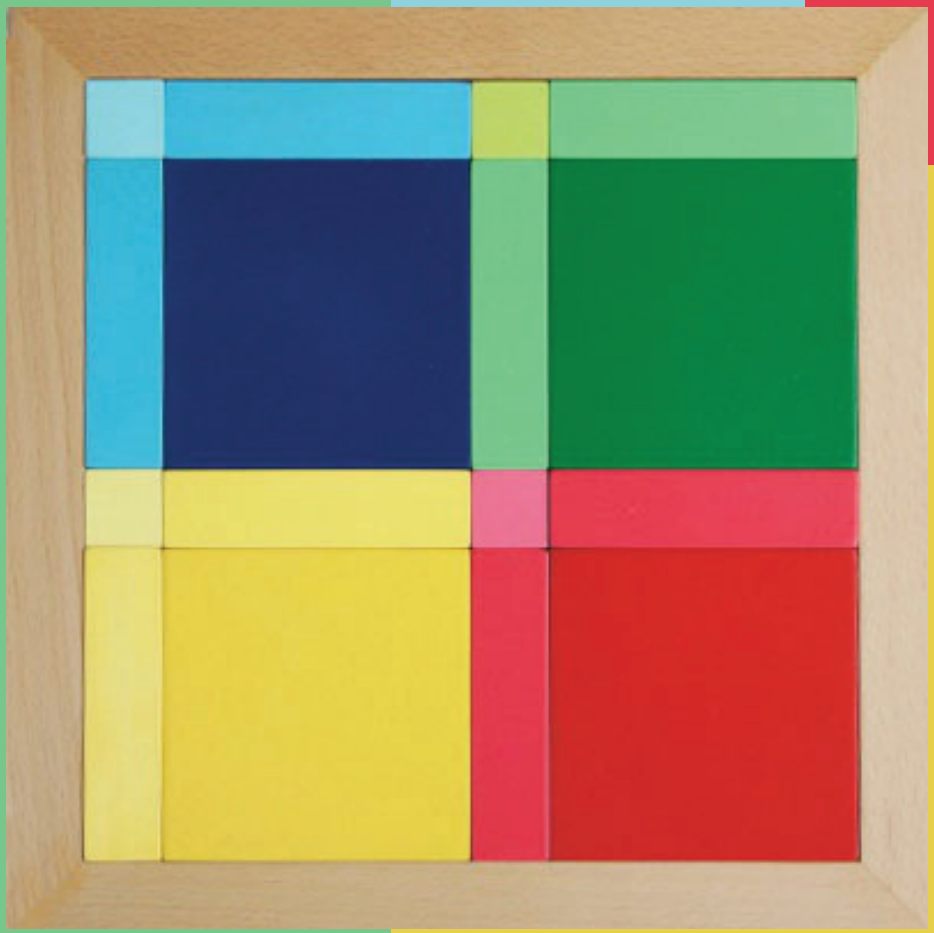

Teaching with the Binomial Squares Puzzle

WARNING
CHOKING HAZARD: Small Parts
Not for children under three years.
For ages 3 +

Made in Vietnam

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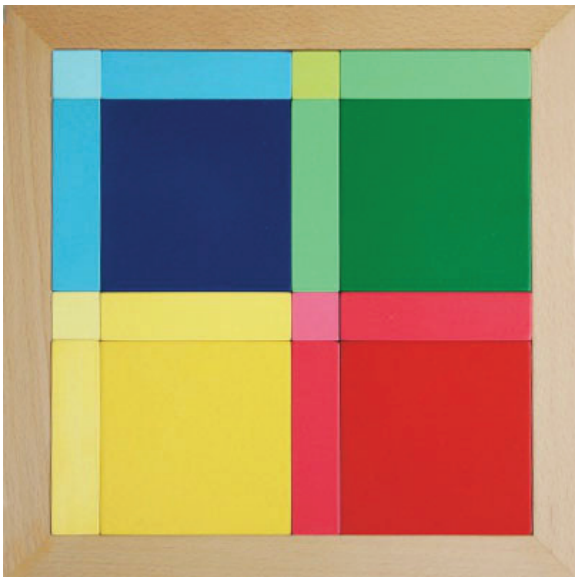
Directions for Teaching with the Binomial Squares Puzzle

Exploration



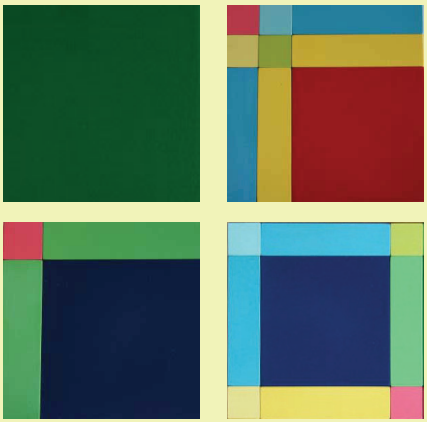
All teaching with manipulatives should begin with a period of free exploration. While this applies especially to children younger than seven, it is also true of all children. The free exploration of the puzzle parts will provide the child with visual imagery and kinesthetic experiences that will facilitate a deeper understanding of explicit instruction later on. What are some of these ideas? Laws of combinations, place-value, numeration, fractions, proportions, multiplication of whole numbers, areas, and binomial multiplication are the more notable ones.

Guided Play with an Instructor

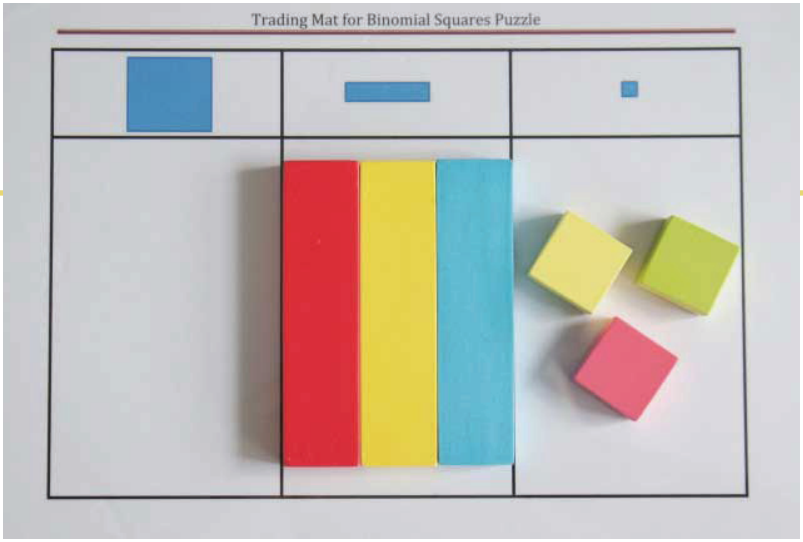
When students observe relationships among the puzzle pieces or enjoy rearranging the pieces in different combinations, the time is right to create structure for these explorations. Here are descriptions of some guided activities.

How many squares can you find?

Of course, the term "squares" brings to mind the differences between squares and rectangles. Talk about the difference between a square and a rectangle. Measure the length and the width of some squares. Then measure the lengths and widths of some rectangles.



Place Value Trading Game



1) On a traditional die, cover the sides with 4, 5 and 6 dots with tape and write 1, 2 and 3 dots on the tape. The six sides should have two faces with 1 dot, two with 2 dots, and two with 3 dots. Alternatively, cut up small squares of paper and put the numbers 1-3 on separate pieces of paper. Have students draw and replace the pieces of paper.

2) Use one trading mat per child along with one set of Binomial Squares puzzle pieces per child.

There is a downloadable trading mat available at http://www.euclidkids.com. Alternatively, simply mark off three columns on a sheet of 8 1/2 x 11 paper and mark it, as shown.

3) The adult "pays" the student the number of small squares shown on the die. Each player takes a turn.

4) When a player has accumulated four small squares (equivalent to ones), he or she can trade four of them for a rectangle. The area of the rectangle is 4 x 1, so it is equivalent to four of the 1 x 1 squares. In place value terms, it is equivalent 4 or the base value in this base-four trading game.

5) When a child accumulates four rectangles, he will have the equivalent of one large square. In place value terms, the large square is equivalent to four squared, or four to the second power.

6) Depending on the amount of time allotted to the play of the game, winning can be the first to get one, two, three or four large squares.

7) Educational value of this game:

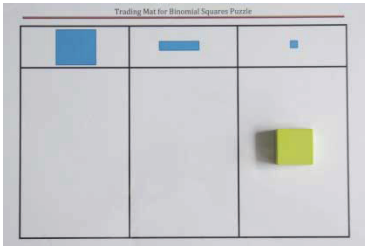
a. For younger children, four to six years old, the game provides opportunities for counting and for visual counting. Visual counting is the ability to recognize the number of items in a set without pointing individually at each element of the set.

b. For children five to seven the game provides opportunities to enact place value concepts. In any place value system the smallest integer values are the ones; the place to the left is the base value, in this case, the fours; and the place to the left of that is the four-squared place. In base-ten, the places from right to left are the ones, the tens, and the hundreds.

c. This game provides students with experience in exponentiation. The large square is four-squared.

Once a place value system has been established, in this case, base-four, any number from 1 to 100 can be represented with the pieces.

What's My Number?



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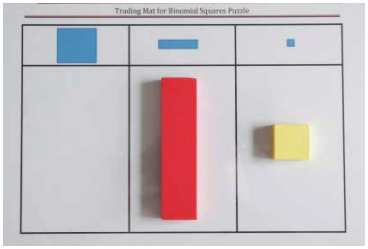

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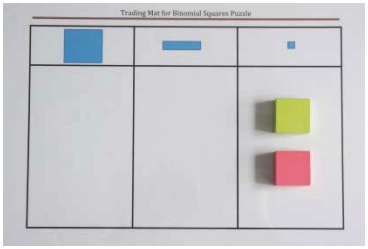

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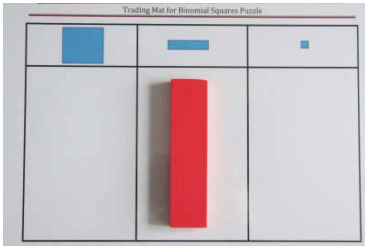

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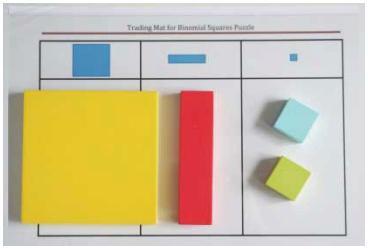

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Perhaps the greatest benefit

...is the visual image of binomial multiplication. Area models are good representations of multiplication with the length and the width representing the two factors. Many students have difficulty understanding the parts of multiplication problems, especially when applied to mixed numerals or binomials.

If we think of the large square as having equal sides of one unit, then the small square must have sides of ¼ unit and the rectangle is one unit by ¼ unit.

What happens when we multiply 1¼ by 1¼ ?

$1\frac{1}{4} \times 1\frac{1}{4} = (1 + \frac{1}{4})(1 + \frac{1}{4}) = 1 + \frac{1}{4} + \frac{1}{4} + {}^{1}/_{16}$

The four terms of the answer are represented by the four regions of the square.

We have just multiplied one mixed numeral by another. Many students believe erroneously that they should multiply the whole numbers together and then multiply the fractions together. In reality, the process requires four steps. We have just squared 1¼.

We can generalize this to the multiplication of binomials. We can think of the length and width of the large square as being x units long and the length and width of the small square as being one unit long. At the left is (x + 1) times (x + 1) or (x + 1) squared.

This visual imagery can provide students with a deeper understanding of important mathematical processes.