

# MAKING FOURTHS

- Area
- Congruence
- Fractions

## Getting Ready

### What You'll Need

Geoboards, 1 per child

Rubber bands

Geodot paper, page 90

Overhead Geoboard and/or geodot paper transparency (optional)

## Overview

Children try to find different ways to divide their Geoboards into fourths. In this activity, children have the opportunity to:

- ◆ build mental images of fourths
- ◆ find the area of a variety of shapes
- ◆ realize that shapes with the same area may not look alike
- ◆ learn that fourths of the same whole must have the same area
- ◆ discover that shapes that represent the same fractional part do not have to be congruent



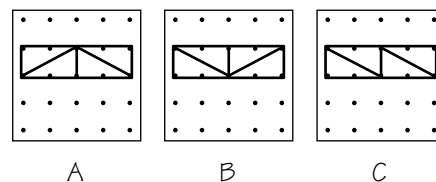
## The Activity

Before children work on this activity, you may want them to do *The Cake Problem* (page 74), in which they are asked to find all the possible ways to divide a Geoboard “cake” into two fair shares.

You may want to provide some experiences with finding area on the Geoboard before doing this lesson. See introductory material.

## Introducing

- ◆ Ask children to talk about what it means to share fairly among four people.
- ◆ Display a one-by-four rectangle on a Geoboard. Ask children to make the same shape on their Geoboards.
- ◆ Invite children to use two or more rubber bands to divide their shape into four equal parts.
- ◆ Have children hold up their Geoboards. Choose a few volunteers to show their fourths to the class. Ask children to consider whether the solutions are different.
- ◆ Use either children’s shapes or the ones shown below to illustrate what “different” means. Let children know that A and B are not different ways to show fourths, but A and C are.



## On Their Own

*How many ways can you show fourths on your Geoboard?*

- Use as many rubber bands as you need to divide your Geoboard into 4 equal parts.
- Do this in as many different ways as you can.
- Record each of your solutions on geodot paper.
- Compare your results with the rest of your group's.
- Be ready to explain why each of your solutions shows fourths.

## The Bigger Picture

### *Thinking and Sharing*

Have a volunteer from one group post one solution and explain his or her reasoning. Ask a volunteer from another group with a different solution do the same. Continue until no one has any more solutions to offer and the class agrees that no duplicates have been posted.

Use prompts such as these to promote class discussion:

- ◆ How did you go about finding your solutions?
- ◆ How did you know that you had found fourths?
- ◆ Do you think the class has found all the possible solutions? Why?
- ◆ What do you notice about fourths?
- ◆ In what way are all the solutions the same?
- ◆ If you chose two pieces, each from a different solution, how would their areas compare? Explain.

### *Writing*

Ask children to choose one solution to describe, and then explain how they discovered it.

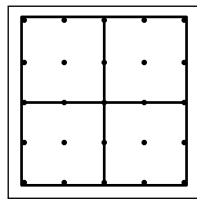
### *Extending the Activity*

1. Challenge children to find all the possible ways to divide their Geoboards into eighths.
2. Have children mark off a three-by-four rectangle on their Geoboards. Then have children find all the possible ways to divide their rectangle into halves, thirds, or fourths.

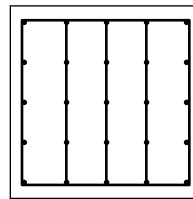
## Where's the Mathematics?

In this activity, children work with fractional parts—fourths, in particular—in a geometric setting that involves the concepts of area and congruence. Although there are many solutions to the activity, it is not necessary for children to find every one.

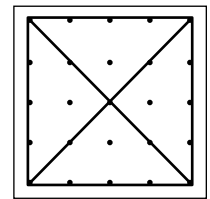
Children are likely to begin their search by dividing their Geoboards in half horizontally and in half again vertically, making four two-by-two squares (D), then go on to make four rectangles, each rectangle one-by-four (E) and four triangles, by connecting opposite corner pegs (F). In D and E, the numbers of squares in each fourth are easy to count and compare. In F, rather than count parts of squares, children may rely on visualization, or make a cutout of one triangle, to convince themselves that they have divided their Geoboard into equal parts.



D

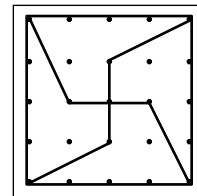
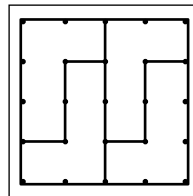


E

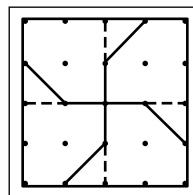


F

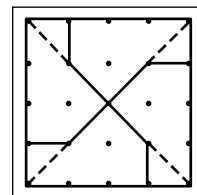
At some point, children usually realize that the dividing lines need not be straight. This results in another set of solutions, such as the ones below.



One system that children may discover is to start with solutions such as D or F and produce new solutions by moving each rubber band one peg in one direction at one end, and one peg in the opposite direction at the other end.



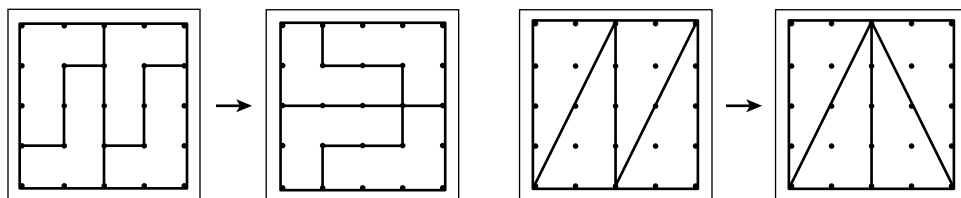
New solution made  
from D



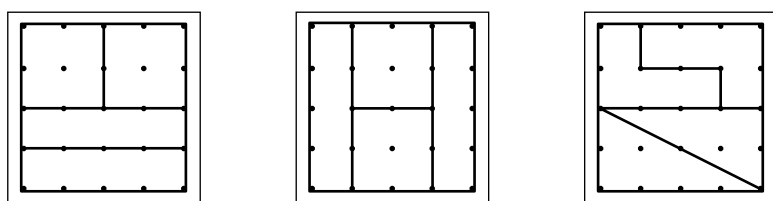
New solution made  
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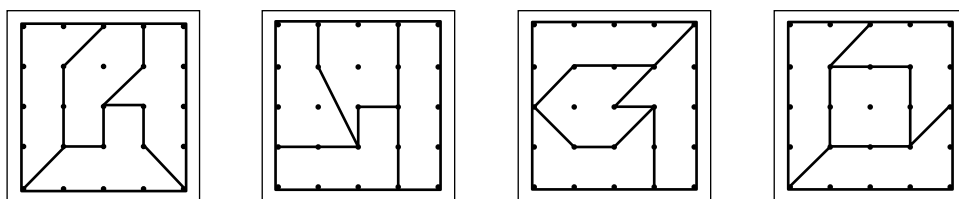
As their search continues, children may see ways to rearrange shapes they have already used to create new solutions.



Children who understand that the fourths need not be congruent may use a combination of shapes from different solutions to create new ones.



They may then realize that as long as each shape has an area of 4 square units, the Geoboard is divided into fourths.



This activity can provide a springboard for children to make the connection between one of the fourths on their Geoboards and its symbolic representation,  $\frac{1}{4}$ . It can also help children in their future studies to understand why  $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = 1$  and not  $\frac{4}{16}$ .