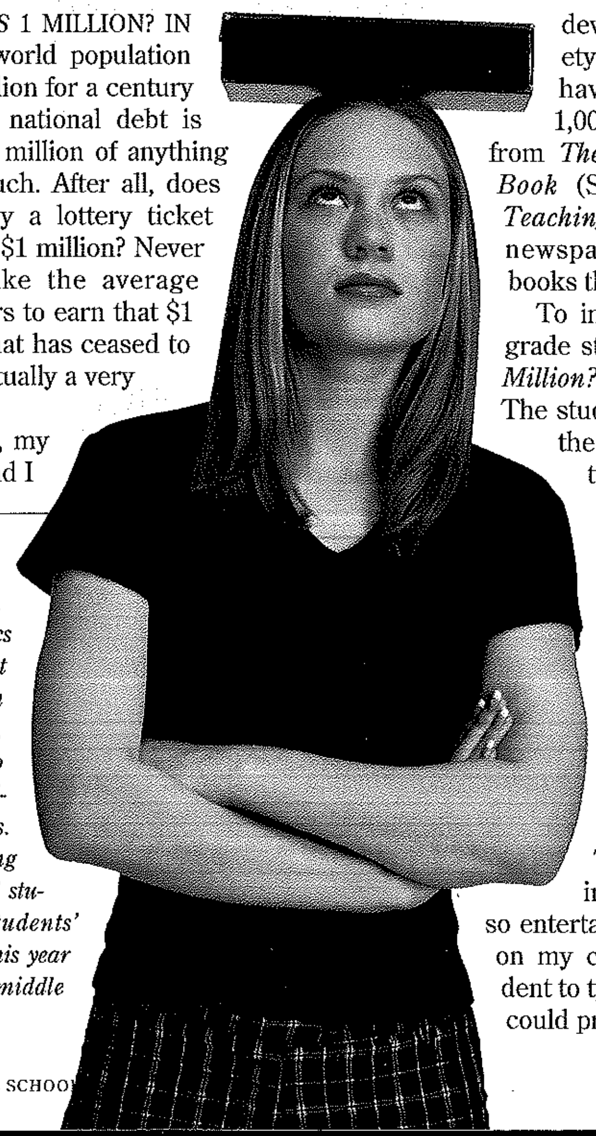
Making a Million Meaningful

KIM ELLETT



JUST HOW MUCH *IS* 1 MILLION? IN a time when the world population has been over 1 billion for a century and our country's national debt is over 7 trillion dollars, 1 million of anything does not impress us much. After all, does anyone rush out to buy a lottery ticket when the jackpot is *only* $1 million? Never mind that it would take the average teacher over twenty years to earn that $1 million. For a number that has ceased to amaze us, 1 million is actually a very interesting number!

To convince students, my colleague Helen Chan and I developed a unit based on a variety of meaningful explorations, all having to do with the number 1,000,000. We used several ideas from *The Magic of a Million Activity Book* (Schwartz and Whitin 1998), *Teaching Children Mathematics,* the newspaper, and several children's books that touch on the subject.

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To introduce the unit to my sixth-grade students, I read *How Much Is a Million?* to my class (Schwartz 1985). The students were amazed by many of the claims made and were ready to challenge them when I finished reading. To get them into the right frame of mind for all the calculating we were about to do in relation to 1 million, I gave them a short writing assignment. They were to discuss what they would or would not want 1 million of, and then what they might do with 1 million chances, books, friends, cars, trees, and so on. They were only limited by their imagination. The results were so entertaining that I created a template on my computer and asked each student to type his or her answers so that I could print them for the whole class to read (see **fig. 1**). The students enjoyed reading all the responses.

What would I do with 1 million?

I wish I had 1,000,000 . . .
Balloons
Dollars
Million dollar bills
Hundred
Hot guys
Dirt bikes
Pieces of food
Friends
Crumbs
Pancakes

I would not want 1,000,000 . . .
Spiders
Brothers
Pets
Chocolate bars
Skateboards
Toe funguses
Dogs
Fish
Homework assignments
Vegetables
Rainy days
Children (when I am an adult)
Moms and dads
Moldy crumbs
Feet
Cows
Days off from school
Years
Bug bites

I can make 1,000,000 . . .
Cakes
Carrot cakes to eat
Pencil marks
Stars on paper
Starburst bracelets
Toys
Smiley faces
Dollars in the stock market
Drawings
Footsteps
Cookies
Paper cranes
Muffins
Made up stories

I could eat 1,000,000 . . .
Cookies
Crumbs
Pieces of pizza
Fingerprints
Pancakes
Paper airplanes
Starburst jellybeans
Pizzas
Sweet and sour pork with fried rice
Peas
Jelly beans
Cakes
Puddings
Macaroni noodles
Pieces of sugar
Skittles in two weeks
Sandwiches
Starbursts
Tipan platters of anything
Milk shakes
Bowls of ice cream
Pieces of gum in year
Strawberries

I could never eat 1,000,000 . . .
Pizzas
Plates of spaghetti
Peas
Brussels sprouts
Worms
Slugs
Breads
Apples
Pieces of candy
Fish
Pieces of pizza
Horses
Squids
Red peppers
Pieces of 14-year-old gum
Mushrooms
Bowls of spinach
Hot dogs

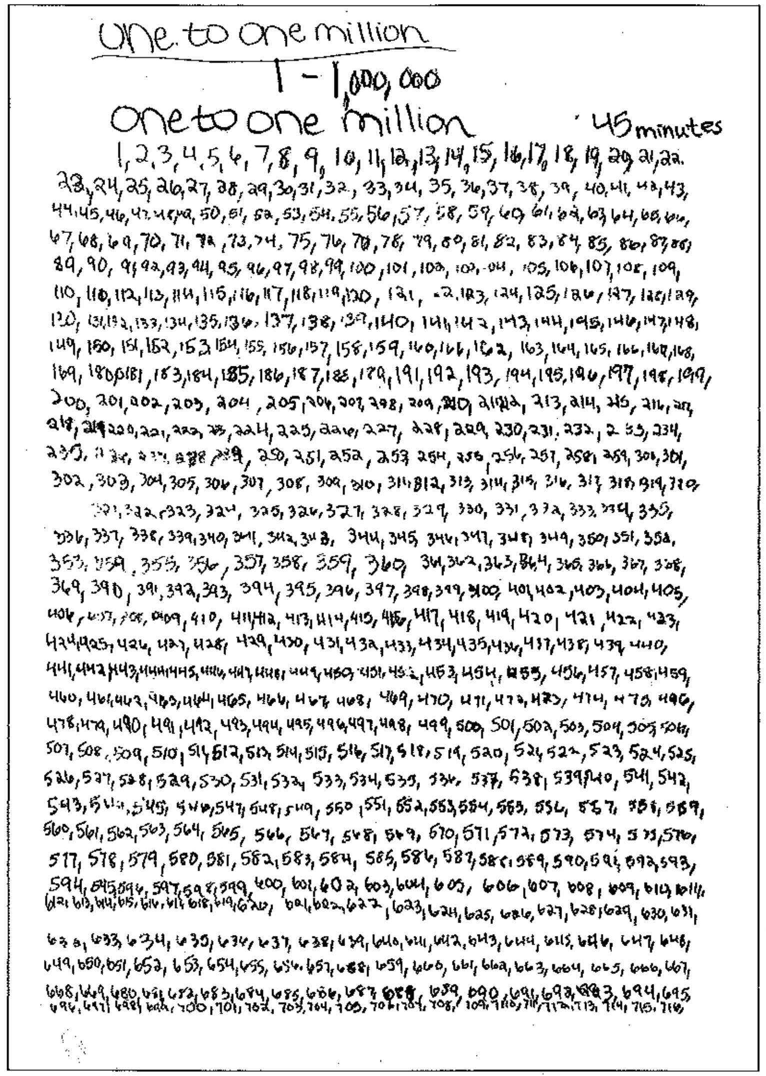
Having 1,000,000 _________ would be great!
Dollars
Fireworks
Balloons
Kitties
Acres
Bikes
Cats
Hot chicks
Cute guys
Packs of gum
Paintball guns
Friends
Pools
Horses
Crumbs
Outfits
Girls
Four wheelers
People to do my homework

Having 1,000,000 _______ would be a problem!
Homework assignments
Fish
Dogs
Cats
Monkeys
Brothers and sisters
Bills
Birds
Animals
Crumbs
Dinosaurs
Frogs
Cars

If I had $1,000,000 I would . . .
Give some to the poor and some to my friends and family. Then I would use the rest wisely.
Put it in a college fund.
Buy my own house.
Buy a lot of stuff.
Spend it all.
Buy everything I want.
Buy a store.
Spend it on things I need.
Go shopping, go on vacation a lot, and the movies a lot.
Save some then go shopping.
Blow it all!
Go shopping every day, go on vacation every weekend, go shopping, buy pets, and go shopping more.
Save until I had more.
Put it in a high interest bank account.
Buy whatever I want to.
Buy everything I wanted and more!
Be rich.
Go to the mall!
I would save it in the bank.

Fig. 1 Students reply to the various questions about quantities of 1 million.

By now, they were more than ready to examine some of the claims made in the book that we had read. It states that it would take over 11 days to count to 1 million. My students were pretty sure that they could do it in less than a day, maybe two. We discussed what we could do to actually find out just how long it might take—without really doing the counting. The students decided to work in pairs and time each other counting aloud for one minute. Some students were easily able to use the data they collected to make a proportion to determine how long it would take them to count to 1 million. Others needed to set up a table that listed the number of minutes and how far they had counted. After they



One to one million

1 - 1,000,000

One to one million · 45 minutes

1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22.

Fig. 2 Julia made it up to 716 in the quest to write all the numbers from 1 to 1 million.

had extrapolated their "counting" data up to 30 minutes, they knew that they could double that counting number to see how far they could count in an hour. With some prompting, they realized that were they to multiply this number by 24, they would know how far they could count in a day. Most students calculated that it would take them between four and six days to count out loud to 1 million.

Someone quickly pointed out that it is much faster to say the single or double-digit numbers than it is to say the five- or six-digit numbers. One student volunteered to be timed as he counted aloud beginning with 345,678. We calculated how long it would take him to reach 1 million, and this time it was around 17 days. This result intrigued the students, and many still did not believe it. Although they had the data and the calculations on their papers in front of them, it just seemed like it could be done faster.

As a homework extension for this assignment, I gave the students a choice of investigations. They could either repeat the experiment we had done in class, but instead of counting in English, they could count in their native language (Spanish, Japanese, or Ukrainian) or they could calculate how long it would take them to write the numbers from 1 to 1 million. I offered some extra credit points to anyone who was able to bring in a handwritten list of all the numbers up to 1 million by the next day.

The following day, the students began to discuss their findings even before class started. Several had taken me up on my extra-credit offer to write the numbers up to 1 million, but they had not finished (see **fig. 2**). I offered them one more day, which included the weekend, and they were sure that by Monday they would have it done. Of course no one did, although some had spent a good deal of time trying (in some cases, with the assistance of a family member or two). My students were beginning to grasp just how big 1 million actually is.

It became smaller again, however, when someone mentioned that dinosaurs roamed the Earth only 65 million years ago. Obviously, none of us had been alive for 1 million years, but had we been alive for 1 million months? Weeks? Days? Hours? Minutes? Seconds? These questions, of course, led us to another investigation. How long is 1 million seconds, hours, days, weeks, or months? Do we go to school for 1 million days?

One million seconds is just over 11 1/2 days, 1 million minutes is just under 2 years, 1 million days is more than 2,700 years. That meant that none of us had been alive for 1 million days, weeks, or months! To help students get a better grasp on the length of each of those time measurements, I asked them to do a miniresearch project on something that happened 1 million days, weeks, and months ago. Some students were perfectly happy to round their answers and share events that were occurring approximately that long ago. Other students were much more precise, calculating their answers to an exact date and including leap years.

By far, the students' favorite part of the unit was the Junk Food Activity (see **fig. 3**). I asked each student to bring to class a factory-sealed bag of their favorite junk food. The bag had to have the nutrition label printed on the side and had to be unopened. Skittles, M&M's, Raisinettes, or a similar type of candy works best because each piece is approximately the same size, which makes them easy to count. Some students brought Cheetos and counted all the pieces that were about the same size, then put the smaller pieces together to make a "whole" Cheeto. This activity could be adapted to any kind of food with a nutrition label on it, but I enjoyed seeing the students' amazement as they calculated how many calories are in their favorite snacks.

Favorite Junk Food Activity
(Part 1)

Materials needed:

- Calculator
- Paper towels or a clean plastic bag
- One bag of junk food
- Pencil

1. Write down the name of the junk food you brought to class.

   Skittles

2. How many pieces of your junk food do you think are inside one bag?

   50 Skittles

3. How long do you think it will take you to eat 1 million pieces?

   10 days

4. Open your bag of junk food carefully. Count and write down the number of pieces in the bag. If there are small or broken pieces, just make an estimate.

   60 Skittles

5. Let's pretend that you eat one bag of this junk food every day. How many pieces would you eat in one week? (Hint: There are 7 days in a week.) Show how you got the answer.

   I would multiply 60 Skittles by 7 days in a week. That is 420 Skittles in a week.

6. There are 52 weeks in one year. How many pieces of junk food would you eat in one year? Show how you got your answer.

   I would multiply 420 Skittles in a week by 52 weeks in a year. That is 21,840 pieces in one year.

Favorite Junk Food Activity
(Part 2)

7. Use the calculator to divide 1,000,000 by the number of pieces you wrote down in #6. This will give you the number of years if will take you to eat one million pieces of junk food. How long will it take?

   21,840 $\overline{)\,1{,}000{,}000}$ = 45.78754579 or 46 yrs.

8. Look on the back side of your junk food bag. Write down the number of calories per serving.

   240 calories per serving

9. Write down the number of servings per container.

   1 pack

10. Multiply #8 and #9. This tells you how many calories are in one bag. Write down the number.

    240 calories per container

    240 cal. per serving
    × 1 serv. per container
    240 cal.

11. Use the calculator to divide 1,000,000 by your answer from #10. This will tell you how many bags of junk food you will need to eat to reach one million calories. So how many bags will you need to eat?

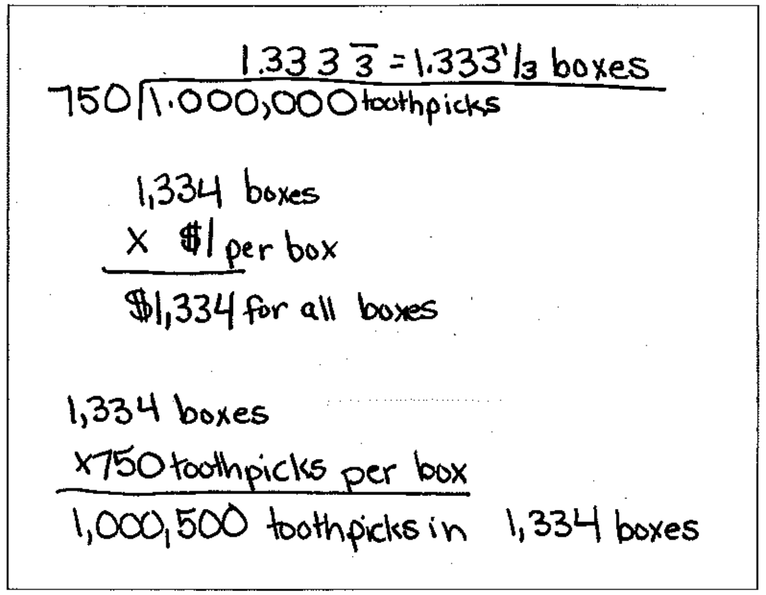
    4167 packs

12. Look on the back side of your junk food bag again. Write down the grams of fat per serving.

    2.5 grams of fat per serving

Fig. 3 This activity, a student favorite, explored junk-food totals.

First, we estimated how many pieces we thought were in our bags and how long we thought it would take us to eat 1 million pieces of each junk food. Then the students opened their bags, counted the pieces, and calculated how many pieces they could eat (eating one bag per day) in a week and a year. Next, they calculated how long it would actually take them to eat 1 million pieces of their junk food. We did a similar exploration to calculate how long it might take someone who ate one bag per day to consume 1 million calories or 1 million grams of fat (this number involved some additional calculations for students who brought in a 1 pound bag of M&M's). Finally, the students were allowed to eat their junk food as they wrote a paragraph that explained what they had learned in this activity. One student wrote, "I thought I could devour 1 million Skittles in about a month, but it actually would take around 48 years. I learned that 1 million is a lot bigger than you think!" Her sentiments were echoed by another student who wrote, "I have learned that 1 million pieces of candy is a lot. I think I should really think before I say it will take a million years or even one hundred thousand." Most of the students would agree with the student who wrote, "I learned that there is a lot of math to go through to find an answer to 14 questions about Oreos." Many students had never read the nutrition label and were amazed to find out how many empty calories were in a bag of junk food.



$1.33\overline{3} = 1.333\frac{1}{3}$ boxes

750 ⟌ 1.000,000 toothpicks

1,334 boxes
x $1 per box
$1,334 for all boxes

1,334 boxes
x750 toothpicks per box
1,000,500 toothpicks in 1,334 boxes

Fig. 4 A newspaper article about toothpicks resulted in these calculations.

To conclude the Junk Food Activity, I read *If You Made a Million* to the students, which was also a good lead-in to the next activity. There is always something in the newspaper that relates to what we are learning in class, and this unit was no exception. A short article in the newspaper had reported that a thief had stolen $20,000 worth of toilet paper! We calculated how much toilet paper that would be. My students were becoming proficient at setting up proportions and working with large numbers. Another article detailed how two Miami men had constructed a display using exactly 1 million toothpicks. They planned to charge people $1 to view the display. My students calculated how much it would cost to buy 1 million toothpicks and how long it would take the men to recover their investment. (See the calculations in **fig. 4.**) It was interesting to note that no one in the class volunteered to repeat this amazing feat.

Next, I brought a *Calvin and Hobbes* cartoon to class that shows Calvin in a bathtub, holding a piece of paper, explaining to Hobbes that "I added it up and figured out I spend an average of four days a year taking baths!" I designed an activity, shown in **figure 5,** around this cartoon. I asked the students to calculate how long *they* spend in the shower or bathtub each day, week, and year. We estimated that an average shower uses 3 gallons of water each minute. Next, the students calculated how much water they use in a day, a week, and a year. I asked several students to call the city swimming pool to ask how many gallons of water were in the pool so that we could compare the calculations with a concrete representation. Of course, we also calculated just how long it would take us to use 1 million gallons of water. Depending on the length of their showers (between 5 and 30 minutes), it would take between 30 and 180 years to use 1 million gallons of water.

1. How many minutes do you spend in the bathtub or shower every day?
   about 10-15 min. in the shower
2. How many minutes do you spend in the bathtub or shower every week?
   70 min. in shower a week
3. How many minutes do you spend in the bathtub or shower every year?
   3,640 min. in shower a year
4. Determine the number of hours you spend in the bathtub or shower every year.
   $60.\overline{6}$ *hrs. in shower a year*
5. Determine the number of days you spend in the bathtub or shower every year.
   $2.5\overline{27}$ *days in shower a year*

Fig. 5 This activity discussed a *Calvin and Hobbes* cartoon about the length of time spent in a bathtub.

Up until now, we had done a lot of calculating, a lot of extrapolating, and a lot of estimating. Many of my students needed something less abstract than numbers on paper—they needed something they could touch. What did 1 million look like? I have a poster that has 1 million dots on it, but it was professionally done, so the students had their doubts. I passed out a 35 × 50 sheet of grid paper to each student. We calculated how many squares were on each sheet of paper (1,750), and how many sheets of paper we would need to total 1 million squares (a little over 571 sheets) (see **fig. 6**'s calculations). I wondered if we could actually color *exactly* 1 million squares, since our answer was 571.42857. . . . Some students did not understand how to figure out an exact answer, but others set to work and quickly figured out that if we colored 571 whole pages, plus 750 squares on another page, we would be able to have exactly 1 million squares colored. I directed them to color their grid papers, being as creative as possible, and incorporating the squares into their designs. (See **fig. 7** for the various art projects produced by students.) This part of the unit was a welcome relief from all the calculating we had been doing, and the room was silent. Someone wondered aloud how many sheets everyone would have to color to reach the 1 million mark. The students quickly determined that everyone would have to color a little over 24 sheets each. With 23 students in the class, they were ready to give it a try. Some students turned in as many as 17 pages, but by the end of the unit, we had only 196,000 squares colored—not even a quarter of a million!

How can we create a mosaic mural of one million squares?

1. How many squares are along the horizontal direction?
   35 squares
2. How many squares are along the vertical direction?
   50 squares
3. How many squares are in total on this paper?
   50 squares × 35 squares = 1,750 squares on total paper
4. How many squares are there on two sheets of paper?
   1,750 squares × 2 papers = 3,500 squares on 2 papers
5. How many squares are there on three sheets of paper?
   1,750 squares × 3 papers = 5,250 squares on 23 papers
6. How many squares are there on four sheets of paper?
   1,750 squares × 4 papers = 7,000 squares on 4 pieces of paper
7. How many squares are there on five sheets of paper?
   1,750 squares × 5 papers = 8,750 squares on 5 papers
8. How many squares are there on ten sheets of paper?
   1,750 squares × 10 papers = 17,500 squares on 10 papers
9. How many squares are there on twenty sheets of paper?
   1,750 squares × 20 papers = 35,000 squares on 20 papers
10. How many squares are there on one hundred sheets of paper?
    1,750 squares × 100 papers = 175,000 squares on 100 papers
11. How many squares are there on one thousand sheets of paper?
    1,750 squares × 1,000 papers = 1,750,000 squares on 1,000 papers
12. How many pages would you need to have one million squares? Explain how you got your answer.

$$\begin{array}{r} 1{,}750 \\ \times\ 571 \\ \hline 999{,}250 \text{ sqs} \end{array}$$

$$1{,}750\,\overline{\smash{)}\,1{,}000{,}000}\quad 571.428574$$

571 pages is less than 1,000,000 squares. You would need 571 pages + 750 extra sq. because 1,750 × .4285 = 750.

13. Color a pattern on your grid. Put it together with others to make a million mosaic.

Extension: Figure out how many sheets would fit on your classroom walls.

Fig. 6 Another set of calculations involved a mosaic project.

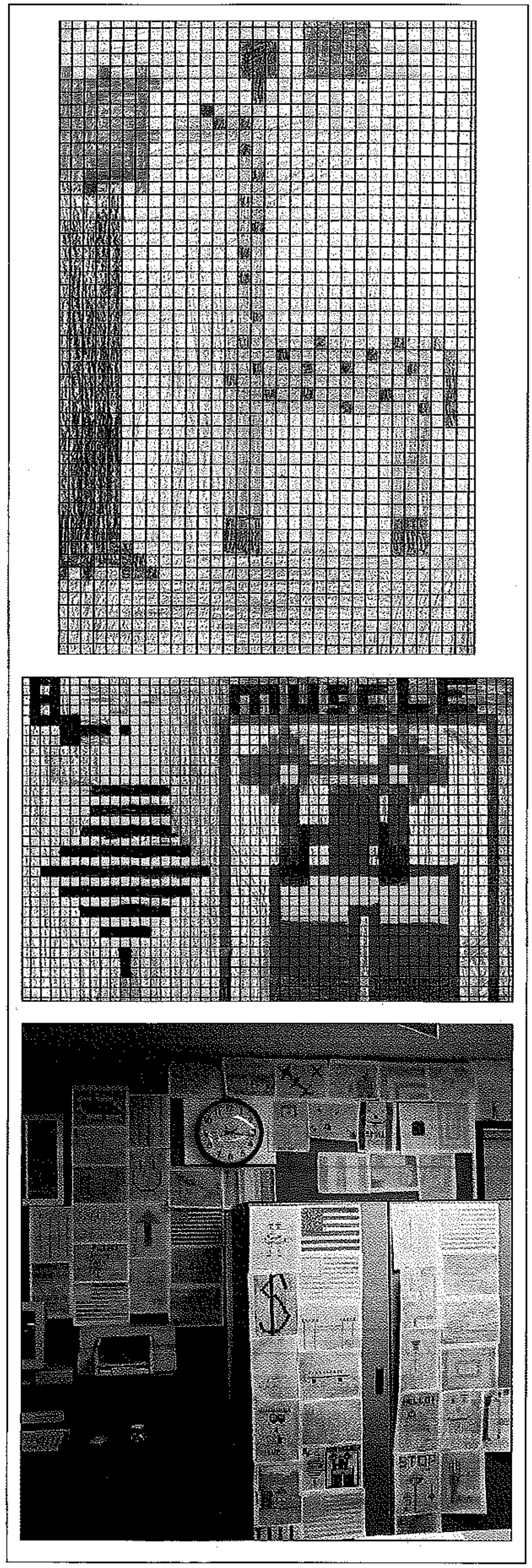


Fig. 7 A few of the colored tilings are shown.

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Another activity that visually demonstrates 1 million, or in this case many millions, is the Planet Activity. Earth is 93,000,000 miles from the sun, but how far (or close) is that in relation to the other planets? After we had determined each planet's approximate distance from the sun, we picked an arbitrary number to represent the distance between the sun and Mercury (use a number smaller than 50 cm or the most distant planets will be unmanageable). I assigned each group a planet, and the students set up proportions to determine the scaled distances between their planet and the sun. After I had checked their work, they cut a piece of string the length of the scaled distance. They made signs to represent their planet and their calculations. We went out to the field to set up our "solar system." The students were amazed by the visual representation of how far away some planets are, even Mars, which had been in the news when this project was under way.

Finally, we used the knowledge we had gained during the unit to sharpen our estimating skills. I brought in a jar each of popcorn kernels, rice, and pinto beans. Everyone individually estimated how many items they thought were in each jar. Next, we traced around the bottom of the jars; filled in each tracing with popcorn, rice, or beans; and counted how many of each would cover the bottom of the jar only. The students then were allowed to revise their estimates. Someone suggested that since we knew how many items were in one layer of each jar, all we had to do was count the layers and multiply that number by the number in each layer. I asked the class if that idea would work, everyone agreed, and the students revised their estimates. By now, we were all curious about just how many pieces really were in each jar. We opened the jars, and everyone began counting. One boy joked that he hoped that the total was not 1 million or we would be counting for the next 11 1/2 days! After we found out how many pieces were in each jar, we calculated how many jars of each we would need to have 1 million kernels of popcorn, grains of rice, or pinto beans. Would all those jars fit in our classroom? We calculated that we would need over 400 jars of rice and that they *would* fit.

I then read aloud *A Grain of Rice* (Pittman 1996). This was a good book to read at the conclusion of the unit, since it was funny and made the students think about the mathematics as the story progressed. To further demonstrate the relationships between large numbers that we take for granted, I created a bulletin board that incorporated this theme (see **fig. 8**). An article I read in the *Los Angeles Times* titled "In Our Brains, a Billion Doesn't Count for Much" gave me the idea for this project. The article details an experiment in which participants were asked to decide where on a number line the number 1 billion would be. On one end of the number line is 0, on the other is 1,000,000,000,000 (1 trillion). Along the number line are four letters—A, B, C, and D. A is about 1/10 of the way between the 0 and 1 trillion, B is about 1/3 of the way, C is 2/3 of the way, and D is about 3/4 of the way between 0 and 1 trillion. Most people think that 1 billion would be B or C when in actuality 1 billion is much nearer to 0 than it is to 1 trillion, making the answer A. This surprised many of my students.

The article also listed some interesting facts that I included on the bulletin board: There are more than 200 billion stars in the Milky Way. The human eye can distinguish between 1 million different shades of brightness. The national government spends more than $1 trillion each year. To finish it off, I decorated the bulletin board with stars, rainbows, and dollar signs (to represent the three facts I included).

One of my students asked me what number comes after a trillion. Several students had heard of numbers like a *googol* (a 1 followed by 100 zeros), or a *googolplex* (a 1 followed by a googol zeros). But no one could tell me what came after a trillion. Many guessed a zillion, which is not a number. After a trillion comes a quadrillion, then a quintillion. Someone noticed that the prefixes were the same as those used for polygons, which also led to an interesting discussion.

This unit helped students understand the magnitude of large numbers. It gave them a practical application of proportions and also reinforced the problem-solving technique of using smaller numbers. We had a lot of fun with the various investigations, and some rich mathematical discussions stemmed from great questions that the students asked while working on the activities.

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Fig. 8 A newspaper article provided the idea for making a number line and placing different large numbers in order.

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