A Teacher's Guide to

A MILLION DOTS

by Andrew Clements

ABOUT THE BOOK

How many is a million? This book was created to answer that question, and to give children an appreciation of large numbers. Each dot in this book represents a number between 1 and 1,000,000. Dot number 1 is under the point of the arrow after the opening pages. Dot number 64 is in the upper left corner of the grid page featuring the mosquito and the Empire State Building. Dot number 1,860 is in a yellow circle at the top of the same picture. And so on.

Below the grid of dots on each page there are engaging facts that relate to the number represented by all the dots up to a particular dot circled on the grid above. If each of the dots from Dot Number 1 to Dot Number 1,860 were a step, then that is how many steps a person must climb to walk to the top of the Empire State Building.

HELPFUL NUMBERS

23,808 dots per grid page
192 dots per horizontal row
124 dots per vertical column
42 grid pages

INTRODUCING *A MILLION DOTS* TO YOUR CLASS

Before opening the book, engage your students in a discussion of the number one million. How many is it? If you had a million seashells, where would you keep them? If you traveled a million miles, how far would you go? If you counted by ones to a million, how long would it take?

Open the book to the first page of text. In order to experience looking at the million dots in this book, a student should be close enough to see the single dot in the center of the opening page. This proximity can be achieved in a number of ways:

- Work with a small group and multiple copies of the book.
- Use a classroom set of books, which is part of a transportable unit on Large Numbers.
- Have groups of several students share one copy.
- Have a place in your classroom called The Dot Spot, where students can look at the book on their own.

Looking

Read the first page. Tell students to look at the dot in the center of the opening page. Now look away from the dot, at the corner of the page. Do you still see the dot? Look at the giant orange dot on the opposite page. When you look away this time, what happens? How far away can you look and still see the orange dot? Contrast these two experiences of looking. How does the size of the dot *and the attention you give it* affect your ability to see it?

Counting

Read and discuss the orange page. What do ten dots look like? A hundred dots? A thousand? Have students count the ten dots, one by one, first without and then *with* a magnifying glass. Talk about the experience of focusing on each dot.

The dots in each block of dots can be counted by determining the number of dots in one row and the number of rows in all. Record the results on the chalkboard.

Read the opposite page. Challenge students to count the dots that appear in a row at the bottom of the page. Remind them that the arrow is pointing to Dot Number One. What is the number of the last dot in the row? **63**

Turn the page. Have students describe what they see. Where is Dot Number 64? Talk about how this book works and the grid of dots on each picture. The dots go from left to right, top to bottom. Where is Dot Number 600? It is in the third row and has a dark blue circle around it. What is the number of the dot with a yellow circle around it? These two dots are featured on this page because of the facts below the picture.

Look at the opposite page. Who can find the featured dot on the picture? Read the fact below. What does each dot up to Dot Number 24,901 represent? **One mile.**

Look through the pages of the book. Encourage the students to read the large numbers. Challenge them to find the featured dots in the picture. (Some dots are hard to find, even with a magnifying glass.) Talk about what the dots represent for each fact. Do one or more of the activities listed below.

Make sure that each student has an opportunity during the week that follows to look at a million dots!

THE DOT SPOT

Set up a table where students can explore *A Million Dots* on their own. Create a notebook in which the first student to find a featured dot can record its location. Have the following materials available:

- **magnifying glass**
- **paper**
- **pencils**
- **ruler**
- **jeweler's loupe**
- **calculator (optional)**
- **computer station (optional)**

MORE MATH CONNECTIONS

The following activities, math problems, and topics for discussion are intended for use with a group. Many of them, however, can be adapted for individual use.

Number Sense

- **153,000** Which would take longer—to weave this sheet by hand or to make this many dots? Aren't we glad there are machines to weave cloth and print them with polka dots?
- **330,000** What a very long carpenter's saw that would be! Imagine a very long number line. Before you turn the page, is the number of dots you have seen so far (333,375) closer to a quarter million or a half million? **The halfway point between a quarter million (250,000) and a half million (500,000) is 375,000, so 330,000 would be closer to a quarter million than a half million.**
- **385,500** Ask your students how long it would take you to correct this many papers. (Just kidding!)
- **513,920** How many spins does it take to dry one load of laundry? Have your students write their guesses on strips of paper. Then they can practice reading and writing large numbers as you arrange the answers in order. Use a calculator to find the answer. **Divide 513,920 by 365.**
- **765,174** Ask students about the U.S. postal employees they see in their own city. Where are they and what are they doing? Help the class determine the number of employees they actually see. Where would that Dot Number be in this book?
- **823,680** Which would take longer—to walk this many pieces of uncooked spaghetti laid side-by-side OR to eat this many pieces of spaghetti, cooked? **It takes about 20 minutes to walk a mile.**

Place Value

- **364,800** If there are two servings in each can, how many bowls will you need for all this soup? Use place-value patterns to demonstrate the math. **(2x300,000)+(2x60,000)+(2x4,000)+(2x800)=729,600 bowls**

Round Numbers

- **238,857** How many trips would you have to make from Los Angeles, California to New York City to go the distance from the Earth to the moon? To answer this question, it helps to work with round numbers (since you're not building a rocket ship!). Round the number of miles between Earth and the moon to the nearest 10,000. Round the number of miles between these two cities (2,790 miles) to the nearest 1,000. **240,000÷3,000=80**
- **975,744** Use rounding rules to round this number of railroad ties to the nearest ten, the nearest hundred, the nearest thousand, the nearest ten thousand, the nearest hundred thousand. Help your students discover that there are about *one million* railroad ties on this one set of tracks. Point out that this is just one set of tracks between these two cities. Ask them to imagine how big this number might be if they knew how many sets of tracks are between these two cities…between all the cities in Pennsylvania…between all the cities in the United States.

Estimation

- **554,000** A big barrel pencil is about the same width as the pencil in the picture. Show your students how to estimate the number of dots printed on the pictured pencil, by using an actual big barrel pencil and the block of one hundred dots on the orange page. **A good estimate would be between 250 and 350.**

Addition and Subtraction

- **100,000** How much would ten whales this big weigh? Have your students use addition to find the answer. **1,000,000 pounds**
- **133,381** With the class, compare the heights of these mountain peaks. Which mountain is highest? Lowest? What is the difference in feet between Mount Aconcagua and Mount McKinley? If you stood Mount McKinley on top of Mount Kosciusko, would it then be as high as Mount Everest? **No. No regrouping necessary.**
- **232,224** Collect shoeboxes. How many shoeboxes would it take to go from the floor of your classroom to the ceiling? Have your students write their guesses down before discussing. To check their answers without using a ladder, students can raise the stack one shoebox at a time from floor level. *How many more* shoeboxes would you need to make the stack of shoeboxes in the picture? **Subtract the number of shoeboxes in your stack from 232,224.**
- **265,000** Take a vote: are there more moths or butterflies? There are actually about 250,000 different kinds of moths living on Earth. That means there are how many different kinds of butterflies? **265,000-250,000=15,000 butterflies**

- **500,000** Challenge your students to find the half-millionth dot. If no one does, remind your class that there are 23,808 dots on this picture and that there are 476,223 *dots so far,* according to the previous page. With this information, how would you find the number of dots on this picture that come before Dot Number 500,000? Where would you expect to find the half-millionth dot? **500,000-476,223=23,717 23,808-23,717=91. You would expect to find the half-millionth dot by counting back ninety-one dots from the last dot on this grid page.**
- **529,245** Compare this number of children with the number of children born in *your* state in the year 2002, or, if you live in California, in another state. Which state had more babies born in 2002? Subtract to find the difference. How old are these babies now? **Your state's Department of Health should have statistics for live births for a particular year.**

Multiplication and Division

- **1,860** There are several ways to find out the number of dots on one grid page. One way, of course, is to count them. That's why we have math. Another way is to do the following calculation: Subtract the number of dots on the opening page (63) from the number of *dots so far* after the first two grid pages (47,679) to find out the number of dots on the first two grid pages. Divide this number in half to find the number of dots on the first grid page, and every other grid page as well. **47,679-63=47,616 47,616÷2=23,808**
- **416,000** Have each student follow these steps to estimate the number of words in the book he or she is reading. 1) Count the words in one line. 2) Count the lines on one page. 3) Count the pages in the book. Now multiply the number of words per line by the number of lines per page. Then multiply your answer by the number of pages. Discuss what to do about pages with pictures on them or pages with large blank spaces.
- **578,504** If you wanted to tie this many shoelaces together, how many pairs of sneakers would you need? **500,000÷2=250,000 70,000÷2=35,000 8,000÷2=4,000 500÷2=250 4÷2=2; 250,000+35,000+4,000+250+2=289,252 pairs**
- **750,000** Use the information in this fact to find out how many hairs are on the head of one person. Think of a strategy to find out. Find a pattern. **75÷5=15 750÷5=150 7,500÷5=1,500 75,000÷5=15,000 750,000÷5=150,000**

Measurement

- **464,000** Set an empty aquarium and an empty school-lunch milk carton next to a sink. Ask students to guess how many cartons of water/chocolate milk it will take to fill the aquarium. Record their guesses. Find out the answer by having students count the number of times you pour from the carton into the aquarium. Now ask the students to guess how many aquariums of water/chocolate milk it would take to fill the swimming pool in the picture. Use a calculator to find the answer. **Divide 464,000 by the number of cartons it took to fill the aquarium.**
- **622,538** A ton is a unit for measuring weight. Find the red mark that shows how large a car would look on the deck of the world's largest ship. An average car weighs about one and a half tons. A pickup truck weighs about two tons. A locomotive weighs about 200 tons. Have your students think of other things that would weigh at least one ton. **A ton is 2,000 pounds.**
- **720,000** How much does one *Tyrannosaurus rex* weigh? Have your students develop a strategy for finding the answer. Use a calculator. **720,000÷45=16,000 pounds.**
- **942,500** How much **area** will the cards in one deck cover? A desktop? A tabletop? Determine the surface that would be covered by 52 playing cards spread out edge-to-edge. Now ask the students to estimate how many of these surfaces would cover a football field. Use a calculator to find the answer. **Divide 942,500 by 52.**

Time

- **600** How many times do the wings of a mosquito beat in a minute? What do you need to know to answer this question? **There are 60 seconds in a minute. If 6x600=3,600, then 60x600=36,000.**
- **525,600** How much time is between two birthdays…in years, in months, in weeks, in days, in hours, in minutes, in seconds? **One year, 12 months, 52 weeks, 365 days, 8,760 hours, 525,600 minutes, 31,536,000 seconds. You deserve to blow out one more candle!**

Money

- **134,000** If you had one dollar for every time you blinked in one week, how much money would you have? **$134,000.00**
- **200,000** If you had a million pennies, how much money would you have? Start simple. What if you had a hundred pennies? A thousand pennies? Ten thousand pennies? One hundred thousand pennies? One million pennies? List the number of pennies and the dollar amounts side by side. Who sees a pattern? **1,000,000 pennies = $10,000.00**

Fractions

- **675,000** How many s'mores could you make with this many chocolate bars? Each s'more takes 1 graham cracker, one marshmallow and 1 chocolate bar. Discuss strategy for finding the answer. Use place-value patterns to demonstrate the math. **2x600,000+2x70,000+2x5,000=1,350,000 marshmallows**
- **902,400** If the school cafeteria workers cut each of these apples into quarters, how many pieces would there be? **900,000÷4=225,000 2,000÷4=500 400÷4=100; 225,000+500+100=225,600**

Geometry

- **800,000** Discuss the properties of Silly Putty, including the fact that it takes impressions. Have the class imagine that every student in their school, with some help from the elephants, made their handprints on the faces of the **cube** in the picture. How many faces of the cube would that many handprints cover? What do you have

to know to answer this question? To find out how many handprints would cover *one* face, create a piece of brown wrapping paper that is 7 feet 4 inches square, and have a group of students trace their hands on it until it is covered.

- **864,948** Dots, anyone? Place an empty tennis ball can next to a stack of construction paper. Encourage students to make dots by tracing around the can. Show them how to find the **diameter** of a tennis ball by measuring the length of the diameter of the dot. If they line up 109 dots, they can see how big the sun would be if the Earth were the size of a tennis ball.

OTHER CURRICULUM CONNECTIONS

Art

- **996,480** Talk about how movies are made. Sometimes the director of the movie wants one scene filmed more than once. Sometimes entire scenes are deleted after they have been filmed. Get your class to talk about numbers larger than a million. Have them imagine what the number of still pictures would be if all the film, including all the takes and all the deleted scenes, was counted.
- **700,000** The artist George Seurat used dots to make paintings. Show your students a sample of his artwork. Invite your students to make a picture of a heart by only drawing dots.

Language Arts

- **444,768** Divide your class into reporters and truck drivers and people living in Kansas City on the day of The Big Give Away. Have reporters interview the witnesses. What was that day like?
- **615,100** Are there more than this many words in the English language? Yes. Use the chalkboard or a large-group presentation device to do this activity, which demonstrates how one word can be used to form others. Open the classroom dictionary and list a sequence of six entry words. Now have the class expand the list by adding suffixes, changing the tense and making plurals. Insert each new word where it belongs on the list alphabetically. Is the new list twice as long? What would happen to the number 615,100 if you doubled it in the same way? **1,230,200**

Science

- **87,600** Learn more about the sooty tern. How can it fly without stopping? How does it get its food? Use this Fact to make up a math problem.
- **186,000** Which is faster—a jet fighter plane or light? Light. **The fastest jet fighter plane can only travel ONE HALF MILE per second.**
- **300,000** What is true of all beetles? Have each student choose a *different* beetle to report on. After all, there are plenty of choices!
- **350,000** Discuss the word **migration.** What are some other animals that migrate every year? Compare the distances they travel.
- **650,000** Let's assume that this well-traveled arctic tern is wearing a *digital* camera. Pictures taken with a digital camera are made up of dots. The dots are called pixels. The more pixels in a picture, the clearer the picture will be. Use a digital camera to take group pictures of your students, and make 5x7 prints. Each print contains about one and a half million dots of color. Arrange the photos on a bulletin board and discuss how many dots of color are represented in this one space. **Multiply 1,500,000 dots by the number of photos.**
- **924,000** Talk about how images are made up of tiny dots. Let students use a jeweler's loupe to see the dots of color between the not-so-tiny black dots.

Social Studies

- **24,901** Show a globe to your students. Have available a ball of string and a pair of scissors. Talk about the meaning of the word **equator.** Invite students to each cut a piece of string that they think would fit exactly around the globe at the equator. Have the students take turns testing their "string theories".
- **66,660** If each dot in this book stands for one person, then how many copies of *A Million Dots* would you need to show the number of people living on Earth today? **6,000 copies. Earth's population in 2006 is more than six billion—6,000,000,000.**

INTERNET RESOURCES

Color and resolution, George Seurat: http://www.omsi.edu/visit/tech/resolution.cfm
TV and computer screens: http://www.colorado.edu/physics/2000/tv/index.html
http://home.att.net/~RTRUSCIO/COLORTV.htm
Pixels and resolution:
http://www.glencoe.com/norton/online/ezine/printer_friendly.phtml?id=230

ABOUT THE AUTHOR

Andrew Clements is the author of many popular middle-grade novels, including *Frindle,* which won the Christopher Award, and the recent *New York Times* bestseller *Lunch Money.* Mr. Clements, a former teacher, lives with his wife and four children in Westborough, Massachusetts.