

FINDING SHAPES WITH SYMMETRY

GEOMETRY

- Symmetry
- Congruence
- Transformational geometry

Getting Ready

What You'll Need

Geoboards, 1 per child

Rubber bands

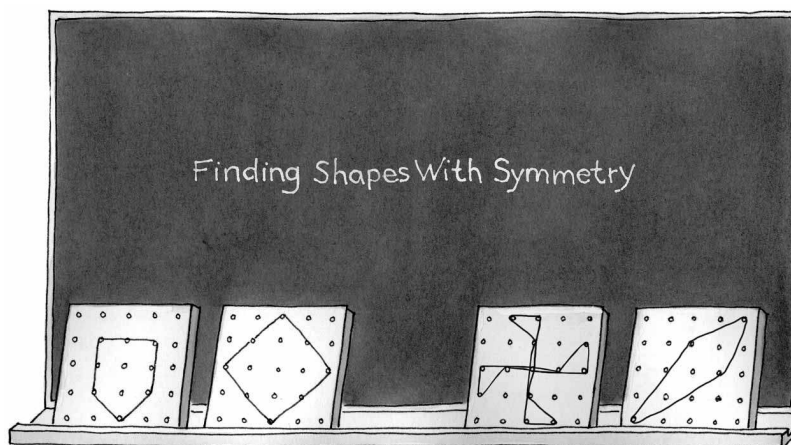
Geodot paper, pages 90–91

Overhead Geoboard and/or geodot paper transparency (optional)

Overview

Children use their Geoboards to create designs that have different types of symmetry. In this activity, children have the opportunity to:

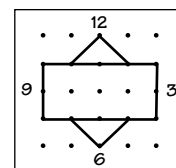
- ♦ discover characteristics of symmetrical designs
- ♦ develop strategies that test for symmetry
- ♦ make designs with rotational symmetry and line symmetry



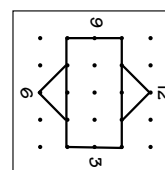
The Activity

Introducing

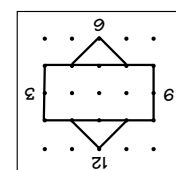
- ♦ Display this design on your Geoboard. Note the four numbers that correspond to a clockface. Copy the design on geodot paper. Fold it to show that it has horizontal and vertical lines of symmetry.



- ♦ Have children make the design on their Geoboards. Ask them to turn the Geoboard design a quarter turn, or 90, and compare the turned figure to the one on display.



a quarter turn



a half turn

- ♦ Repeat the process for a half turn, or 180.
- ♦ Elicit that the displayed design looks identical after a half turn, but not after a quarter turn. Therefore, it has half-turn symmetry but not quarter-turn symmetry.

On Their Own

Can you create Geoboard designs with certain kinds of symmetry?

- Work with a partner to create at least one design for each of these descriptions:
 - ♦ The design has at least one line of symmetry and looks the same after every quarter turn.
 - ♦ The design has no lines of symmetry and looks the same after every quarter turn.
 - ♦ The design has a line of symmetry but no quarter-turn symmetry and no half-turn symmetry.
 - ♦ The design has quarter-turn symmetry but no half-turn symmetry.
- Copy your designs onto geodot paper. If there is no possible design for a description, explain why.
- Be prepared to discuss the different kinds of symmetry in each of your designs.

The Bigger Picture

Thinking and Sharing

Invite children to post some of their designs. Ask volunteers to come up and point out types of symmetry in the various designs. Have children verify that the designs meet the conditions described. If a group believes there are no possible solutions for a part of the problem, have children explain their reasoning.

Use prompts such as these to promote class discussion:

- ♦ How did you go about creating your designs?
- ♦ How did you check for lines of symmetry?
- ♦ How did you check for quarter-turn symmetry?
- ♦ How are turn symmetry and line symmetry alike? How are they different?
- ♦ Describe a strategy for creating a design with only one line of symmetry.
- ♦ Describe a strategy for creating a design with quarter-turn symmetry.

Children can use a mirror to see if a shape has lines of symmetry.

Writing

Have children describe how shapes that have symmetry are different from those that do not have symmetry.

Extending the Activity

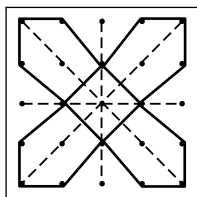
1. Have children work in pairs. Ask one child in each pair to make a Geoboard design that has quarter-turn symmetry. Then ask the other child to modify the design to create a different design that also has quarter-turn symmetry.

Teacher Talk

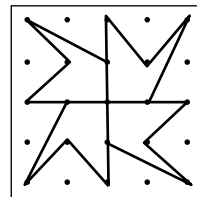
Where's the Mathematics?

Although they may be somewhat familiar with the concept of line symmetry, many children may be unfamiliar with the concept of turn symmetry. To recognize and test for turn symmetry, children may need to turn their Geoboards to see if a rotation of the shape is congruent to the shape in its original orientation. Some children may find it easier to check for turn symmetry by first recording the design in its original orientation on geodot paper and then comparing the rotated Geoboard design to the drawing.

When making designs to fit the first description, children may conclude that any shape that has quarter-turn symmetry must also have line symmetry. The designs they create initially may all have lines of symmetry, reflecting children's previous experiences with symmetric designs. However, in attempting to make a design to fit the second description, some children may come to realize that a shape can have quarter-turn symmetry without also having line symmetry. The examples below show designs that have quarter-turn symmetry, one with line symmetry, and one without.



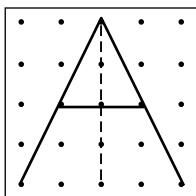
quarter-turn symmetry
4 lines of symmetry



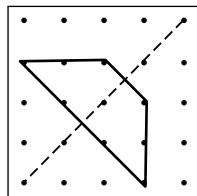
quarter-turn symmetry
no lines of symmetry

To make a design that fits the third description (line symmetry but no turn symmetry), children will need to be sure that the design has only one line of symmetry. Children may find that many simple shapes and letters of the alphabet meet this requirement.

2. Ask each child to make a symmetrical Geoboard design that he or she finds pleasing. Have children copy their designs onto geodot paper and color them to show symmetry.
3. Invite children to create their own Geoboard designs that involve line symmetry and/or turn symmetry. Then ask them to write a description of their designs. Have children exchange descriptions and find designs that fit the descriptions.



1 line of symmetry
no turn symmetry



1 line of symmetry
no turn symmetry

As they make shapes and check for turn symmetry, children see that shapes that look the same when turned a quarter of the way around will also look the same when turned halfway around. Based on this experience, children should discover that there is no design that fits the fourth description (quarter-turn symmetry, but no half-turn symmetry).

Children may begin to recognize the characteristics of symmetric designs, but may or may not be able to verbalize their generalizations. Their ability to make successive designs that have certain kinds of symmetry is evidence that they understand the nature of these characteristics.

Working with line and turn symmetry provides children with a foundation for dealing with future studies in transformational geometry, where children will encounter reflections and rotations of geometric shapes in a plane.