Filling Boxes

Find how many cubes will fill each box. Use as much math/science language as possible. Explain your strategy and reasoning. Can you make any generalizations? Organize your work neatly and provide as much detail as you feel is necessary.

Grade Levels 6 - 8

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Context

I teach math and science and try to find as many ways as possible to integrate the two disciplines. We were beginning a study on density and I wanted to assess my students' ability to extend their knowledge of area to volume using concrete materials. I gave each child a box (collected through the year from food packages) and a bucket of cubes. I often like to introduce new concepts to students by presenting a problem that they will be able to solve if they rely on previous knowledge. In this case, I knew the class had worked with area the year before. Instead of reviewing area formally, I felt this problem would call upon that knowledge in a meaningful way.

What This Task Accomplishes

This task allows students to construct their own mathematics. Instead of presenting my class with a formula for finding the volume of rectangular solids, I allowed them to use materials that would allow all students to have a hands-on experience with volume and allow some to discover their own formulas. The task also assesses their ability to use previously acquired knowledge in new situations and to make connections.

What the Student Will Do

Most students began by filling the bottom of the rectangular solid with cubes. Many realized that they then could count how many layers high their solid was. Some started with filling the whole box with cubes, but almost all finally realized there was a quicker way. Some just lined the length, width and height with cubes and multiplied. Some were beginning to see that the area of the base multiplied by the height found the volume. Not many students had the word "volume" as part of their vocabulary. Some were frustrated because they knew they had heard the word, but could not come up with it during the assessment.

Time Required for Task

45 minutes

Interdisciplinary Links

I use this task in our beginning study of density when we talk about finding the volume of

different materials. We extend this to all prisms and cylinders and then talk about submerging irregular shapes in water and measuring the cubic centimeters that get displaced.

Teaching Tips

I asked the students to first estimate the number of cubes they thought would fill their boxes. I was pleased that some students, after solving the problem, went back to their estimates and made comments about how close or far off they were.

I used two types of commercially bought cubes. One set are cubic inches (for the larger boxes) and the others are centimeter cubes (for the smaller boxes). I do not give each table enough cubes to fill each box - this makes them have to think of a more efficient method.

Suggested Materials

- *Boxes
- Cubes (I beg, borrow and steal from colleagues for this activity.)

*You will need to take time collecting reasonable boxes. The students love to see all the different foods that are presented. I cut the top off the boxes so they can fill them with cubes.

Possible Solutions

Solutions will vary depending on the size of the empty box. I was looking for which students could come to a generalization about length x width x height (or better yet, area of base x height).

Benchmark Descriptors

Novice
This student uses a strategy that does not help solve the problem. S/he adds the dimensions to find the number of cubes in the box. The student uses incorrect or simplistic terms like squares and blocks. There is no math representation.

Apprentice
This student uses a strategy that is only partially useful. S/he multiplies two dimensions, but fails to use the third length. There is some use of mathematical notation and representation.

Practitioner
This student has a broad understanding of the problem. S/he counted the number of cubes on the bottom of the solid and multiplied that by the height. This strategy leads to a solution. There is a clear explanation with a diagram to help communicate the solution.

Expert
This student shows a deep understanding of the problem and is able to identify the appropriate mathematical concepts necessary for its solution. S/he has an efficient strategy leading directly

to a solution. S/he multiplies the length, width and height and is able to generalize the solution at the end with a formula. There is a clear and detailed explanation using correct math language. The representation is used to help communicate the solution.