Pentominoes

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Resources

Teacher resources:

Burns, M. (1987). A collection of math lessons from grades 3 to 6. New York: The Math Solutions Publications.

- Chapter 12 is *A Geometry Lesson with Pentominoes – Grade 6*. There is no reason this lesson couldn't be done with younger children.
- A related lesson is in the book with the same title, except grades 1-3. Chapter 12 is Explorations with Four Toothpicks. Flips, rotations, congruence are addressed here, as well as determining sequences by changing just one toothpick in a design. Don't limit yourself to grades 1-3 on this one!

Kohl, H. (1987). Mathematical puzzlements: Play and invention with mathematics. New York: Schocken Books.

- I am afraid this book may be out of print, but it has a great chapter on pentominoes. **News flash!** I just found it online at Powell's Books by searching for the author. http://www.powells.com

Websites:

- An online game, putting all 12 pentominoes in a 5x12 rectangle. http://gamescene.com/Pentominoes.html
- National Library of Virtual Manipulatives. This is a really cool site with many more activities than just pentominoes http://nlvm.usu.edu/en/nav/vlibrary.html

Novels:

Balliett, Blue (2004). *Chasing Vermeer*. New York: Scholastic. 5th grade reading level
Balliett, Blue (2006). *The Wright* 3. New York: Scholastic.

- These two novels are a delight. *Chasing Vermeer* has been described as a *DaVinci Code* for children but it didn't feel like that to me. Both are mysteries, set in present Chicago. The children attend the University School at the University of Chicago (think John Dewey!). The first book involves a Vermeer painting and the second book, a Frank Lloyd Wright building. The pentominoes connection occurs with a secret code and hidden pictures in *Chasing Vermeer*. They don't play a dominant role in *The Wright 3*, but why stop reading? There is certainly geometry in Frank Lloyd Wright's work!
- Scholastic has a great website with interactive pentomino games and full-sized colored pentominoes to print. http://www.scholastic.com/titles/chasingvermeer/index.htm

The Math

Big Ideas/Concepts:

- Congruence, flips (reflections), slides (translations), turns (rotations), area and perimeter, tessellations

The basic lesson:

- Define pentomino. Relate to dominoes, triominoes, tetrominoes.
- Students 'find' all pentomino shapes. Discussions will include congruence, flips, slides, turns. There are 12 unique shapes. Remember FLIPN TUVWXYZ. (flipping and the last 7 letters in the alphabet.)

Activities

Rectangles:

- Use all 12 pentomino shapes to create rectangles

3x5	any 3 pieces
4x5	4 pieces
2x10	4 pieces
5x5	5 pieces
3x10	6 pieces
7x5	7 pieces
4x10	8 pieces
9x5	9 pieces
10x5	10 pieces
11x5	11 pieces

10x6	all 12 pieces. It is possible to arrange them in such a way that each pentomino touches the border of the rectangle. Don't give up. There are 2,339 ways to do this.
12x5	all pieces (1,010 ways)
15x4	all pieces (368 ways)
20x3	all pieces (only 3 ways)

Boxes:

- Have students visualize folding the sides to make an open box. Then fold pentominoes to check their guesses. Mark an X on the square that is the bottom of each box.
- Have children save (and wash!) milk cartons. Cut off the top to make an open box. Cut the boxes into the different pentominoes.
- Box cutting machine. Imagine that a factory needs to cut out open boxes from sheets of cardboard. They need to design a cutting machine with vertical blades that will cut straight down through several sheets at once. Have students determine the most economical way to cut out open boxes from a single sheet. Use a piece of 1" squared paper as the sample piece of 'cardboard' and the pentomino pieces that make squares. They may repeat pieces, use a variety of pieces, and not use all of the pieces.

Area and perimeter:

- Determine the perimeter of each pentomino. Help them realize that the area stays the same while the perimeter can change. Discuss how the shape of the pentomino affects the perimeter (take a look at interior 'seams').

Tessellations:

- Use individual pieces to tessellate the plane. Explore whether every pentomino can tessellate the plane.

Sorting:

- Sort by perimeter, or those shapes that have mirror symmetry.

Play the game!

- Make 'checkerboards' of 8x8 one inch squared paper. Take turns placing pieces on the board with the winner being the last person to place a piece. Try other rectangular boards such as 5x12. Variations include using just one set of pentominoes between two players, or each player using one set (allows for a shape to be used twice). Another variation is to make the last person to place a piece be the loser!