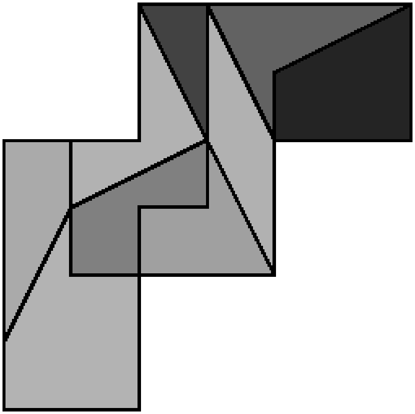
For 1 or 2 players
Age 10 to adult

SHARDINAIRES-9™

An original dissection/transformation puzzle by George Sicherman



Pentomino constructions
Tetromino constructions
Symmetrical shapes
Convex polygons
Fancy designs
A game for 2

A product of
Kadon Enterprises, Inc.

SHARDINAIRES-9 *is a trademark of Kadon Enterprises, Inc., for its set of 9 tiles, no two alike, invented by George Sicherman and produced under license. The tiles are a dissection of squares that can be rearranged into dozens of different polyomino-related shapes plus many other free-form figures.*

Contents

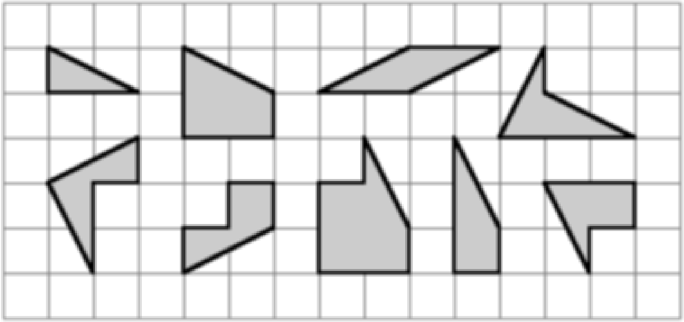
About George Sicherman:

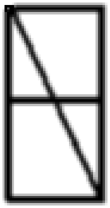
George Sicherman is a retired computer programmer. Originally from Buffalo, he now lives in New Jersey. He loves recreational mathematics and often studies it with the help of his programming skills. George's best-known invention is Sicherman Dice, designed in 1977. He maintains a large website,

https://userpages.monmouth.com/~colonel/polycur.html

about polyforms, and sometimes designs puzzles based on his research. On occasion he analyzes problems for Kate Jones and other mathematics enthusiasts.

The nine Shardinaires-9 tiles

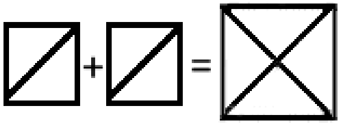




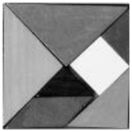
Although the tiles look like a random collection of “shards”, notice how they actually consist of squares and triangles, giving them an even area of 1, 2, 3, and 4 squares. The triangles are cut off from a square at an angle that divides them into one-fourth and three-fourths of a square (see figure at left). There is one triangle of size 1 square; six are 2 squares in size; and there is one each of size 3 and 4. The total area of the set is 20 squares. Therefore we can form pentominoes (shapes made of 5 squares) with each of their squares made of a 2x2 area. We can also form tetrominoes (shapes made of 4 squares) by assigning the equivalent of 5 squares of area, in their various segmented parts, to the four parts of each tetromino.

There are 12 distinct shapes of pentominoes and 5 tetrominoes, for a total of 36 different size variations shown on the following pages. It’s a good idea to record your solutions for future reference. A few of the shapes easily convert into others. Then solve the other figures and create your own original designs.

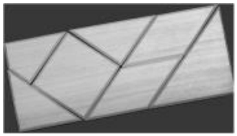
A bit of history



Shardinaires-9 is a member of a class of recreational mathematics known as “dissection puzzles”. Such puzzles in a great variety of shapes have been enjoyed in many countries for centuries. The earliest dates back to Plato (427-347 BC) in ancient Greece, involving the challenge of turning two equal squares into one larger square with four pieces.

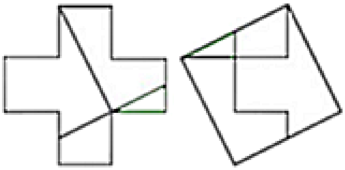


A notable relative is *tangrams*, invented in China in the 1700s and popularized throughout the world. Tangrams are used in schools, for art and math, with thousands of designs to build with their 7 pieces.

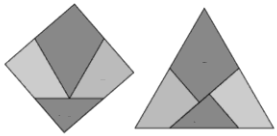


F. A. Richter company in Germany published a series of dissection puzzles in the late 1800s. Kadon makes one of their 7-piece puzzles under the name of Grand Tans (a play on the word *tangrams*). Its basic shape is a rectangle the size of two joined squares. Its proportions differ from tangrams in having two rhombuses instead of tangrams’ parallelogram, and having a “kite” shape, a triangle with a corner cut off. See www.gamepuzzles.com/prpuzzl2.htm#GB.

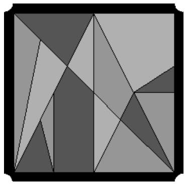
Kadon then introduced three small 4-piece puzzles, named *Tiny Tans*, in the shape of a T, a U, and a Square. Each little puzzle has 4 parts and includes a repertoire of all possible symmetrical figures the pieces can form. For their 25th anniversary, a special edition of all three as a single ensemble was released: *Trio in a Tray*, an octagon with endless shapes to make. See www.gamepuzzles.com/prpuzzl2.htm#TY.



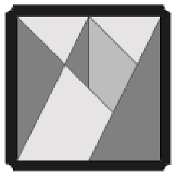
One of the most famous American puzzle designers, Sam Loyd (1841-1911), showed a way to dissect a Greek Cross into just four pieces that could also form a square.



Another world-famous puzzle creator was the Englishman, Henry Ernest Dudeney (1857-1930). He found a way to dissect a square into four parts to form an equilateral triangle. Dudeney's work inspired much research of dissecting geometric shapes into the minimum number of pieces that would transform into another, or even be hinged as the pieces rotate to form the other shape.



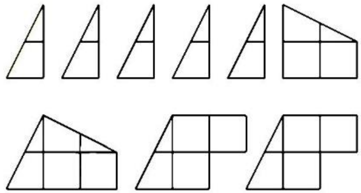
A famous ancient Greek dissection puzzle is Archimedes' Square, the *Stomachion* or *Ostomachion*, attributed to Archimedes, c. 287–212 BC. Its most recent incarnation is published by Kadon with the addition of three colors and a full solution count. See www.gamepuzzles.com/histfun.htm#AS.



In 2012, Serhiy Grabarchuk, the renowned Ukrainian/American puzzle designer, created *Tangramion*, a cross between Archimedes' Square and Tangrams. Published by Kadon, its seven pieces start as a square and transform into dozens of other convex, symmetrical, and fanciful figures. See www.gamepuzzles.com/tiling3.htm#TGM.

Interest in dissection puzzles has continued to increase among mathematicians and puzzle designers, and their popularity among the public is well established. A fine compendium by Greg Frederickson, *Dissections: Plane and Fancy*, was published in 1997 by Cambridge University Press.

Since Loyd's Greek Cross transformation into a square with just four pieces is actually a case of forming a pentomino (5 unit squares in size, with 12 shapes), and a tetromino (4 unit squares in size, with 5 shapes), puzzle explorer Donald Bell pursued a dissection problem of identifying a minimum number of pieces that could form all 12 pentominoes plus all 5 tetrominoes. There were a number of different 8- and 9-piece dissections that Donald presented at the 2018 Gathering for Gardner in Atlanta. He reported on the solution (at right) developed by a group at the Politecnico di Torino, led by Livio Zucca.



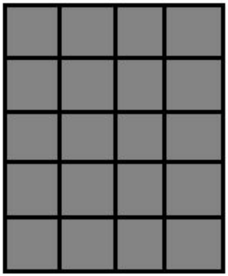
The many identical triangles worked, but were not as satisfactory as a set of all different shapes would be. Donald then, with help of a computer program, identified a group of 10 pieces that were all different, plus several groups of 9 and one group of 8 pieces that also worked, but had repeated shapes of tiles. Donald eventually found 9 all different tiles, including one rectangle.

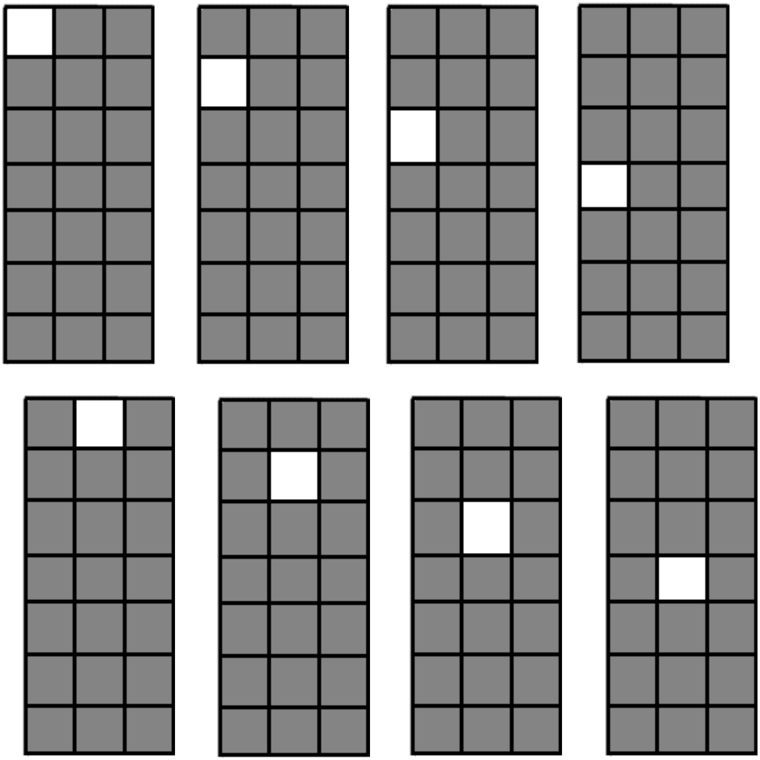
All these activities inspired George Sicherman, a life-long puzzle creator, to work out the 9-piece combination that solves all 17 target shapes plus many others, and has all different angular tiles and no rectangle. A peak design achievement!

We proudly present that set and its many challenges here as Kadon's *Shardinaires-9* set. Happy puzzling!

Rectangles

White squares are empty spaces.



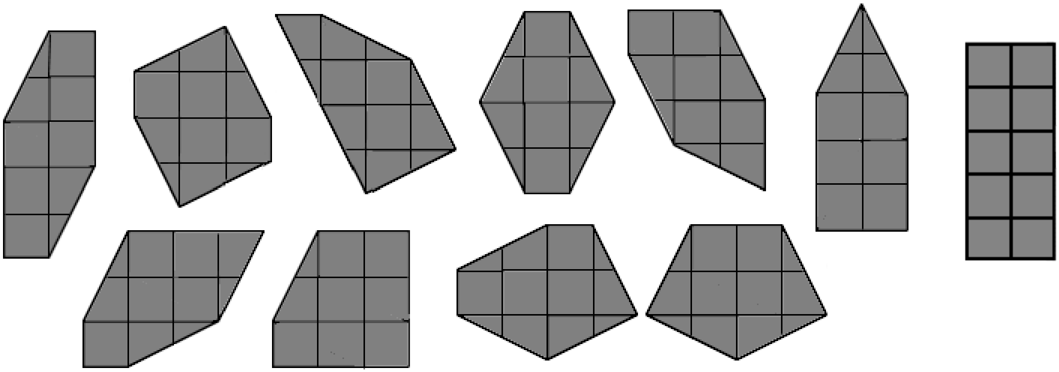


See how this rectangle is tilted on the square grid! It is not the same dimensions as the 4x5 rectangle above although it has the same exact area.

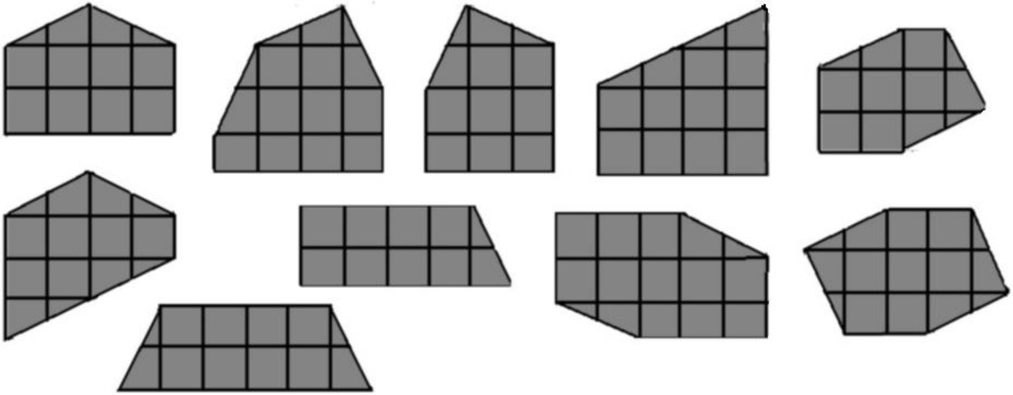
Convex polygons

Some are even symmetrical. Warm up with these small ones:

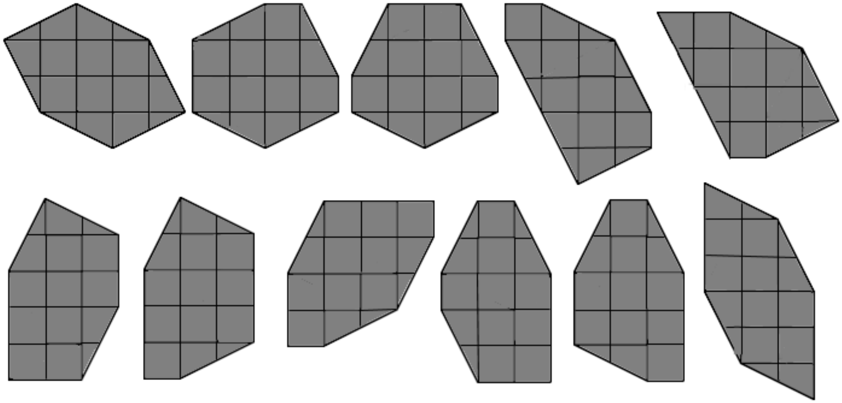
Use four pieces:



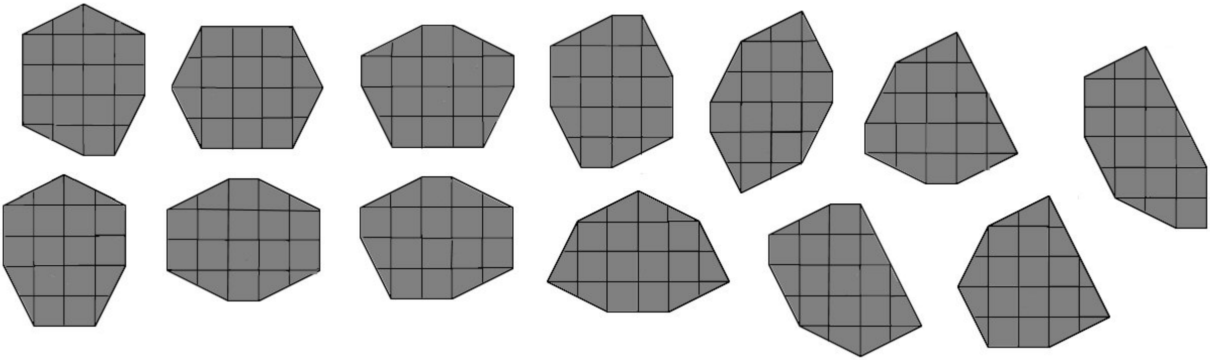
Use five pieces:



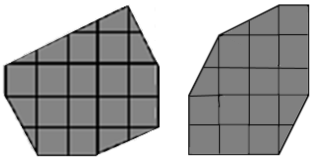
Use 6 pieces:



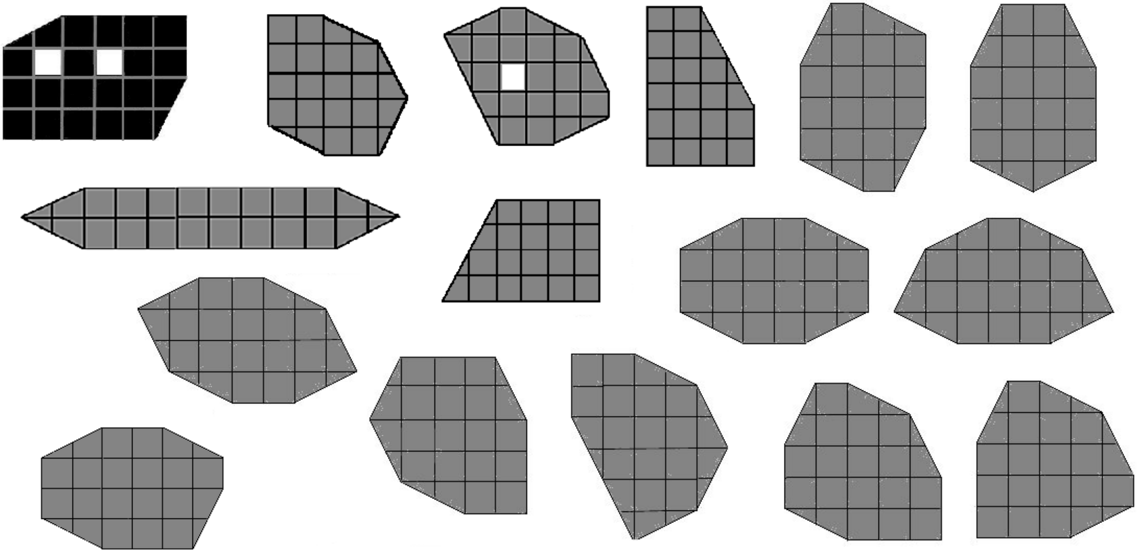
Use 7 pieces:



Use 8 pieces:

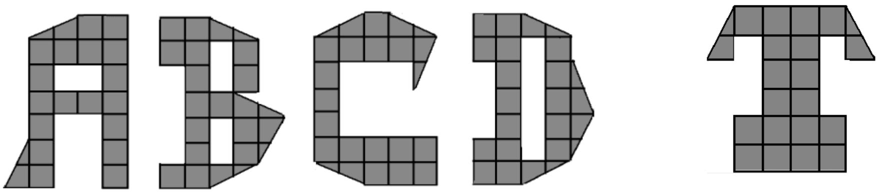


Here are some full-set convex polygons, some with holes. Can you find others?



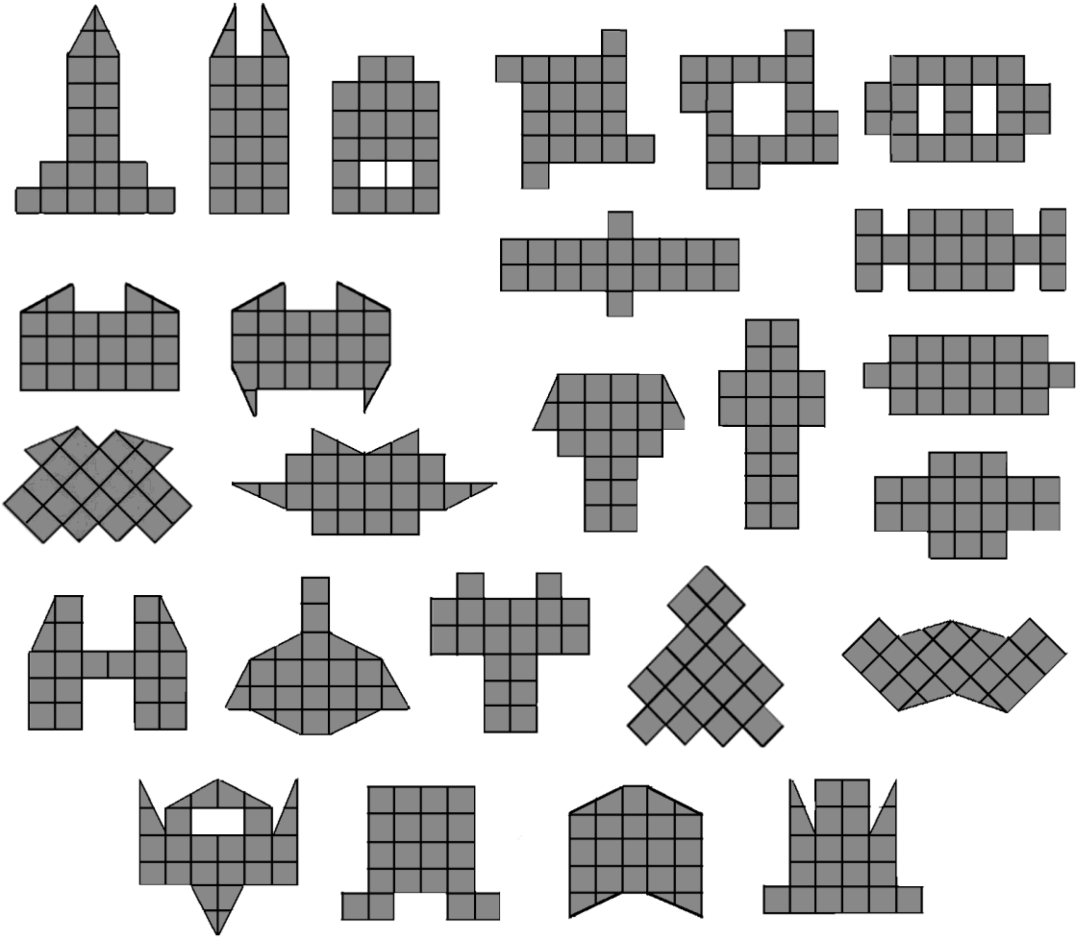
These figures range from 4 to 8 edges of perimeter.

Alphabet. A neat idea is to form letters of the alphabet. We start with ABCD and a T. Designing and solving the remaining letters is your challenge. Send us your best designs, to kadon@gamepuzzles.com, and you may win a prize.



Fancy designs and symmetries

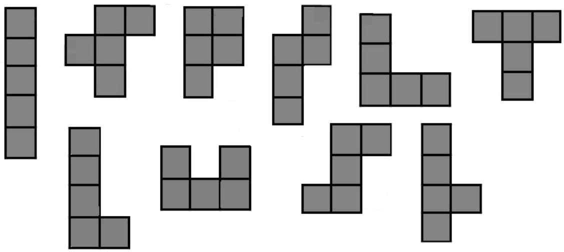
How many others can you find? See also page 14 and back page.



Polyomino constructions

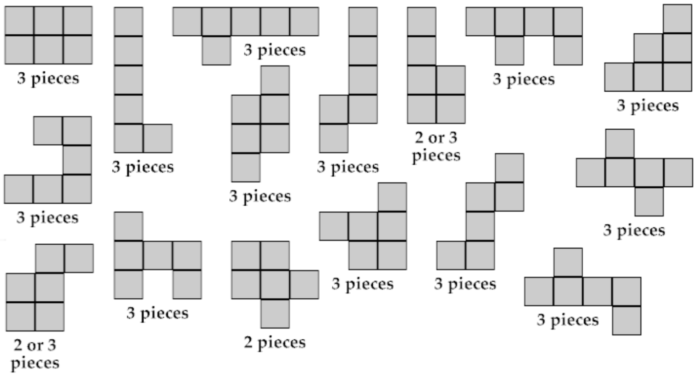
Scaled-down pentominoes

There are 12 pentomino shapes (5 squares each). We can form 10 of them, as shown below, using just a few of the Shardinaires-9 tiles. How many or few tiles does it take to form each one?



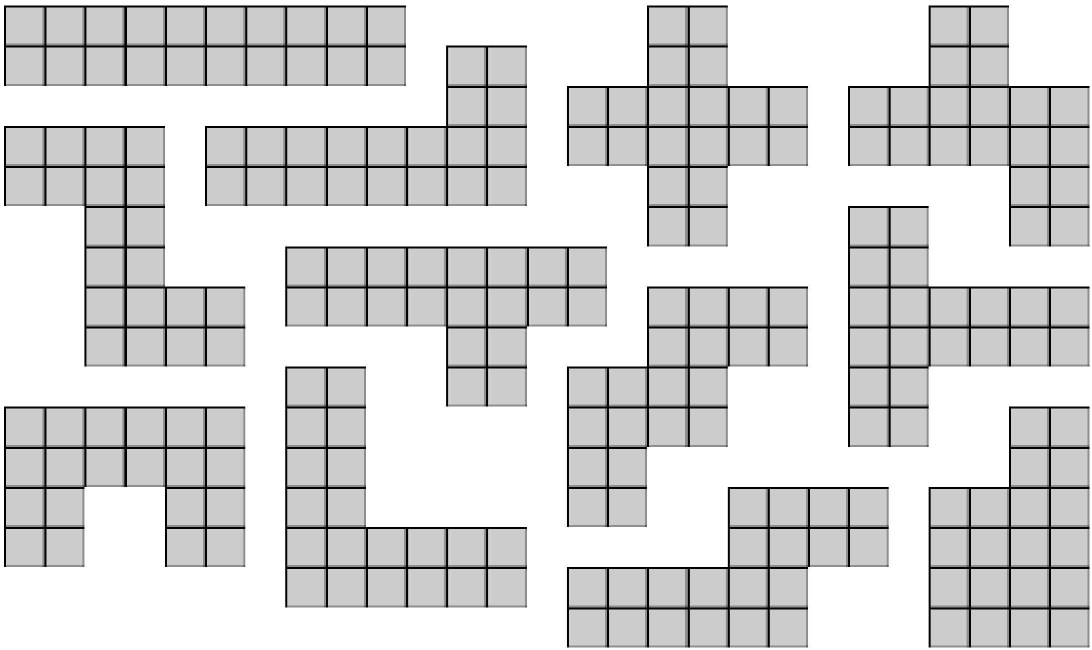
Scaled-down hexominoes

There are 35 hexomino shapes (6 squares each). We can model 16 of them using just a few of the Shardinaires-9 tiles. Shown here are the 16 solvable hexominoes, together with how many pieces each takes.



Full-scale pentominoes

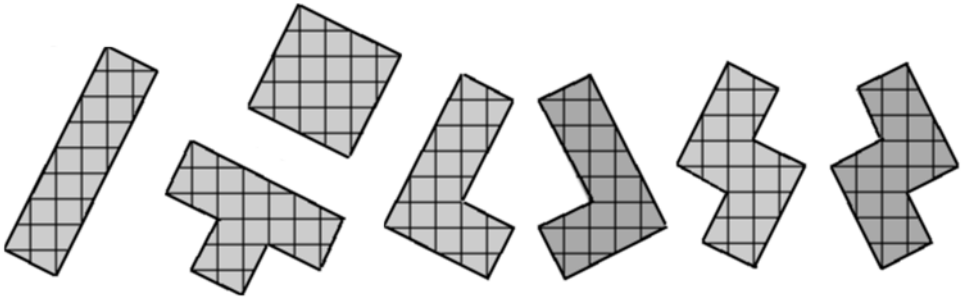
These are the main goal for which this set of pieces was invented. How the angles on the tiles adjoin within the squares of the grid is for the puzzler to discover. One hint is that the squares will always line up precisely with the grid lines, and the diagonal edges join the opposite corners of two adjacent squares, like the sample on page 3.



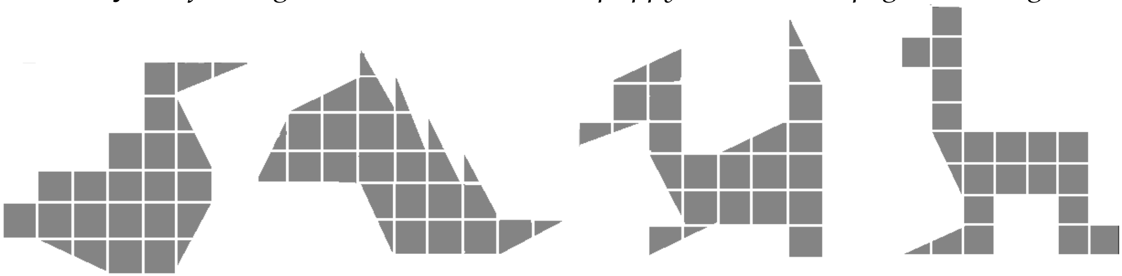
See dozens of other pentomino-related games and puzzles on the Kadon website, www.gamepuzzles.com/polycube.htm.

Full-scale tetrominoes

To fill a four-square area with the same set of pieces that can form five squares, it's necessary to turn the pieces so that the sides of the tetromino squares are formed by the hypotenuse of the triangles we get by connecting opposite corners of two adjacent squares. We include the mirror images of the two non-symmetrical tetrominoes.



Artistry—*Left to right: Duck, horse's head, puppy, llama. Back page: Running man.*



Create your own without end! Send us your best: kadon@gamepuzzles.com

Touch and Go

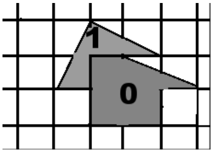
A positional game for 2 players

Start: Take turns choosing pieces until both players have four. Place the 9th one as a starter piece on the play area.

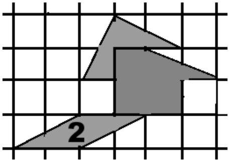
Goal: To score points on each turn for perimeter edges. Highest score wins.

Play: Take turns placing a piece from your hand against a piece on the table, matching unit lengths of sides to stay in the grid. After each move, the player scores the number of edges of the figure formed. Here are some sample moves:

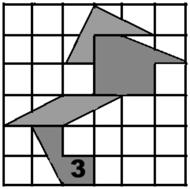
Piece 1, 9 points



Piece 2, 13 points

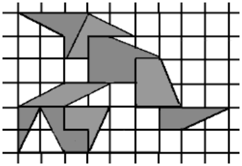


Piece 3, 18 points

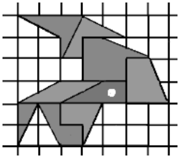


Once all pieces have been joined, take turns repositioning one piece and score the number by which the previous edge count has been *reduced*. Sample moves:

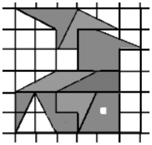
Last edge count, 25



Move white-dot piece, new count 17 (score 8)



Move dotted piece, new count 16, score 1



If not reduced, score 0 for that turn. Do not disconnect any part of the array. Game ends when each player has had four repositioning turns. High score wins.

SHARDINAIRES-9™

from Kadon

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