Oh No! My Ominoes!

Objective: Find all the possible ways to arrange five squares into shapes called pentominoes

Materials: Overhead color tiles
Color tiles
2 sheets centimeter grid paper
Scissors

Procedures:

1. Begin the lesson by having students practice their mental visualization skills. Ask students to close their eyes and imagine a large box. Ask them if they can see it in their mind's eye. Sometimes it helps if it is a particular kind of box, such as a large refrigerator box with a brand name written across the side. Then tell them that the mind can do magic. In their minds they can shrink the box and make it a long, skinny box. Give them what prompts you need to help them see the box. Now do more magic on the box and shrink the length so that it becomes a cube. Each side is a square. Each square is the same size. Now take the top off of the box and throw it away. Get the mind's scissors and cut along some edges until the sides will fold down flat. Looking down on it you should see five squares, the bottom and the four sides. Open your eyes and draw what you saw in your mind.

2. As you walk around the room, you will notice that most students will draw what we call the red cross. Make note of any that have something different and ask students to use the overhead tiles to illustrate what they drew on their paper.

3. Tell the students that you used this technique to introduce different shapes that can be made from five squares. Explain that these shapes are called pentominoes.

4. Discuss rules for the activity. (a) When you arrange the squares into shapes, the requirement is that at least one whole side of each square touches a whole side of another. Illustrate on the overhead with tiles. (b) You will have to decide if the shapes you create are the same or different. If two cut-out shapes fit exactly, they are called congruent and count as only one shape. In other words, if it can be flipped or rotated and it matches another one -- it's the same, not a new one.

5. Discuss the derivation of the word pentomino. A domino is made from two squares. Discuss triominos (three-square versions) and tetraomino which is a four-square shape. Pentominoes are five-square versions.

6. With the entire class, find all the different arrangements of three squares. What shapes could you make? Allow students to discuss and make shapes. Stress that cutting out shapes will help determine if shapes are congruent because you can flip and turn the cut-out shapes.

7. Once the class understands the procedure, present the problem to be solved in small groups. Each group is to find all the possible ways to arrange five squares into pentominoes. Each group must cut each of them out of the squared paper provided. Each group should make one set of all the different pentominoes, accounting for all possible arrangements. Emphasize that the pentominoes do not have to fold up into a box.

8. Groups need to decide when they think they have found all possible solutions. Find out what strategy they used to decide when they think they have found them all. Other groups usually overhear the discussion and offer the total number that they have found. When one group has more, it encourages the other groups to find them.

9. To summarize, discuss any strategies that groups used to discover all shapes.

10. Allow one group to post its findings so that other groups can compare. For future use, students need to sketch all 12 shapes on centimeter-squared paper.

Extensions:

1. Start with the shape that looks like the Red Cross symbol. Ask the students to visualize how they could fold up the sides of this shape so that it would be a box without a lid. Predict which side would be the bottom of the box, opposite the open side, by putting an X on the appropriate square on their group's pentomino. For each of the other pentominoes, have students inspect the pentominoes and predict whether or not each would fold into a box. They can mark an X to indicate the bottom of the box and test their predictions.

2. Sort the shapes in several ways. Categorize which shapes have rotational symmetry, line symmetry, and no symmetry.

3. Using a 5 x 12 squared sheet as a game board, with squares matching the size of the squares used for pentominoes, use the board and try to fit all 12 pieces onto the board. This could be a two-person game, with players

taking turns placing pieces on the board. The object is to play the last possible piece so that it is impossible for the opponent to fit in another.

4. Have students find the perimeter and area of each shape.

Assessment:

1. Questions:
   - What strategies did you use to find the shapes?
   - How did you convince yourself and your group that all the shapes had been found?
   - How did you judge whether a shape was new or the same as (congruent to) some other?
   - What is alike about all the shapes?
   - In what ways are the shapes different?

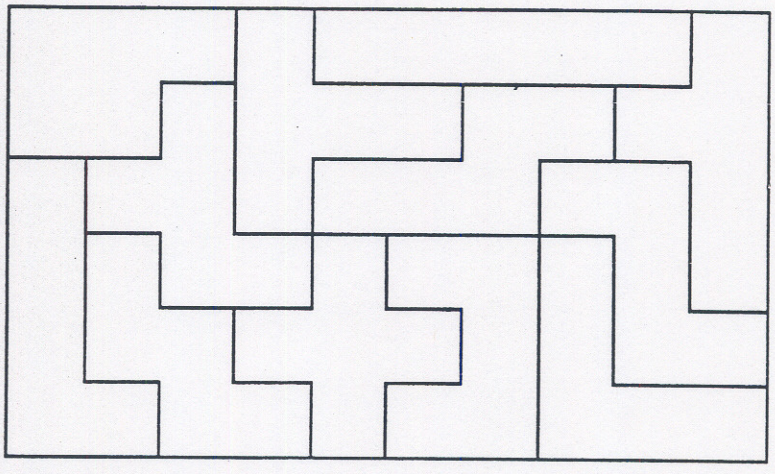
2. Observations:
   - Did students work together to develop a strategy for finding all the shapes?
   - Did students use appropriate geometric vocabulary when discussing the shapes?
   - Did students use appropriate strategies for determining whether shapes were different?

3. Tasks:
   - Separate the shapes into two or three groups and explain your sorting rule.
   - In your mathematics journal, discuss how your group decided all the shapes had been found.

Resource:

Additional activities can be found in the May 1990 issue of *The Arithmetic Teacher* in an article by Barry Onslow entitled "Pentominoes Revisited."

Sample Rectangles with Pentominoes



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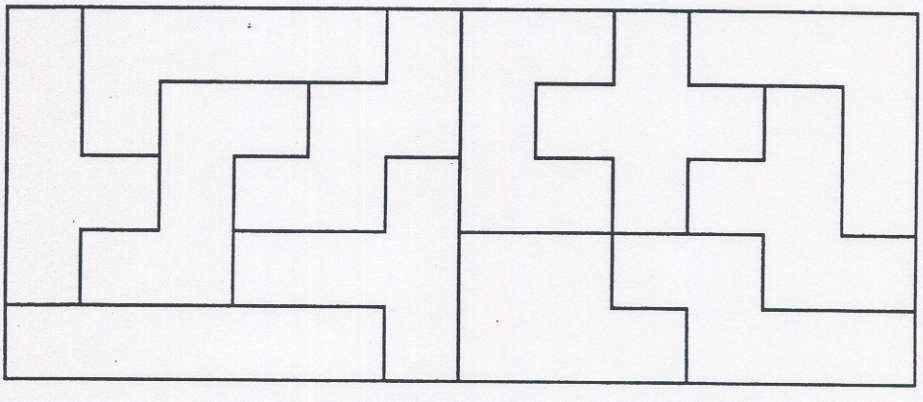

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