Use pentominoes to match the shapes.
Use 2 pentominoes to make each shape.
Use 2 pentominoes to cover each skyscraper. Then cover each skyscraper a different way.
How many pentominoes do you need to cover each shape?
Now cover each shape.
Use pentominoes to make the letters.
Use pentominoes to make the numbers.
Use two sets of pentominoes.
Find the "twins" that make each shape.
Use three sets of pentominoes.
Match up shapes from the three sets.
Then find the "triplets" that make the shape.
Use 3 pentominoes to make the left rectangle.
Then use 4 pentominoes to make the right rectangle.
How many pentominoes do you need to make the square?
Now make the square.
Use a pentomino to make each shape. Then turn each pentomino halfway around. Which pentomino still matches the shape?
Match the blue pentomino.
Flip it along one long edge.
How many flips do you need to match each shape?
Match the yellow pentominoes.
Then use blue pentominoes to make the mirror images.
Use 2 yellow pentominoes to make the stairs. Then use 2 blue pentominoes to make the mirror image.
Use 1 pentomino to match the small red shape.
Then use 4 pentominoes to make the larger shape.
Use 1 pentomino to match the small Z.
Then use 4 pentominoes to make the large Z.
Dear Teacher,

What in the world are pentominoes? Just 12 simple shapes made up of five squares attached together in different configurations. This set includes three sets of pentominoes each in red, blue, and yellow sturdy plastic.

What makes pentominoes so interesting? They can be sorted, matched, combined, compared, traced, flipped, reflected, rotated ... and that's not all! Pentominoes can also be used to teach an amazing array of skills: colors, shapes, letters, numbers, counting, adding, measuring, small motor skills, critical thinking, creative problem solving, and logic. Pentominoes can even help young children grasp such advanced concepts as area, perimeter, and spatial relations.

How will children learn so much from pentominoes? This teaching guide shows the way with seven reproducible work pages and more than 30 intriguing games and activities.

Pentominoes, anyone?

Best regards,

Tina Thoburn

Tina Thoburn, Ed.D.

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Caution: Not suitable for children under 3. Small parts may be a choking hazard.

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Explorations

Introduction

When you introduce the pentominoes, let children have some free time to handle them and discuss them informally. Here are some ideas to help you guide their explorations.

• You may want to begin by introducing the word *pentomino*. Point out to children that both sides of the pentomino are made up of five squares. Tell the children that in the Greek language, the word for five is *penta*.

• Ask what color the pentominoes are. (Red, blue, yellow.) Have children hold up yellow pentominoes and name other things that are the same color. Repeat with the other colors.

• Have children spread out all twelve of the red pentominoes. Ask if they can find any two pentominoes that are the same shape. (No.) Discuss the shapes with children (for example, a long, skinny rectangle, and a zigzag).

Sorting Pentominoes

• Mix all three sets of pentominoes together and have children sort them by color. They should have three piles: red, yellow, and blue.

• Then have the children sort the three sets of pentominoes by shape. They should end up with twelve piles with a red, yellow, and blue tile of the same shape in each.

Building Roads

Using pentominoes to build roads and city streets provides a fun way to acquaint children with attributes of the various pieces. Show children how to connect the pieces end to end to make a roadway and how to avoid dead ends.

Naming Pentominoes

Pentominoes are often given letter names because many of the shapes resemble letters of the alphabet. To make it easy for children to identify the pentominoes, ask children to use their imaginations and think about the letter that each pentomino resembles. Here are some ideas and typical answers:

• Ask which of the pentominoes might have more than one letter name. (The C might be turned and named U; the M might be flipped and named W.)

Making Words

Challenge older children to use pentomino letter names to spell words such as *fix, mix, pin, vim, clip*. (Note that the options are limited because I is the only true vowel.) Using two sets of pentominoes will give children a few more options, such as using the C as a U to form words like *cup* or *plum*. 
**Match My Shape**

Have children take turns playing this matching game. Spread the red pentominoes on a tabletop, and put the yellow set in a bag. The first player chooses one red pentomino from the bag and places it on top of the matching yellow pentomino on the table, turning it over or rotating it to make a perfect match. Then the next player takes a turn, and the game continues until all the red pentominoes have been matched. Extend the game by putting blue pentominoes in the bag and having children match them to the stacked red and yellow pentominoes.

**Card 1: Pentomino Match**

Have children spread one set of pentominoes on the table. Ask them to locate the pentomino that matches each pentomino shape on the card. Encourage them to turn and flip over the pentominoes until they find an exact match. Guide them to turn the card to identify the shapes by pentomino letter name. Then have children place the pieces in the outlines on the card.

**Tracing Pentominoes**

Provide children with paper, pencil, and crayons. Show them how to hold a pentomino firmly on the paper and trace around it with the pencil. Have children begin with the simple I shape and then move to more complex shapes. Encourage them to trace their favorite shapes again to challenge their friends to find the matching pentominoes.

**Pentomino Count**

Have children work in small groups to examine a full set of pentominoes. Review with children that there are squares marked on the pentominoes and ask them to tell you how many squares are on each piece. (Five squares.) Then ask how many pentominoes have all five squares in a row. (One: I.)

- Ask how many pentominoes have four squares in a row. (Two: L, N.) How many squares are not in the row? (One.)

- Ask how many pentominoes have three squares in a row. (Eight: C, F, N, P, T, V, X, and Z.) How many squares are not in the row of three? (Two. They may be together in a two-row as on P, V, and N; they may be separated on the same side of the row as on C; or they may be arranged individually on opposite sides of the three-row as on F, T, X, and Z.)

- Have children look at the pentominoes that are left and describe the arrangement of the squares. (The M has 2, 1, and 2.)

- Ask children to count to see how many pentominoes are in one set. (12.)

**Pentomino Addition**

Point out to older children that pentominoes are good models to use to make different equations that add up to five. For example, the L pentomino and the Y pentomino show $4 + 1 = 5$ and $1 + 4 = 5$. The C, X, and F pentominoes show $1 + 3 + 1 = 5$. The I pentomino shows $5 + 0 = 5$ and $0 + 5 = 5$.

**Skip Counting**

Have children skip count by 5s to determine the number of squares in two or more pentominoes.
Constructions

Fit Together

Have children work in pairs. Ask each child in the pair to choose a pentomino. Then have them fit their pentominoes together in different ways to see what shapes they can make. Encourage them to flip their pieces over and turn them around. Here are two ways the X and F pentominoes can fit together.

Drawing Shapes

Provide children with 1-inch square graph paper on which to draw and trace pentominoes and shapes made from pentominoes. Smaller squared graph paper can be used to make scale drawings. Encourage children to keep a record of their favorite constructions, which may be colored and bound together to make individual or class pentominoes' booklets.

Card 2: Two-Pentomino Shapes

Have children work with a complete set of pentominoes. Challenge them to find the two pentominoes that can be put together to cover each shape on the card. The first shape has dotted lines to show an example of how two pentominoes (the X and M) can fit together to make a new shape. The second shape can be covered only by the P and Y pentominoes.

Card 3: Skyscrapers

Have small groups of children work on this card together. Direct each group to find two pentominoes to cover each skyscraper. Then ask them to look for different pairs of pentominoes to cover the skyscrapers.

Card 4: How Many?

Ask children to guess how many pentominoes they will need to cover these shapes. Then let them try to cover shapes using the number of pentominoes they guessed. They will discover that they need three pentominoes. Have them try to find as many ways as they can to cover the shapes and to compare their solutions. A possible answer for each is given.

Make-and-Trace Worksheet

Have children find two pentominoes to cover each shape. Then have them remove one of the pentominoes and trace around the edges of the remaining piece to show where the two pentominoes fit together. Then let the children color the pentominoes in each shape, using either the same color or two different colors.

For older children: For this activity, and for cards 3-6, you may want to provide older children with squared graph paper on which to record their answers.
Use two pentominoes to cover each shape.
Then trace the pentominoes to show how they fit.
Two-Ways Worksheet

Have children find three pentominoes that cover the top shape. Help them trace the edges of the pentominoes to show how they fit together. Then challenge children to cover the bottom shape a different way and trace their solutions. Have children color their papers and compare their answers. You may want to display the completed worksheets on the bulletin board. Possible answers using one color are shown. Other options are possible using more than one color.

Card 5: Pentomino Letters

Review with children the letter names they gave each pentomino. Point out that two or more pentominoes can be combined to make some of the other letters of the alphabet. First, have them use the pentominoes to cover the letters on the card. Then challenge them to place pentominoes on their desk tops to create other letters of the alphabet.

Card 6: Pentomino Numbers

Have children find pentominoes to cover the numbers on the card. Challenge them to use pentominoes to create other numbers.

Card 7: Twins

Have children work with two sets of pentominoes. Begin by having them make "twins" by matching up the shapes from the two sets. Then have them find twins that can fit together to cover each shape on the card.

Encourage children to try to find different solutions for each shape.

Card 8: Triplets

Have children work with all three sets of pentominoes. First have them make "triplets" by matching up the shapes from the three sets. Then have them find the triplets that fit together to cover the shape on the card. Encourage them to try to find different solutions and to share their findings.

Animal Constructions

Direct children to work with single sets of pentominoes to make objects with recognizable shapes. The animal constructions shown below provide real challenges for older students. Have children solve the puzzle by fitting the pentominoes in the outline to create the animal. To help students get started, you may wish to build each animal and trace around it on a large piece of paper, inserting a few internal lines where pieces meet.
Two Ways

Use three pentominoes to cover the top shape. Now cover the bottom shape a different way.
**Geometry**

**Counting Corners**

Have children work in small groups to count the corners of the various shapes of pentominoes. First hold up the L piece and talk about inside and outside corners. Help children see that L has five outside corners and one inside corner, or six corners in all.

As children count the corners, help them record their findings by drawing each pentomino and coloring the inside and outside corners two different colors, or constructing a table such as the following:

<table>
<thead>
<tr>
<th>Pentomino</th>
<th>Inside Corners</th>
<th>Outside Corners</th>
<th>Corners in All</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>L</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>M</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>N</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>P</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>T</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>X</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Y</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Z</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Ask which pentomino has the greatest number of corners. (X: 12.) Ask which has the least. (I: 4.) Have children group the pentominoes that have the same numbers of corners. (L, P, V have 6; C, N, T, Y, Z have 8; F and M have 10.) Older children may note that all pentominoes have an even number of total corners. Point out to children that if the number of inside corners is even, so is the number of outside corners. If the number of inside corners is odd, so is the number of outside corners.

**Card 9: Rectangles**

Use the I pentomino to review that a rectangle is a figure with four square corners and four straight sides, with opposite sides of the same length. Have children point out objects that have rectangle shapes such as paper or books. Discuss the rectangles on the card and have children find three and four pentominoes that fit together to cover them. Guide children to try to find different solutions to these puzzles. Challenge older children to see if they can make other rectangles using pentominoes. Possible answers are shown below.

**Card 10: Square**

Remind children that a rectangle that is equal on the same length on all four sides is called a square. Ask children to point out squares in the classroom such as floor tiles. Then show the card and have children guess how many pentominoes they will need to cover the square. (5.) Let children choose a pentomino set and give them time to try to solve the puzzle. Meanwhile, other children can use other sets of pentominoes to make similar squares. Possible answers are shown below.

**How Many Sides? Worksheet**

Hold up an I pentomino and point out its sides to children. Tell them that each edge between two adjacent corners is thought of as a separate side. Show them that the I has four sides. Repeat with the L to show that it has 6 sides. Have children count the sides of each remaining pentomino and record the count on the matching pictures on the worksheet. (N: 8 sides; X: 12; Z: 8; P: 6; T: 8; F: 10; Y: 8; M: 10; C: 8; V: 6.)

Ask which pentomino has the greatest number of sides (X: 12.) and the least. (I: 4.) Have children group the pentominoes that have the same numbers of sides. (L, P, and V have 6; C, N, T, Y, and Z all have 8; F and M have 10.) Older children may note that all pentominoes have an even number of sides.
How Many Sides?  

This pentomino has four sides.  This pentomino has six sides.

Now write how many sides are on each pentomino.

_ _ sides

_ _ sides

_ _ sides

_ _ sides

_ _ sides

_ _ sides

_ _ sides

_ _ sides
Card 11: Turns

Place a pentomino on the table top and show children how to turn, or rotate it without lifting it. Ask them to observe how different the piece looks as it is turned. Next, place a blue 1 pentomino on the table and put a red 1 on top of it with the edges matching. Turn the red piece and help children realize that when it is turned halfway around, it matches the blue piece again. Tell children that the 1 has turn symmetry. Repeat with blue and red F shapes, noting that they don't match in any other position. Have children match pentominoes to shapes on the card and turn them to try to make other matches. (X, I, and Z have turn symmetry; M does not; X is symmetrical under both a halfturn and a quarter turn.)

Turn-About Worksheet

Have children fit pentominoes on each shape, then turn the pentomino halfway around. If they get a match after the turn, have them color the shape to show that it has turn symmetry. (Children should color the Z, X, and I.)

Encourage children to discuss which of the remaining pentominoes look the same under a half turn. (Only the three colored-in shapes.)

Flips

Discuss flips or somersaults, emphasizing that when people do flips, they turn upside down. Then place a C pentomino on a piece of paper and trace around it with a marker. Ask children if it will look the same if you flip it over. Flip it horizontally to fit it in the outline. (It will not fit.) Finally, return the C to its original position and flip it vertically. (Now it fits.) Explain that the C pentomino has flip, or line symmetry in one direction.

Card 12: Flips

Have children place the V pentomino on the blue shape A, then flip it along one of its edges so that it lands in outline B. (One flip to the right.) Have them start again at A and flip the V to get to outline C. (2 flips either clockwise or counter-clockwise.) Start again at A, having them find ways to get to D. (3 flips clockwise; 1 flip counter-clockwise.) Ask how to start at A and flip back to A. (4 flips in either direction.) Have children experiment flipping other pentomino shapes.

Card 13: Mirror Images

Use a mirror to discuss mirror images, stressing that when we look in the mirror, we see ourselves as if we have been flipped. Have children match the yellow Y pentomino shape, then use a blue Y to show its mirror image. Repeat, using the other yellow shapes on the card.

Card 14: Stepping Up

Have children find two yellow pentominoes to match the stairs at the left. Then have them use the same kind of pentominoes in blue to show the mirror image on the right.
Use a pentomino to match each shape. Then turn the pentomino halfway around. If it is still a match, color the shape.
Use a pentomino to match each shape. Then flip the pentomino upside down. If it is still a match, color the shape.
Measurement

**Area of Pentominoes**

Have children look at the squares on the pentominoes and note that all the squares are the same size. Tell children that the squares can tell them how big the pentominoes are and that the *area* of each square—its *size* or the space it covers—is one square inch. You may want to use a ruler to show that each square is one inch on a side. Ask how many squares are on each pentomino. (Five.) Help children conclude that the area of each pentomino is five square inches.

**EXTENSION:** Have children make other shapes with three or more pentominoes and challenge classmates to guess the area. Children may find that they can skip-count by 5s to discover the total number of square inches in a given number of pentominoes. Then build a table like the one shown to show the relationship:

<table>
<thead>
<tr>
<th>Number of Pentominoes</th>
<th>Area in Square Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

**Area Worksheet**

Have children use pentominoes to cover each of the shapes. When the pentominoes are in place, have children count the squares to determine the area in square inches. You may want children to trace each pentomino to show which two they used to cover the larger shapes at the bottom.

**Perimeter of Pentominoes**

Explain that the distance around a shape is called the *perimeter.* Show children the I pentomino and help them count the inch segments around the edges. (There are 12 segments, so the distance around the I is 12 inches.)

**Perimeter Worksheet**

Discuss how to determine the perimeter of the I pentomino at the top of the page and how to write the answer on the line. Then have children use the actual pentominoes to count the number of square inches around each and record this number on the line beside the small picture. Work through several of the exercises with the children to be sure they do not confuse counting square inches with counting the number of sides. (All have 12-inch perimeters except the P, which has a 10-inch perimeter.)

**Card 15: Growing Bigger**

Ask children to tell what they notice about the two shapes on the card. (They are the same F pentomino shape. The right F is larger—twice as wide and twice as high.) Ask how many pentominoes it will take to cover the shape at the right. (Four.) Then have them cover it in as many ways as they can. A possible answer is shown below.

**Card 16: Bigger Still**

Have children find the pentomino to match the shape at the left. (Z.) Then use pentominoes to cover the large shape at the right. Answers are shown below.

**EXTENSION:** Challenge older children to see which other pentominoes they can enlarge using four pentominoes. (All except V and X.)
Area

Cover each shape.
Then write how many square inches each shape is.

______ square inches  

______ square inches

______ square inches  

______ square inches

Name ________________________
Perimeter

This is 1 inch. ----
How many inches are around this pentomino?

Now count the inches around each of these pentominoes.

? ______ inches  cnJ ______ inches

b ______ inches  _____ ______ inches

_____ inches  _____ ______ inches

_____ inches  _____ ______ inches

[ ] ______ inches  [ ] ______ inches