! Triangular Areas, That is!

Objective

- To use Geoboard to find areas of triangles using the surrounding rectangle technique

NCTM Standards

- Select and apply techniques and tools to accurately find…area…to appropriate levels of precision
- Develop and use formulas to determine…the area of triangles

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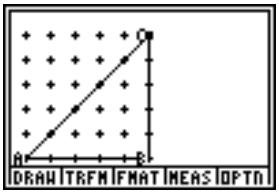
Investigation

The surrounding rectangle is a powerful technique that provides a method for indirectly finding the area of many shapes, including most triangles. The triangle's vertices are points on the surrounding rectangle. When using the surrounding rectangle to find the area of a triangle, students need to subtract the area of one, two, or three right triangles, and occasionally a rectangle or square.

Answers to Student Activity pages

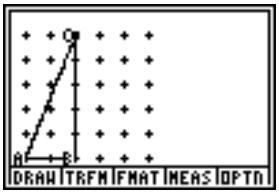
1. 0.5
2. 5
3. 2
4. 4
5. 3
6. 0.5
7. 2.5
8. 2
9. 1.5

10. Since the area of the greatest surrounding rectangle is 25 square units, the area of the greatest triangle would be 12.5 square units.



11. Problems 3 and 8 are congruent triangles because they are the same shape and the same size. Problems 1 and 6 have equal areas but are not the same shape.

12. If you surround Triangle ABC with a rectangle, the rectangle is 180 by 450 cm. The area of the surrounding rectangle is 81,000 square centimeters. Therefore, the area of the triangular pig pen is one-half of 81,000, or 40,500 square centimeters.



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Group Problem Solving: The area of rectangles

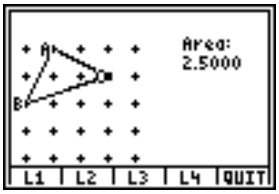
The Group Problem Solving cards are challenge problems that can be used alone or with the individual sections of this book. The problems are designed to be used in groups of four (five or six in a group are possibilities using the additional cards) with each person having one of the first four clues. Students can read the information on their cards to others in the group but all should keep their own cards and not let one person take all the cards and do the work.

The numbers at the top of the cards indicate the lesson with which the card set is associated. The fifth and sixth clues (the optional clues) have the lesson number shown in a black circle.

The group problems can be solved using the first four clues. The fifth and sixth clues can be used as checks for the group's solution or they can be used as additional clues if a group gets stuck. Some problems have more than one solution. Any shape that fits all the clues should be accepted as correct.

With a little experience, students should be able to design their own group problems. They could then switch problems with other groups for additional problem solving practice.

One solution for this problem solving exercise:



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