

# GEOMETRY PLAYGROUND

Activities | Grades 6–8

[www.exploratorium.edu/geometryplayground/activities](http://www.exploratorium.edu/geometryplayground/activities)

## BEYOND DOMINOES: POLYOMINOES

### Background: What are polyominoes?

Everyone knows what dominoes look like. They're rectangular tiles made of two squares joined together at one edge. If you start adding more squares on to a domino, you'll be making *polyominoes*. Polyomino is the general term for a shape made out of many squares.

The more squares you use, the more different kinds of polyominoes you can make. In fact, mathematicians haven't yet figured out a formula to tell how many polyominoes you can make from a given number of squares.

### Exploring Polyominoes

[45 minutes or longer]

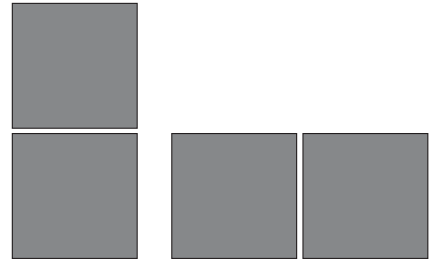
#### Materials:

- 1" Square Grid (included) printed on cardstock (two sheets per person)
- Scissors
- Paper
- Pencil
- Tape

#### Try This:

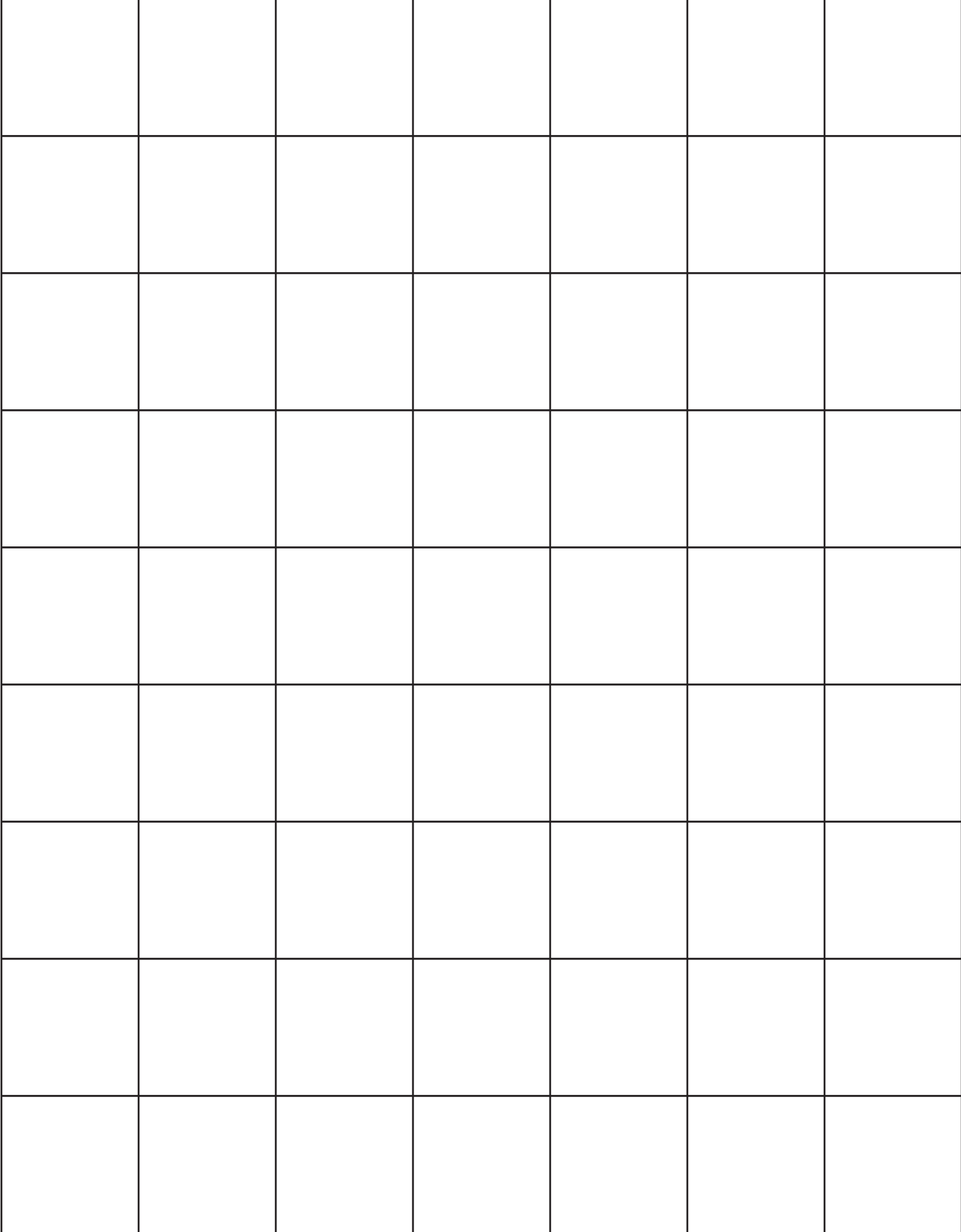
Step 1 Cut out six one-inch squares. Two squares put together make a domino. How many ways can you arrange two squares to create dominoes? The squares must touch along one entire edge, corners touching other corners. Cut out one domino.

Step 2 By rotating the horizontal domino, you can see that it is identical to the vertical domino. The rule for polyominoes—shapes made of squares—is that if two shapes can fit on top of one another, either by rotation or reflection, they are not unique. Therefore there is only one domino. What is its perimeter and area?



- Step 3 How many ways can you arrange three squares to create what are called *trominoes*? (Tri- means three, like in the word triangle, and tri + omino = tromino.) Cut out each unique tromino from the grid paper. Check that your trominoes are unique by rotating them and flipping them over (rotation and reflection). You should find two trominoes. What are their perimeters and areas?
- Step 4 How many ways can you arrange four squares, creating *tetrominoes*? (Tetra- means four, and tetra + omino = tetromino.) Cut out each unique tetromino from the grid paper as you find it. Try to conserve paper as you cut. If you have played the video game Tetris, these shapes may look familiar.
- Step 5 Check that your tetrominoes are unique using rotation (turning them around) and reflection (flipping them over.) How do you know you have found them all? Can you think of a strategy to make sure you've found all the tetrominoes?
- Step 6 When you think you have found all the tetrominoes, check with others to see how many they have found. (There are five.) Share strategies for finding all the tetrominoes. What are their perimeters and areas?
- Step 7 How many ways can you arrange five squares, creating *pentominoes*? (Penta- here means five, like in the word pentagon, and penta + omino = pentomino.) Cut out each unique pentomino from the grid paper as you find it. Try to conserve paper as you cut. Using rotation and reflection, check to make sure your pentominoes are unique. How do you know you have found them all? Can you think of a way to prove that you have found all the possible pentominoes?
- Step 8 When you think you have found all the pentominoes, check with others to see how many they have found. (There are twelve.) Share strategies for finding all the pentominoes. What are their perimeters and areas?
- Step 9 After you have found all the pentominoes, think about which ones can be folded into cube-shaped boxes that are open on one side. Separate your pentominoes into two piles, those that you think will make a box and those that you think will not. Compare your piles with those of others. After you are satisfied with your decisions, fold your pentominoes into boxes.

# 1" Square Grid



## BEYOND DOMINOES: POLYOMINOES

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships:

- Precisely describe, classify, and understand relationships among types of two- and three-dimensional objects using their defining properties.

Apply transformations and use symmetry to analyze mathematical situations:

- Describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling;
- Examine the congruence, similarity, and line or rotational symmetry of objects using transformations.

Apply appropriate techniques, tools, and formulas to determine measurements:

- select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision.