

# Measuring Volume Informally: Teaching Notes

Sinan Olkun

GRADE RANGE: 4–5

MATHEMATICAL TOPICS: Mentally organizing three-dimensional space, unit iteration for measuring volume, composite units

MATERIALS: Sixty wooden cubes (2 cm along each edge) for each pair of students, colored pens

## Discussion of the Mathematics

Students are expected to construct accurate mental representations of rectangular solids made of small cubes when those solids are presented concretely and pictorially. That is, students should develop spatial visualization skills. Students should establish units and composite units based on three-dimensional properties and develop unit iteration schemes to organize each solid into regular patterns (e.g., rows, columns, and layers).

## Implementation

Make copies of the activity pages for each student and overhead transparencies of the pages to use during discussion. Colored pens are used for shading different shares on the drawings.

Show students a wooden cube and demonstrate how to draw it (fig. 6.1 below). Have students construct the building in question 1 on the activity pages using the cubes. Ask students to share the building equally between two people. Ask a couple of students to explain how they did the sharing.

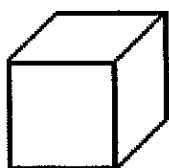


Fig. 6.1. Drawing of a small cube

Ask students to use the picture in question 1 to color each share of the building. Ask one student to show the sharing of the drawing on a transparency of question 1. Ask if anyone did the sharing differently; if so, ask one or two more students to show their drawings of different ways to share. You may repeat this process for the other buildings on the activity pages, or you may ask students to work independently or in pairs to complete the questions, with whole-group sharing of some of the students' answers.

This activity is only one part of a long process of learning about volume. Students will not catch on at the same time; some students will need more experiences, and other students may need special help to do the activities. Before and after these activities, students can be assessed with cube enumeration tasks to probe their current level of understanding (see the references below).

## Students' Typical Responses

There are three types of typical responses from students: (1) dealing with cube faces and building faces, (2) dealing with established units based on three dimensions but with no overall organization of them, and (3) systematically partitioning the buildings using rows, columns, and layers (see fig. 6.2). More information is provided in Battista and Clements (1996, 1998); this activity builds on those ideas.

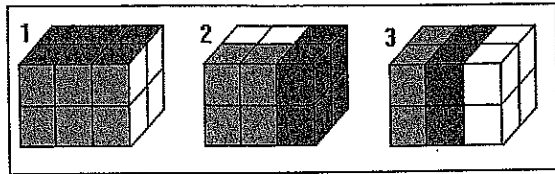


Fig. 6.2. Students' possible answers about a  $3 \times 2 \times 2$  building shared among three people

## REFERENCES

- Battista, Michael T., and Douglas H. Clements. "Students' Understanding of Three-Dimensional Rectangular Arrays of Cubes." *Journal for Research in Mathematics Education* 27 (May 1996): 258-92.
- . "Finding the Number of Cubes in Rectangular Cube Buildings." *Teaching Children Mathematics* 4 (January 1998): 258-64.