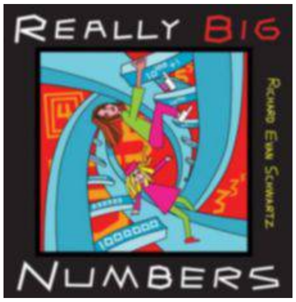
MAKING MATH COUNT:
Exploring Math through Stories

Mathical
Books for Kids from Tots to Teens

Great stories are a wonderful way to get young people of all ages excited and interested in mathematics. Now, there's a new annual book prize, *Mathical: Books for Kids from Tots to Teens*, to recognize the most inspiring math-related fiction and nonfiction books that bring to life the wonder of math in our lives. This guide will help you use this 2015 Mathical award-winning title to inspire curiosity and explore math in daily life with the youth you serve.

For more great books and resources, including STEM books and hands-on materials, visit the First Book Marketplace at **www.fbmarketplace.org**.



REALLY BIG NUMBERS

written and illustrated by Richard Evan Schwartz

Did you know you can cram 20 billion grains of sand into a basketball? Mathematician Richard Evan Schwartz leads readers through the number system by creating these sorts of visual demonstrations and practical comparisons that help us understand how big REALLY big numbers are. The book begins with small, easily observable numbers before building up to truly gigantic ones.

GRADES 3-5 WINNER

KEY MATH CONCEPTS

Really Big Numbers focuses on:

- Connecting enormous numbers to daily things familiar to students
- Estimating and comparing
- Having fun playing with numbers and puzzles

Making comparisons and breaking large quantities into smaller, easily understood components can help students learn in ways they never thought possible. This book emphasizes the importance of finding ways to connect new concepts to existing knowledge.

The Mathical: Books for Kids from Tots to Teens book prize, presented by the Mathematical Sciences Research Institute (MSRI) and the Children's Book Council (CBC) recognizes the most inspiring math-related fiction and nonfiction books for young people of all ages. The award winners were selected by a diverse panel of mathematicians, teachers, librarians, early childhood experts, authors and others.

First Book

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TALK AND ASK QUESTIONS AS YOU READ

Before reading

Think about reading this book a little each day. Introduce the book to your students by explaining that the goal isn't to finish the book quickly, but to understand something new and have fun each time you read it.

Really Big Numbers encourages readers to visualize common objects in order to understand enormous quantities. Get students ready to think this way. ASK: *Give an example of something in the room that there is only one of. What is something there are exactly two of? What is something in the room of which there are more than 50 but less than 150? Is there something in this room that there are more than a million of?*

While you're reading

Before showing each page to students, ask them to estimate the size of a described magnitude. Wait on each page while students attempt to visualize each step of numerical and abstract growth. For example, on page 39, ASK: *About how many hairs do you think monkeys have on their heads? More than 10? More than 100?* (The answer is about 100,000.)

Draw connections after you read

This book uses colorful illustrations and comparisons to explain complex mathematical ideas. ASK: *Did the pictures and comparisons help you understand the math concepts? Why or why not? What else can pictures and comparisons help us understand?*

The author tells us that some of the ideas might be tough but to stay with them as long as we can. ASK: *When you face a tough problem, what do you do to figure it out? How do you feel? What are some good first steps to take when you're faced with a very tricky problem?* Some ideas to share might include breaking a problem into smaller parts, or considering a similar example that is easier to understand, then applying those ideas to the more difficult problem.

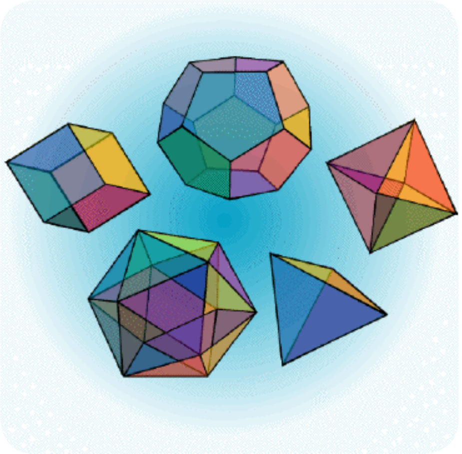

Illustration courtesy of New South Wales Department of Education and Communities, http://www.curriculumsupport.education.nsw.gov.au/primary/mathematics/

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Many of the puzzles in *Really Big Numbers* are solvable by using a pattern like this one, just on a very large scale. Walk through this example with your students.

ORDERING ICE CREAM

ACTIVITY 1

Use these instructions with the ice cream graphic on the next page.

MATERIALS

- Visual aids, such as ice cream cones/bowls or toppings (optional)
- Copies of the graphic on the following page (optional)

INSTRUCTIONS

Imagine that you're at a small ice cream shop. Although you only make a few choices among a small number of options when placing your order, there are many possible final orders.

Think of your choices as a tree with branches, where each new choice that you make creates another level of branches splitting off in sets. Multiplying the number of branches before they split by the number of ways each branch is now splitting will give you the number of possible combinations.

How many possible orders are there? The answer is 2x3x4, or 24 total possibilities.

Encourage follow up questions. ASK: *What if there's whipped cream? What if I want all of the toppings? What if I want two scoops?* As students come up with new ideas, revise the mathematics and the final solution to reflect changes to the options or the new choices students want to add.

For example, if students want every topping combination to be possible (e.g. sprinkles and fudge sauce, but no cherry), this makes each topping into an independent choice (e.g. sprinkles or no sprinkles). Making a tree out of these choices yields a tree with 2x2x2 = 8 options simply for what kind of toppings are used. In addition, there are 2x3x8 = 48 possible orders if they can still use a cone or cup and order chocolate, vanilla, or strawberry ice cream.

See how far you can take this reasoning with your students to calculate the number of possible coloring patterns in the color-by-number in the second activity, on the final page.

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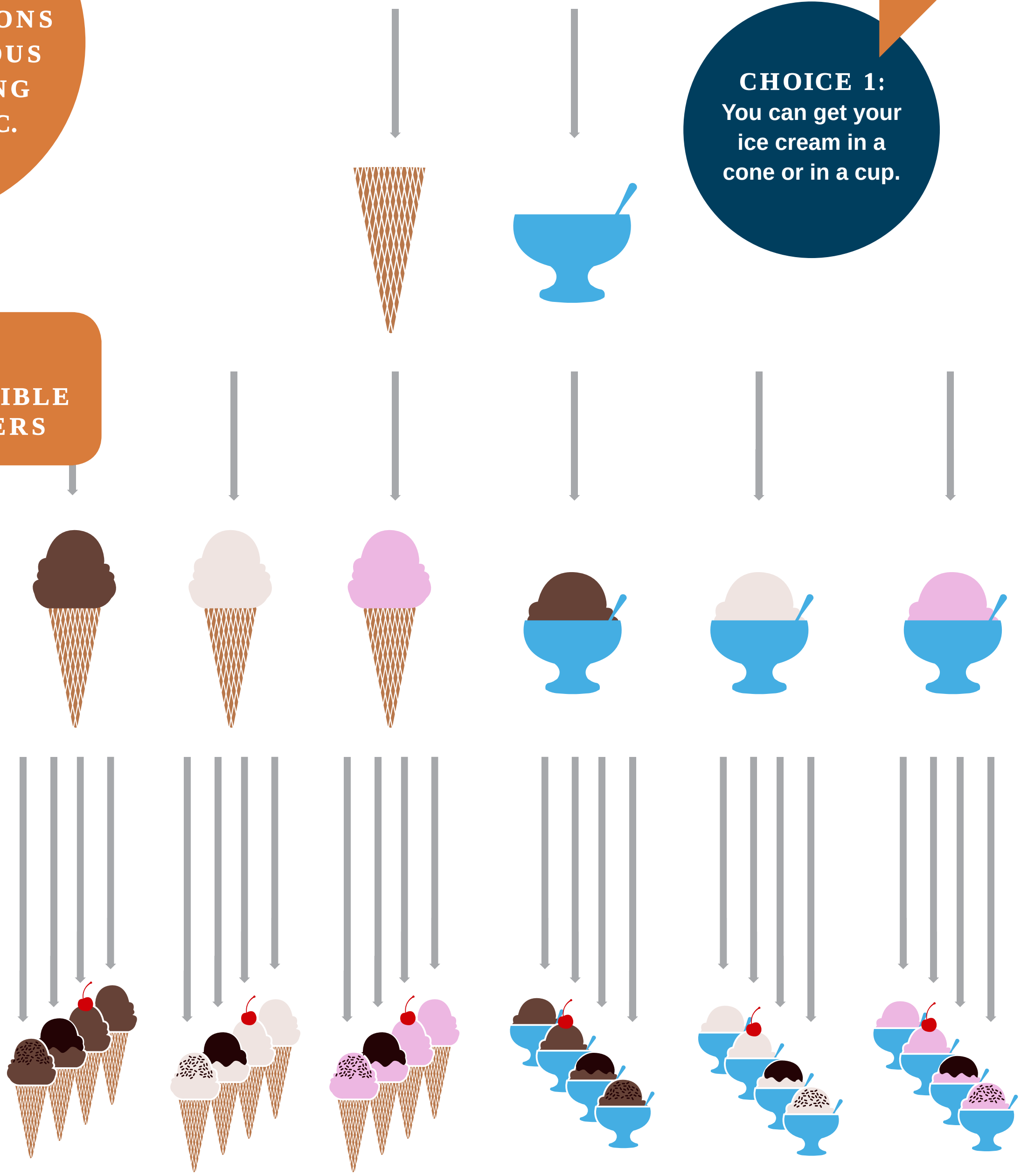
ORDERING ICE CREAM

PLEASE SEE THE INSTRUCTIONS ON THE PREVIOUS PAGE FOR USING THIS GRAPHIC.

2 POSSIBLE ORDERS SO FAR

CHOICE 1: You can get your ice cream in a cone or in a cup.



2x3 =
6 POSSIBLE ORDERS

CHOICE 2: You can get chocolate, vanilla, or strawberry ice cream.

CHOICE 3: You can get sprinkles, fudge sauce, a cherry, or no topping.

2x3x4=
24 POSSIBLE ORDERS

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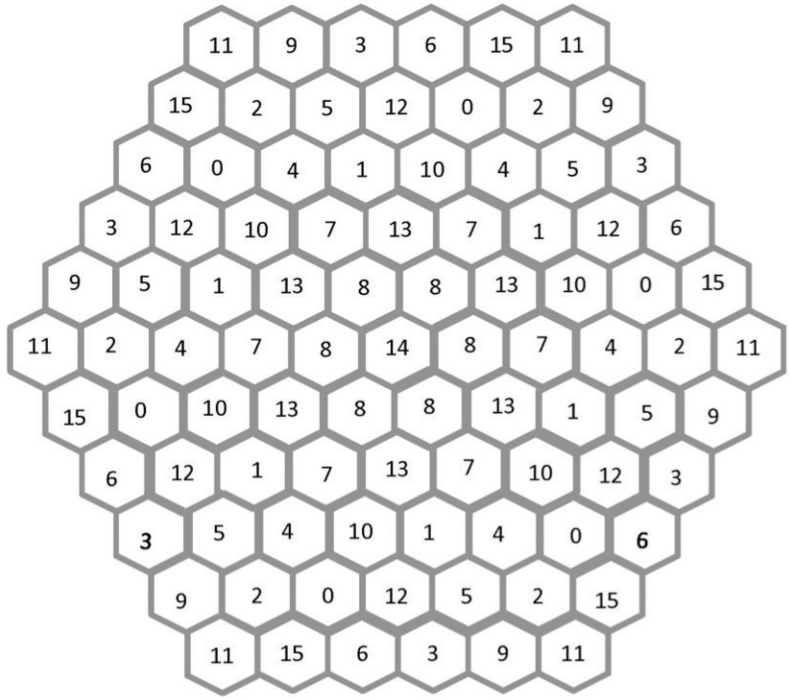
MAKING HISTORY WITH HEXAGONS

ACTIVITY 2

MATERIALS

- Hexagonal mandala (template here)
- Crayons/markers/colored pencils in four colors



1. Preparation
    - Make a copy of the hexagonal mandala for each student. You can use this one or something similar.

2. Color
    - Instruct students to choose four colors and color number pairs in the same color. For example, all the hexagons with 5 in them would be the same color.

3. Review and make connections
    - Display the completed art. Encourage students to compare and contrast what they created with what their peers made. ASK: *Why do you think the art we made looks different?*
    - Work with students to calculate the number of coloring patterns on the mandala using four colors (the answer is 4*4*4*4*4*4*4*4*4*4*4*4*4*4*4*4 or 4,294,967,296 distinct patterns). Consider walking through the example below, then using the same idea to calculate the number of coloring patterns. With so many possibilities, it's unlikely that anyone has ever seen any one of the designs students created!

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