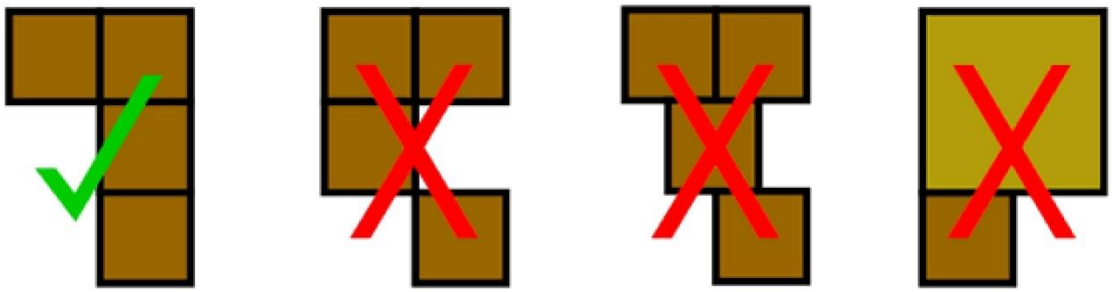
Babushka Squares

A Babushka family of Ukrainian descent is celebrating the birth of a new baby girl. Like good Babushka families everywhere, they celebrate by snuggling into one another.

Baby *Oly* jumps into her little sister, *Poly*, then *Poly* jumps into her teenage sister, *Polyo*, then *Polyo* jumps into her mother, *Polyomina*, and finally *Polyomina* jumps into the father, *Polyomino.*

Polyomino, Polyomina, Polyo, Poly, and little Oly

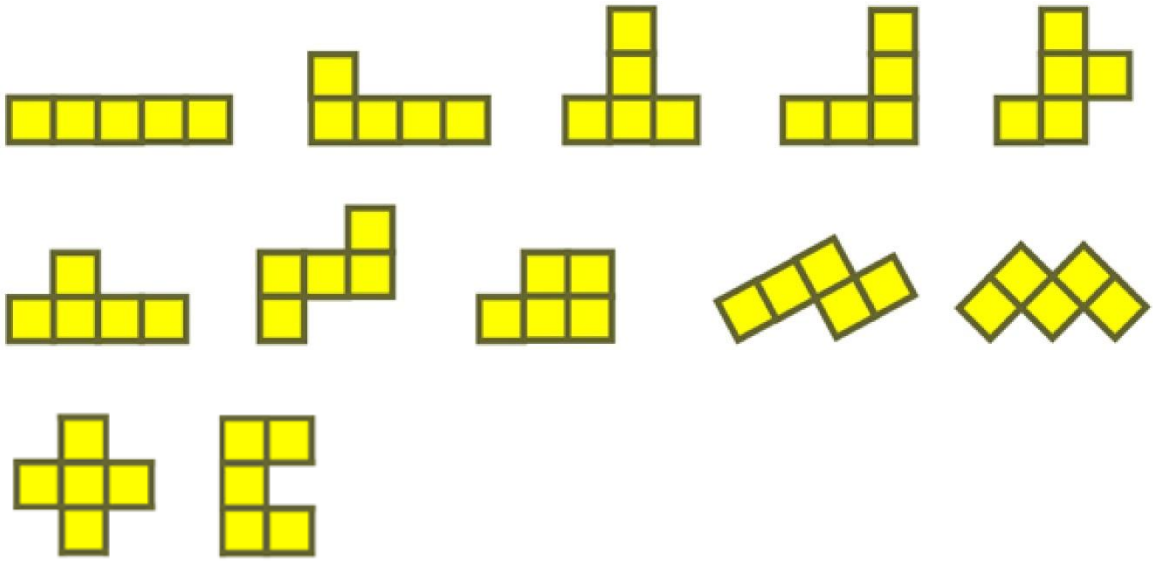
Poly loves to play games with her family. One of Poly's most popular is *Babushka squares*. In this game, a bunch of squares are glued together along their edges like this:



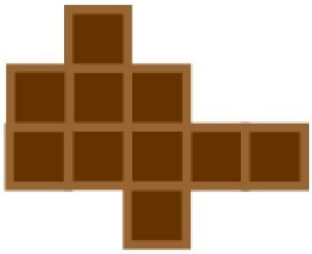
The figures in the middle are not correct because some squares are not glued together along a full edge. The figure on the right is not correct because the squares are not the same size.

When a few shapes have been created, Poly puts the glue away, and the adult Babushkas create a wooden carrying case that can contain any of Poly's shapes. But not just any case will do, the adults must make the case as small as possible. An example follows:

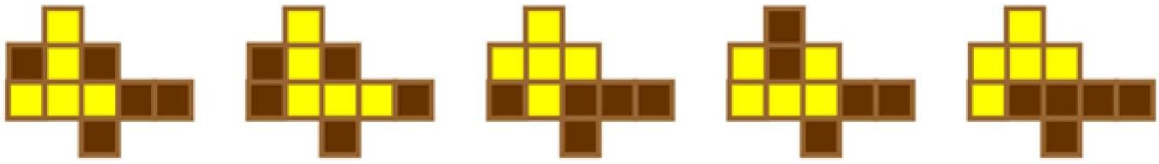
Poly glued 5 squares in 12 different ways and asked the adults to build a wooden carrying case to carry them:



After a week, the older Babushkas presented Poly with this wooden container:



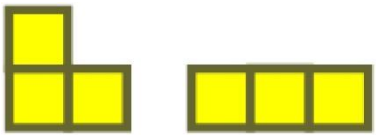
Poly tested it by placing some of her shapes inside...



Can you find another wooden container of the same size that would hold Poly's 12 shapes?

Extensions:

Poly next cut out these two shapes:



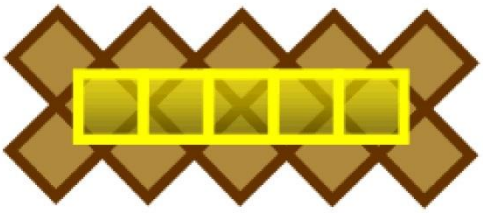
Her parents looked very happy. Poly then said to her teenage sister, "I want you to build all the wooden containers to hold these two beautiful shapes." Then Poly turned to her mother and said, "I want you to build all of the wooden containers that can hold my teenage sister's containers." Then Poly turned to her Father and said, "I want you to build a container that will hold all of mother's containers."

Poly's parent's scratched their heads.

Hint: A month later the father had made a 7-square container, the mother had made four 5-square containers, and the teenage daughter had made two 4-square containers.

Develop an analogous set of questions for the one dimensional case.

For Babushka squares, assume that the squares forming each object superimpose on the squares making up a container... so the following is not acceptable:



Explore what happens if you do allow this type of container?

The Math in This Problem:

A polyomino is a geometric shape, made from any number of squares joined by their edges. In this investigation, we work with pentominoes, five squares, and triominoes, 3 squares, where we study the unique shapes from constructing them in all different ways. Students can observe and comprehend the concepts of reflections and rotations by manipulating the various polyominoes.