Ideas

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IDEAS for this month consists of two posters that provide counting problems from geometry. Students will need several days to consider the questions. Supplementary activities can be found in the NCTM publication *Boxes, Squares, and Other Things*, by Walters.

The posters are arranged so that you can make copies for the students to use along with the posters.

IDEAS For Teachers

"Squares, Squares, and More Squares"

Objective:

To develop two-dimensional visualization and to encourage students to search for patterns as a way to solve problems. Fundamental concepts of area are useful.
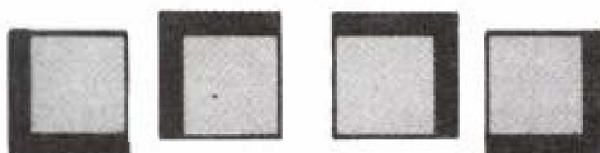
Levels: 2,3,4,5

Directions for teachers:

1. Put the poster on the bulletin board and let students think about the questions for several days. Provide space next to the poster for students to write their answers.

2. Be sure students understand that orientation of the small squares does not matter. The following are all counted the same way:

That is,

means "squares with two colored sides."

Similarly,

means "squares with one colored side," and

means "squares with no colored sides."

3. After students have had several days to think about the poster, discuss the answers with the class. Help students identify patterns in the data. (See tables 1 and 2.)

Table 1

Figure	How many?	
2 by 2	4	0
2 by 3	4	2
2 by 4	4	4
2 by 5	4	6
2 by 6	4	8

Table 2

Figure	How many?		
3 by 3	4	4	1
4 by 4	4	8	4
5 by 5	4	12	9
6 by 6	4	16	16

Note in table 2 that the numbers in the second column are successive multiples of four, and the numbers in the third column are perfect squares.

Going further:

1. Extend each series of figures. Let students predict the numbers of each type of square, then have them check the answers by drawing the figures and counting.

2. Create a new series of figures; for example, 3 by 3, 3 by 4, 3 by 5, 3 by 6, and so on. Have students predict the correct numbers and then check the answers by drawing the figures and counting.

IDEAS For Teachers
"Cubes, Cubes, and More Cubes"

Objective:

To develop three-dimensional visualization and to encourage students to search for patterns as a way to solve problems. Concepts of area and volume are used.

Levels: 5,6,7,8

Directions for teachers:

1. Put the poster on the bulletin board and let students struggle with the questions for several days. Provide space next to the poster for students to write their answers.

2. You may want to provide small cubes so that students can build models of some of the figures. Be sure that students understand that each small cube has six faces, each of which is in the shape of a square.

3. After students have had several days to think about the poster, discuss the answers with the class. Help students identify patterns in the data. (See tables 3 and 4.)

Table 3

Figure	Number of painted faces	
	3	2
2 by 2 by 2	8	0
2 by 2 by 3	8	4
2 by 2 by 4	8	8
2 by 2 by 5	8	12

Table 4

Figure	Number of painted faces			
	3	2	1	0
2 by 2 by 2	8	0	0	0
3 by 3 by 3	8	12	6	1
4 by 4 by 4	8	24	24	8

4. If students have trouble finding the answers, check to be sure that they understand that only the outside layers of cubes have painted faces. The 3-by-3-by-3 and 4-by-4-by-4 cubes have smaller inner cubes, two units smaller on an edge, that do not get painted. Similarly, the cubes with one, two, and three painted faces form patterns. (See fig. 1.)
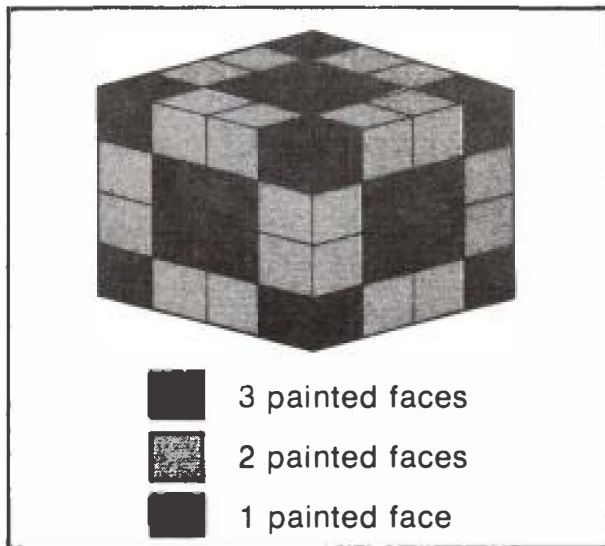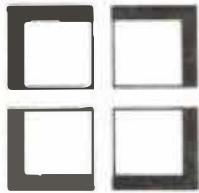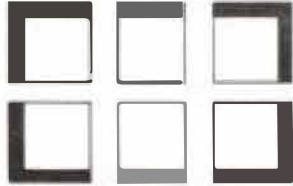
Note that for the cubes (table 4), the numbers in the second column are multiples of 12; the numbers in the third column are six times the perfect squares (6 X 0, 6 X 1, 6 X 4), and the numbers in the fourth column are perfect cubes.

Going further:

1. Extend each series of figures. Let students predict the numbers of each type of cube and then check the answers by drawing pictures of the figures and counting.

Fig. 1

3 painted faces
2 painted faces
1 painted face

Squares, Squares

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and More Squares

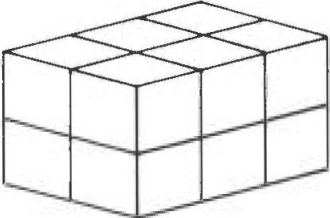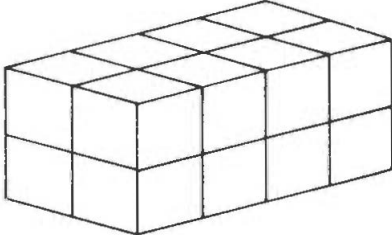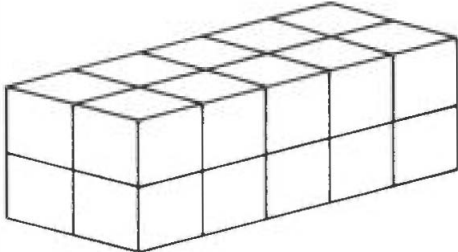|	☐	☐	☐
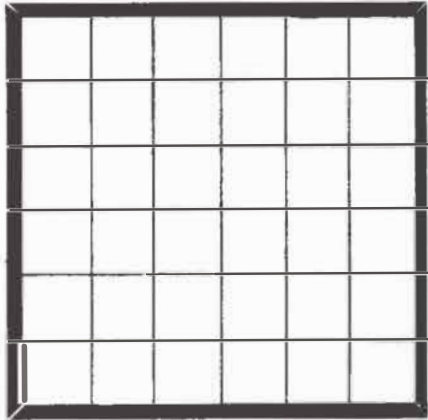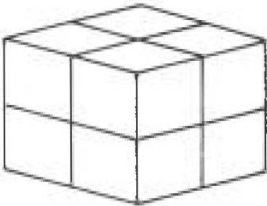
Cubes, Cubes

Each figure is made from small cubes and only the outside surface of the figure is painted.

	How many small cubes have	
	3 yellow faces	2 yellow faces

and More Cubes

	How many small cubes have			
	3 yellow faces	2 yellow faces	1 yellow face	0 yellow faces