Lesson Plan: Break It Down!

Original Lesson

CT Focus: Decomposition	**games.thinking myself.com**
Cross-Curricular Ties: Math	
Age Range: 8–14	
Duration: 30 minutes	
Scan the QR Code or type the URL to see the online game that inspired this lesson.	

Overview

In this lesson, students learn the value of decomposition by breaking large problems into smaller, more manageable bites. Working together, students will receive puzzles that consist of a picture of a brick wall and a set of cardboard faces that can be used to create the bricks for that wall. Students must decompose the puzzle into single-unit problems where they can solve for one brick. After that, they'll apply the information they discovered to each of the subgroups they created until they have answered the puzzle as a whole.

Vocabulary

Decomposition: The process of breaking down a big problem into smaller pieces. Decomposition can help make solutions easier to see.

Lesson Objectives

Students will be able to:

- Break a large problem down into smaller parts
- Create math equations based on images
- Compute the number of items needed to construct an imaginary wall
- Describe in their own words how decomposition can make difficult problems easier to solve

Materials and Resources

- Paper
- Pencils
- Whiteboard or projector
- Puzzle cards

Preparation

1. Read the lesson and decide how it can best fits into the age range of your classroom.

2. Visit http://games.thinkingmyself.com and run through the section on "Decomposition" to illustrate the ideas behind this concept.
3. If students will be working in groups (Grades 3 and higher), print out enough puzzles for each group. If the whole class is working together, you can cut puzzles into individual sheets for use with overhead projection.
4. Consider bringing boxes (such as tissue boxes, cereal boxes, match boxes, or DVD cases) as a physical illustration of what students will be emulating.

Activity

Step 1. Introduction—Take a moment in front of the class to build a simple three-level pyramid. Just the act of doing this will likely grab students' attention. When your pyramid is complete, let students know that you have a puzzle for them.

> "I want to cover each side of each box with paper. I know I can get pieces of paper in exactly the right size to fit each side of each box, but they're really expensive, so I don't want to waste any. How many pieces of each size paper will I need to do all of these boxes?"

Illustrate with sample images of the paper sizes needed to cover one box (either draw on the board with dimensions included, or physically cut out).

Young students will likely start making wild guesses, while older students will probably start to do some mental math. Ask for volunteers with answers.

When you get a student with the correct answer, ask what steps he or she used to solve the problem. (He or she will likely have broken it down to something like "We have *n* [number of] boxes with 2 sides of *x,* 2 sides of *y,* and 2 sides of *z.*")

If your class doesn't get to a correct answer, start to pull the pyramid apart into individual groups for each row (one of 3, one of 2, and one of 1).

> "Here, does this help?"

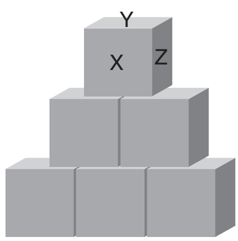
Older students will most certainly get it at this point, while younger students will likely need to be walked through the practice of figuring it out for one box, then multiplying by two to get the answer for the second row, then multiplying by three to get the answer for the third row, and lastly, adding all of those numbers together.

What we just did is called ***decomposition****!* "Decomposing" is breaking something down into smaller pieces, and by using decomposition, we can get a puzzle down into its simplest problem and make quick work of solving it. Next, all we have to do is follow back through our decomposition process, building the problem back up step-by-step until we have a final answer!

Step 2. Play with puzzles—Students should now be excited to try these puzzles on their own. Go through one or two examples with them before you turn them loose, to be sure that students understand that they should be breaking the puzzles down gradually instead of jumping straight from the wall to the individual bricks. This will make it easier to get the final answer when they start putting everything back together.

For young students, use tally marks to keep track of sides, and then count for final answers. Grades 3 and higher should be able to handle using quantities.

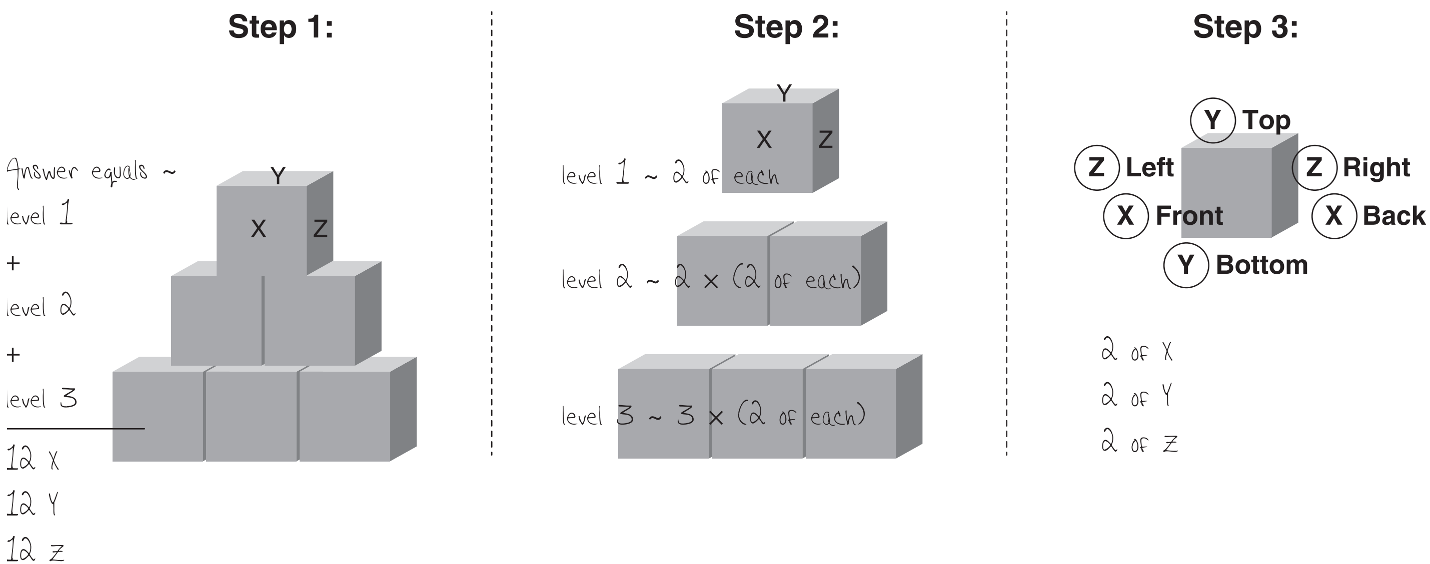
Breakdown:



How many pieces
do we need of each size?

X _____
Y _____
Z _____

Older Student Demo



Decomposing the Bricks Problem

Be sure to explain to students whether you intend for them to write directly on the puzzles or if they should use additional sheets of paper.

Challenge students to come up with extra puzzles for each other when they've finished the examples on the worksheet.

Step 3. Share—Ask students to chat in their groups about the puzzles that they solved. Which was most difficult? Why? What other places in life can students see that breaking a problem down into smaller pieces would make the problem easier to solve?

Step 4. Discuss together—Bring the class back together for a chat.

- Were these problems easier to solve in one glance, or after breaking them into pieces?
- Were there times when it was fine to jump from the whole puzzle down to one brick instantly and then do the math to solve just once?
- Were there times that it was easiest to break the big puzzle down into many subgroups before solving for a single brick? How did that make it easier to solve the whole puzzle?
- Where are some other places in your life that you could use decomposition to make problem solving easier?

What It's All About

In the real world, computer scientists use decomposition all the time. They often get clients who want them to build very large and complex programs. To understand what a big project will take, these pros need to break it down into lots of little elements, so they can figure out how to approach the code. Often, when it's time to program the application, the engineers will break those pieces into even smaller chunks (called *procedures*) to help keep everything as clean and simple as possible.