Cube Coloring Problem

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Lesson Plan for Grades 5–12

Overview

Investigate what happens when differently sized cubes are constructed from unit cubes, the surface areas are painted and the large cubes are taken apart. How many of the 1 × 1 × 1 unit cubes are painted on three faces, two faces, one face, no faces?

Objective(s)

Students will be able to do the following:

1. Work in groups to solve a problem
2. Determine a pattern from the problem
3. Write exponents for the patterns
4. Predict the pattern for larger cubes
5. Graph the growth patterns
6. Extend to algebra

Resources/Materials

A large quantity of unit cubes, graph paper, colored pencils or markers

Activities and Procedures

1. Hold up a unit cube. Tell students that this is a cube on its first birthday. Ask students to describe the cube (eight corners, six faces, twelve edges).
2. Ask students to build a cube on its second birthday and describe it in writing.
3. Ask students how many unit cubes it will take to build a cube on its third birthday, fourth, fifth. . . .
4. Pose this coloring problem: The cube is 10 years old. It is dipped into a bucket of paint. After it dries, the 10-year-old cube is taken apart into the unit cubes. How many faces are painted on three faces, two faces, one face, no face?
5. Have the students chart their findings for each age cube up to 10 and look for patterns.
6. Have students write exponents for the number of cubes needed. Expand this to the number of cubes painted on three faces, two faces, one face, no faces.
7. Have students graph the findings for each dimension of cube up to 10 and look for the graph patterns.
8. For further extension, see NCTM Addenda series/ Grades 6–8.

Tying It All Together

The students will have a chance to estimate, explore, use manipulatives, predict, and explain in writing and orally. They will note that the three painted faces are always the corners---eight on a cube. The unit cubes with two faces painted occur on the edges between the corners and increase by 12 each time. The unit cubes with one face painted occur as squares on the six faces of the original cube. The cubes with no faces painted are the cube(s) within the cube. This is an excellent way for students to become involved in exploring a problem of cubic growth.