## Box It Up

Summary
In this activity students will be finding the volume of rectangular prisms.
Main Core Tie
Mathematics Grade 5
Strand: MEASUREMENT AND DATA (5.MD) Standard 5.MD. 3

## Additional Core Ties

Mathematics Grade 5
Strand: MEASUREMENT AND DATA (5.MD) Standard 5.MD. 4
Mathematics Grade 5
Strand: MEASUREMENT AND DATA (5.MD) Standard 5.MD. 5
Materials

- Counting on Frank
- Let's Build Boxes
- Two-cm graph paper

Multilink cubes
Scissors
Tape

- Which Box?

Additional Resources
Books
Counting on Frank, by Rod Clement; ISBN 9780395703939
Math on Call, A Mathematics Handbook, by Great Source Education Group; ISBN 0-669- 45770-1
Navigating through Measurement in Grades 3-5, by NCTM; ISBN 0-87353-544-8

## Background for Teachers

In this activity students will be finding the volume of rectangular prisms. The volume of a prism is the amount of space inside the prism. Volume is measured in cubic units, which means it tells how many cubes of a given size it takes to fill the prism. The formula for volume of a right rectangular prism is length x width x height. The formula for volume of a right prism with a triangular base is 12 (length x width) $x$ height.

## Intended Learning Outcomes

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
3. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics2

Instructional Procedures
Invitation to Learn
Read the book, Counting on Frank, to your students. Discuss all of the different things the boy measures in the book. Define volume and look in the book for all of the ways the boy finds volume -24 Franks in his bedroom, ten humpback whales in the house, $1 / 10$ of his dad in the portable
television, peas in the dining room, and 745 jellybeans in the jar. In their journals, have students write a summary about Frank and his "pet" boy. Have them pick a new object and write how many of those objects they think it would take to fill their bedroom. Have some students share their ideas. Explain that we don't usually measure volume in Franks, humpback whales, peas, or jellybeans; instead, we use cubic units to measure volume.
Instructional Procedures
Divide students into partners (or groups) and hand out Let's Build Boxes.
Explain to your class that they are part of a company that builds boxes. Their department is in charge of making the bottom part of the box. They need to make different size boxes and determine how much each box can hold, or the volume of that box.
Give each pair of students 4 pieces of two-cm graph paper.
Hold up a sheet of graph paper and demonstrate how to trim it to a $9 \times 11$ rectangle. Have partners trim each of their sheets of graph paper to a $9 \times 11$ rectangle.
Ask students how many unit squares they have on each sheet. Make sure they understand that each sheet has 99 unit squares.
Hold up a sheet of trimmed graph paper and cut one unit square from each corner.
Fold up the outside rows to make a box. Tape the corners.
Tell your students to do the same thing to one of their papers.
Have the partners use multilink cubes to fill their boxes.
Discuss their findings. What strategies did they use to figure out how many cubes they would need? Did they have to fill the entire box with cubes before they knew how many they would need?
Have students fill in the information for Box 1 on their Let's Build Boxes assessment. You may need to fill in the data for the first box together as a class.
Hold up your second sheet of trimmed paper and cut a $2 \times 2$ unit square from each corner.
Fold up the sides to make a box.
Have partners do the same with one of their sheets.
Have students make predictions about how many cubes it will take to fill this new box. Will it be more or less than the last box?
Have them use multilink cubes to fill the new box and record the results on Let's Build Boxes. Discuss their results. How many did it take? Did it take more or less than the last box? Were their predictions correct? If not, why do they think their predictions were off? What strategies did they use to find the number of cubes they needed? Did they have to fill the entire box before they knew how many cubes they would need?
Hold up your third $9 \times 11$ sheet and cut a $3 \times 3$ unit square from each corner. Make it into a box.
Have partners do the same with one of their sheets.
Have the class make predictions about how many multilink cubes it will take to fill the next box. Since it took more cubes to fill the second box, will it take more for the third?
Have partners use multilink cubes to fill the new box and record results on Let's Build Boxes. Discuss their results. Did it take more or less cubes to fill the third box? Why do they think that is the case? Did they use any different strategies this time to find the number of cubes they needed?
Hold up the final sheet of graph paper and cut a $4 \times 4$ unit square from each corner. Make a box.
Have partners do the same with their last sheet of graph paper.
Make predictions on how many multilink cubes it will take to fill the new box. Will it take more or less than Box 3? Why do they think that?
Have partners use multilink cubes to fill the new box and record results on Let's Build Boxes.

Have students look for patterns in their table and complete the worksheet.
Discuss what they noticed about their worksheet. Did they find any patterns? Is there an easier way to find volume than by building boxes and filling them up with multilink cubes? Have the class come up with a formula for finding volume of rectangular solids.
In their journals, have students draw a box and label its dimensions. Have them write a paragraph explaining their findings of the activity. Have them record the formula for volume and find the volume of the box they drew.
Have students complete the assessment, Which Box?

## Extensions

Curriculum Extensions/Adaptations/ Integration
Have advanced learners come up with the formula for volume for a right prism with a triangular base.
Find the volume of other three-dimensional shapes.
Do the activity again with two-cm graph paper trimmed to a $9 \times 9$ square. Have students make as many different boxes as they can, record the information, and look for patterns.
Family Connections
Have students tell their families the story of Frank and his "pet" boy.
Give students a few sheets of two-cm graph paper. Have them work with their family to come up with a box bottom that they think will hold the most (has the greatest volume). Bring the boxes back and share their findings with the rest of the class.

Assessment Plan
Informal assessment includes class discussion and observations.

- Let's Build Boxes
- Which Box?


## Bibliography

## Research Basis

Von Drasek, L. (2006). Teaching with Children's Books: The "Wow" Factor. ERIC Source (ERIC \# EJ729683). Retrieved December 10, 2007, from eric.ed.gov.
Teaching math through children's books motivates children to learn math in exciting new ways; encourages students to think and reason mathematically and build students' appreciation for math and literature.
Ward, R. (2005). Using Children's Literature to Inspire K-8 Preservice Teachers' Future Mathematics Pedagogy. ERIC Source (ERIC \# EJ738003). Retrieved December 10, 2007, from eric.ed.gov. A growing body of research in the fields of mathematics education and literacy supports the inclusion of children's literature with teaching and learning mathematics. The author presents a variety of activities and ideas that are sound strategies for effectively integrating children's literature with the teaching of mathematics.

## Authors

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