EXPLORATIONS

Activity 5

Objective

- To use Geoboard to determine the area of shapes (polygons) by dissection

Materials

- TI-73
- Student Activity pages (pp. 54 – 59)

Cross-Fencing Pastures

In this activity you will

- Review finding areas by counting squares, using surrounding rectangles, using formulas, and using the TI-73.
- Find the area of shapes by dissecting them into parts that are squares, rectangles, and triangles.

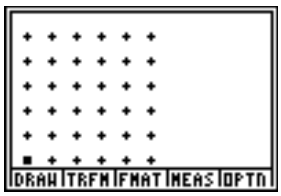
Introduction

Dissection is used to break down larger shapes, whose area is difficult to find, into smaller shapes with easier-to-find areas. The sum of these smaller areas will give the total area of the original shape.

Investigation

This investigation will help you find the area of shapes by splitting them into convenient parts whose areas are easy to find.

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



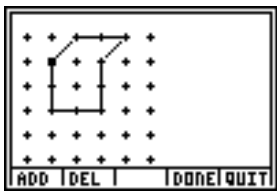
2. To format the geoboard, select **FMAT** and make sure that the following settings are selected:

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

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

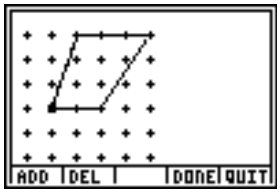
3. On your geoboard, construct the following hexagon and find its area by counting squares and half-squares. Check your answer using your TI-73.

   Your geoboard should look like the screen at the right.



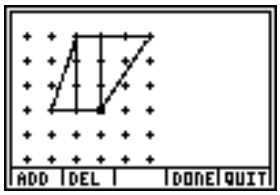
4. For the next shape (a trapezoid), counting squares and half-squares does not work very well because some parts may not be squares or half-squares. Find its area by using a surrounding rectangle. Check your answer using your TI-73.

   Your geoboard should look like the screen at the right.

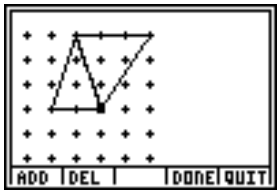


5. Another method for finding the area of this trapezoid is to divide it into shapes whose areas are easy to find. This is called dissection. There are several ways to do this:

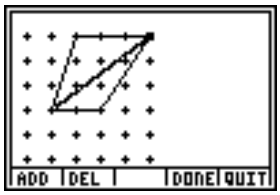
   - Divide the trapezoid into two right triangles and a rectangle. The 3x1 right triangle has area 1.5 square units. The 3x2 right triangle has area 3 square units. The 3x1 rectangle has area 3 square units. This gives a total area of 7.5 square units for the trapezoid.



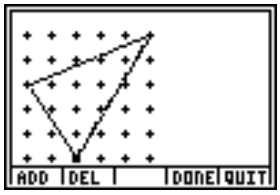
   - Divide the trapezoid into two acute triangles. The lower left triangle has base 2, height 3, and area 3 square units. The upper right triangle has base 3, height 3, and area 4.5 square units. The total area of the trapezoid is 7.5 square units.



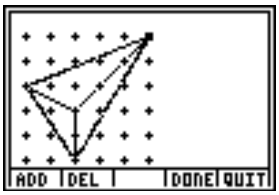
   - Divide the trapezoid into two obtuse triangles. The upper left triangle has base 3, height 3, and area 4.5 square units. The lower right triangle has base 2, height 3, and area 3 square units. This gives a total area of 7.5 square units for the trapezoid.



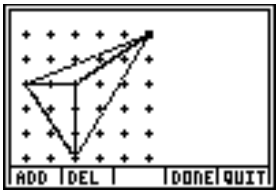
6. It is not easy to find the area of the triangle at the right using the area formula because the base and height are difficult to determine. However, it is possible to dissect this triangle into smaller triangles whose areas can be found by using the formula. Try to find the area of this triangle by using the dissection method.



7. The diagram at the right shows a possible dissection of the triangle. Notice that both of the lower triangles have a vertical base of 2 units, which causes the height of the triangle to be a whole number. This makes it easy to apply the area formula. The lower left triangle has base 2 and height 2 for an area of 2 square units. The lower right triangle has base 2 and height 3 for an area of 3 square units. However, the upper triangle has no horizontal or vertical line segments that we can use as a base, so the area formula cannot be easily applied.



8. Here is a dissection in which each smaller triangle has a horizontal or vertical line segment. The lower left triangle has base 3 and height 2 for an area of 3 square units. The lower right triangle has base 3 and height 3 for an area of 4.5 square units. The upper left triangle has base 2 and height 2 for an area of 2 square units. Combining these smaller areas gives us a total area of 9.5 square units for the original triangle.



Dissection Suggestions:

A large shape can be dissected into smaller, simpler shapes in order to find its area.

1. Whenever possible, dissect the figure into squares, half-squares, rectangles, and right triangles.
2. When dissecting a shape into triangles, try to ensure that every smaller triangle has at least one vertical or horizontal line segment as one of its sides.

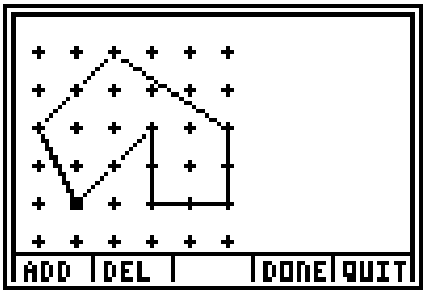
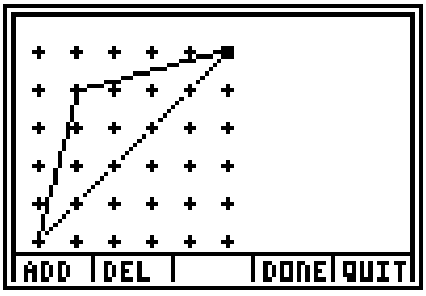
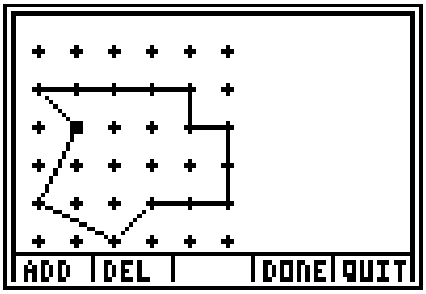
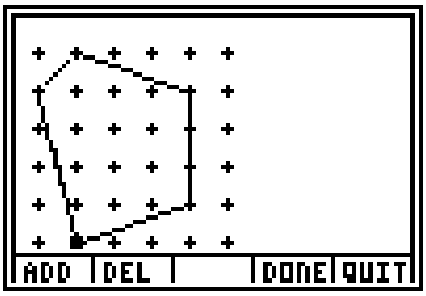
Student Activity

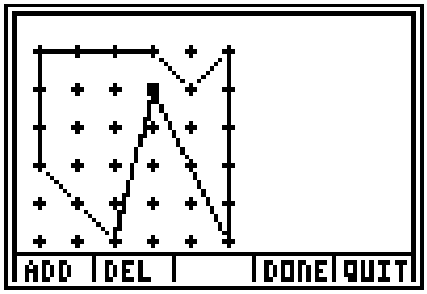
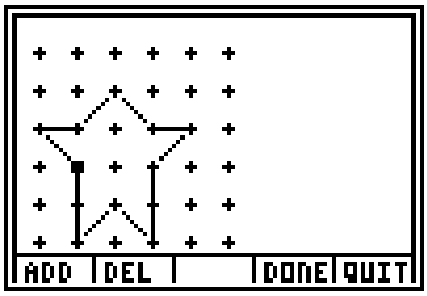
Name _____

Date _____

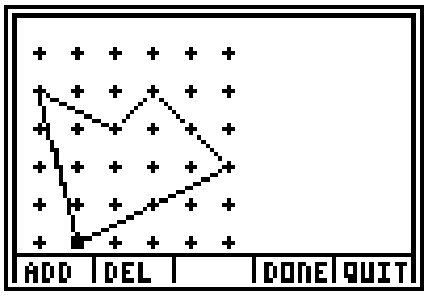
Activity 5.1: Cross-Fencing Pastures

Draw each of the following shapes on your geoboard and find their areas by using the dissection method. Show how you dissected each shape. Check your answers using your TI-73.

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

5. Area: _____ square units	
6. Area: _____ square units	

Show how this pasture could be cross–fenced to easily find the area. Find the total area if the horizontal and vertical distances between posts are 10 feet.

7. Area: _____ square units	

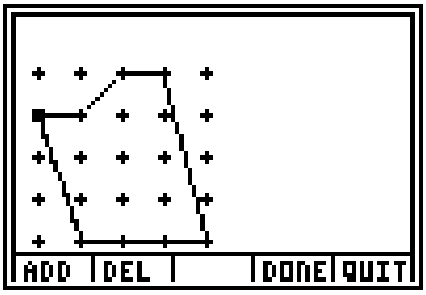
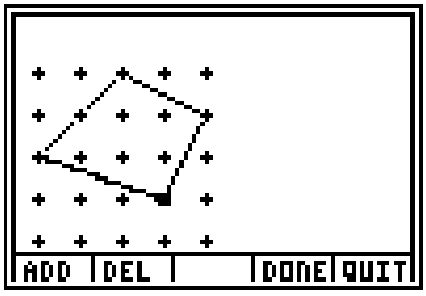
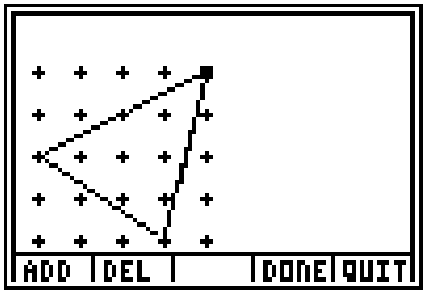
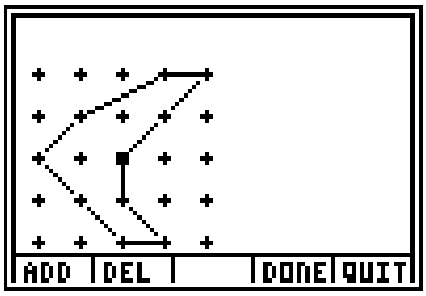
Student Activity

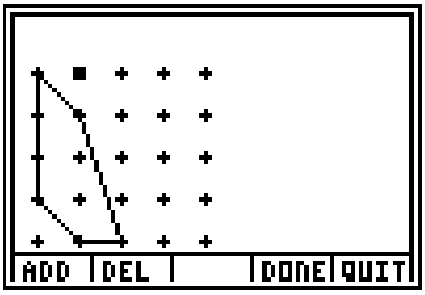
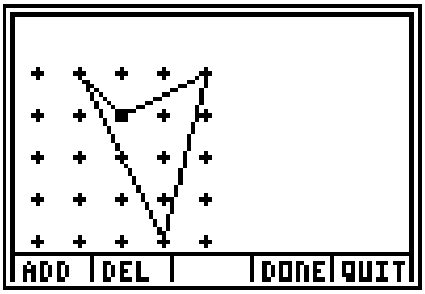
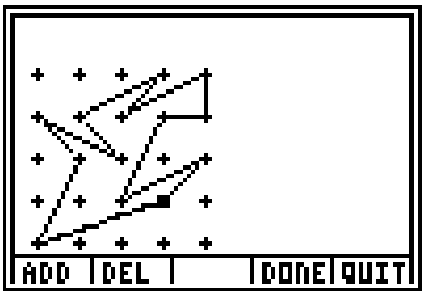
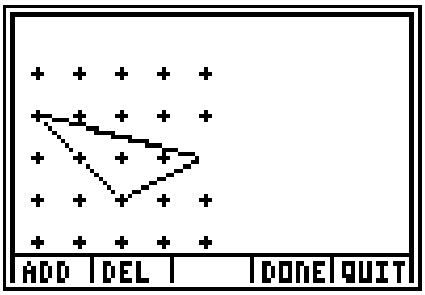
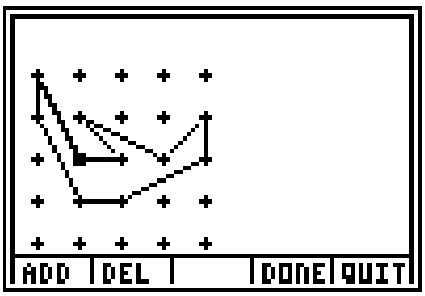
Name _____

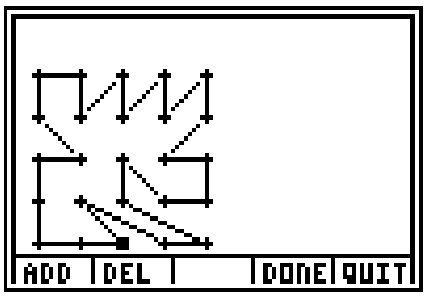
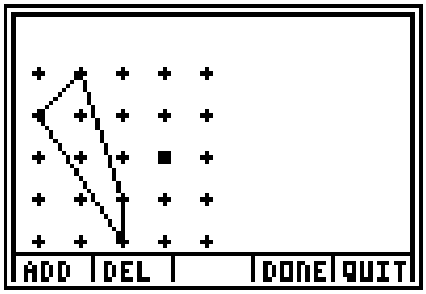
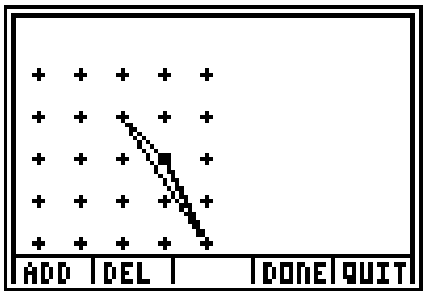
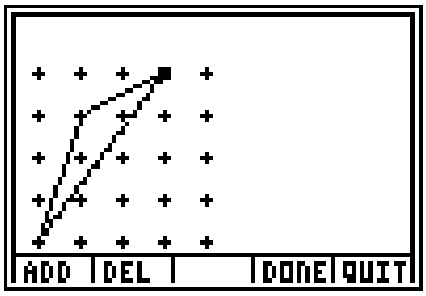
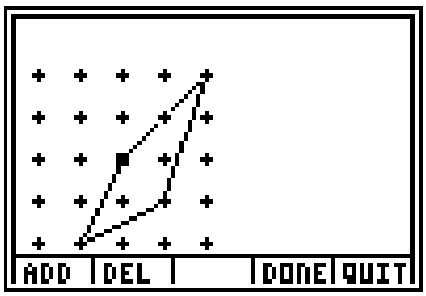
Date _____

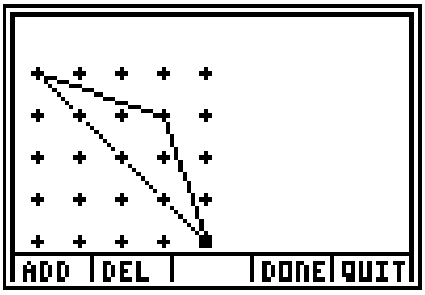
Activity 5.2: Dissecting Shapes

Draw each of the following shapes on your geoboard and find their areas. Use the dissection method when you can. Show each dissection below. Check your answers by using your TI-73.

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

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

10. Area: _____ square units	
11. Area: _____ square units	
12. Area: _____ square units	
13. Area: _____ square units	
14. Area: _____ square units	

15. Area: _____ square units	

⑤ The quadrilateral has 2 pairs of congruent sides 	⑤ There are 4 boundary points 
⑤ The area is 4 square units 	⑤ The shape can be dissected into 4 right triangles 
❺ There are 3 interior points 	❺ The diagonals are perpendicular 

Teacher Notes

Activity 5

Cross-Fencing Pastures

Objective

- To use the geoboard to determine the area of shapes (polygons) by dissection

NCTM Standards

- Select and apply techniques and tools to accurately find…area…to appropriate levels of precision

Investigation

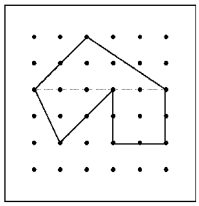
Dissection is an appropriate method to use when formulas or other techniques do not apply or are not convenient. Dissection can be used in conjunction with other methods and strategies. The key to using dissection successfully is ensuring that all of the triangles in the dissection have at least one vertical or horizontal side so that both the base and height of each triangle are whole numbers.

Answers to Student Activity pages

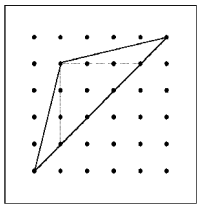
Activity 5.1: Cross-Fencing Pastures

Note: *The answers below represent one possible solution for each question.*

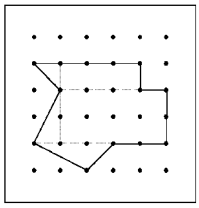
1. 12 square units



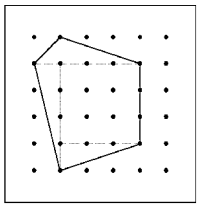
2. 7.5 square units



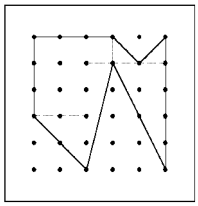
3. 14 square units



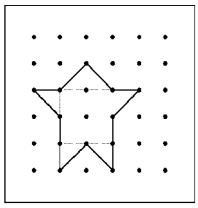
4. 14 square units



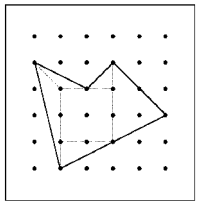
5. 16 square units



6. 7 square units



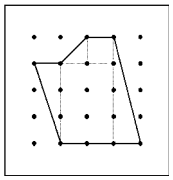
7. 1,050 square feet



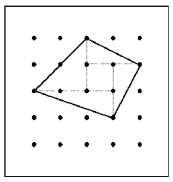
Activity 5.2: Dissecting Shapes

Note: *The answers below represent one possible solution for each question.*

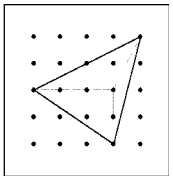
1. 9½ square units



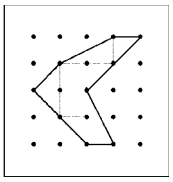
2. 6½ square units



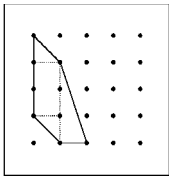
3. 7 square units



4. 6 square units

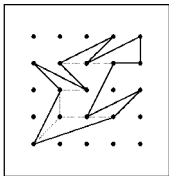


5. 4½ square units

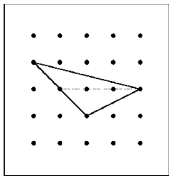


6. 4½ square units

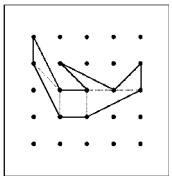
7. 6½ square units



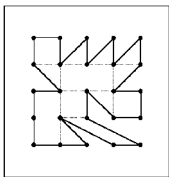
8. 3 square units



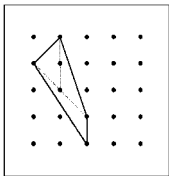
9. 4 square units



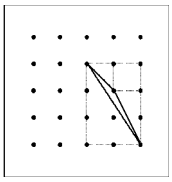
10. 11½ square units



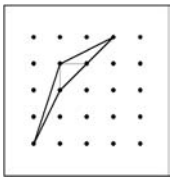
11. 3 square units



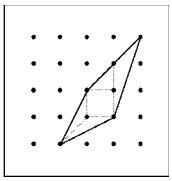
12. ½ square unit



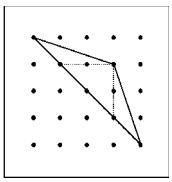
13. 1½ square units



14. 3½ square units



15. 4 square units



Note: *The shape in #12 cannot be dissected, but a surrounding rectangle (with dissection) can be used.*

Group Problem Solving: Dissecting shapes

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: