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# Math + Books = Mathical!

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**Abstract:** Reading books—including fiction, nonfiction, and other genres—can enhance achievement in mathematics. Here the website Mathical is introduced, which promotes children’s and young adult literature with mathematics content. The 2021 Mathical Book Prize Winners and Honor books, as well as additional features of Mathical are reviewed. Reasons to use literature in mathematics instruction, such as for real-world connections and advancing concepts of inclusion and social justice, are provided.

**Keywords:** literacy, applications, cross-curricular connections

## Introduction

It’s about math. It’s about books. It’s a winning formula for sharing mathematics concepts and perspectives combined with engaging stories and appealing information. The Mathical Book Prize is an annual award list of “fiction and nonfiction books that inspire children of all ages to see math in the world around them” (*Mathical*, introductory section, n.d.). From the inception in 2015 to the most recent Mathical Book Prize books announced in February 2021, a total of 88 Mathical Book Prize Winner and Honor Titles for young people have been selected for PreK (ages 2-4), Grades K-2 (ages 5-7), Grades 3-5 (ages 8-10), Grades 6-8 (ages 11-13), and Grades 9-12 (ages 14-18). Plus, seven Hall of Fame Titles have been named. All of the books as well as resources and mathematics-related ideas can be found on the *Mathical* website at <https://www.mathicalbooks.org/>.

These books are engaging and quality literature, and the *Mathical* website provides numerous advantages for the mathematics teacher and students. However, before delving further into *Mathical* and highlighting the 2021 Winning and Honor titles, it is of benefit to explore why it is crucial to include book reading in the mathematics classroom.

## Mathematics and Reading

We recognize that mathematics instruction is more than numbers and formulas. Mathematics also involves observing and using language to describe the world in specific ways. But can reading books, including fictional stories as well as nonfiction (informational) books, enhance achievement in mathematics? Several studies suggest yes, it can. Gomez et al. (2020) conducted an extensive literature review regarding “reading comprehension and its effects on mathematics performance in elementary and middle school settings” (p. 1351), and noted language diversity, phonological processing, language comprehension, reading comprehension, and mathematics problem translation are factors affecting mathematics achievement. In a study using brain imaging with university students in China, Zhou et al. (2018) suggest a “close association” between mathematical problem solving and language processing (p. 368). Using Programme for International Student Assessment (PISA) results, Akbasli et al. (2016) determined that around the world, “reading comprehension” is “one of the biggest factor [sic] on math or science achievement” and recommend “families and

teachers should encourage the students to read” (p. 120). Longitudinal studies in Chicago, Japan, and Britain found book reading resulted in mathematics achievement. In Chicago, students in grades 3 through 8 read passages from a variety of genres including but not limited to poetry, fiction, and nonfiction, and there was a “modest, yet nonetheless significant effect of early reading skills on changes in mathematics, especially on components of mathematics that often give students difficulty such as problem solving and mathematical concepts” (Grimm, 2008, p. 421). A survey in Japan conducted in 2016 and 2017 with over 42,000 fifth-graders “showed that children who read 10 or more books saw their average deviation value in four subjects—Japanese, mathematics, science and social studies—rise by 1.9 points, while those who did not read any books registered a 0.7-point fall in average score” (“Reading improves,” 2018). In Britain, Sullivan and Brown (2015) posit children’s “reading behaviour was strongly linked to test scores in mathematics and vocabulary” (p. 986), and stated “our findings strongly back the need to support and encourage children’s reading in their leisure time” (p. 987) as well as family involvement in reading.

Teachers do implement book reading in the mathematics classroom. At least 25 years ago, Reehm and Long (1996) substantiated an “instructional technique that is currently advocated for elementary students is the use of children’s literature to relate mathematics to the real world and to stimulate interest in mathematics” (p. 35). The National Council of Mathematics promotes using literature in mathematics instruction, such as with publication of the book *Deepening Students’ Mathematical Understanding with Children’s Literature* (Monroe et al., 2018). Several journal articles explain literature integration with mathematics, such as combining geometry and poetry with second- and third-graders (Whitin & Piwko, 2008), and suggesting ideas for using children’s literature to explore functions with middle graders (Billings & Beckmann, 2005), for example.

Reading in mathematics classrooms is not limited to the younger grades. Currently, Sam Shah, a 12th grade calculus teacher in Brooklyn, and Joel Bezaire, a 7th grade pre-algebra teacher in Nashville, include novel reading in their math instruction (Newhouse, 2018). Bezaire uses novels with math content as read-alouds in his 7th grade pre-algebra class, and has a page for “Novel Studies for Math Classes” among the literature and math information on his website at <https://prealgebraone.wordpress.com/>. A list of some of the books Shah has used is available on the “PBS Teachers’ Lounge” at <https://www.pbs.org/education/blog/reading-can-expand-what-kids-think-about-mathematics>, where he provides book descriptions along with recommended grade levels or mathematics content suggestions.

Hopefully, additional research will emerge to establish direct connections between book or story reading and mathematics competence, however there does not appear to be a reason to discount a connection between reading books and success in mathematics. Current research certainly supports the use of Mathical Book Prize books for increased interest and understanding of mathematics.

And now, the 2021 Mathical Award and Honor books!

## 2021 Mathical Award Winners

### PreK

*Lia & Luís: Who Has More?* by Ana Crespo. Illustrated by G. Medeiros. (Charlesbridge, 2020)



After purchasing their favorite Brazilian snacks—Luís chooses a bag of biscoito de polvilho (tapioca biscuits), and Lia chooses two coxinhas de galinha (chicken croquettes)—the children engage in figuring out who has more. Size? Number? Or is there another way? And, being thoughtful, can they each have the same amount? Lia and Luís are members of a Brazilian American family. A few words in the text are Portuguese, and are included in a short glossary at the end. Ideas for

helping children with concepts of comparing and measuring are appended. Part of the “Storytelling Math” series.

### Grades K–2

*The Animals Would Not Sleep!* by Sara Levine. Illustrated by M. Miguéns. (Charlesbridge, 2020)



When Marco’s mom informs him it is time to put away toys for bedtime—all stuffed animals—he suggests he should sort them, like a scientist would! He begins with three baskets: Flying Animals; Swimming Animals; Animals That Move on Land. But the animals would not stay in the baskets. Marco tries other ways to organize, such as by colors, then sizes, and eventually by how they will fit in his bed. This book begs for hands-on sorting and classification in the classroom. Even if

children don’t have stuffed animals to bring in, use an art lesson along with a science lesson about characteristics of various animals—drawing can lead to observational learning. Similar ideas for sorting sets and data are included on a page at the end of the book. Part of the “Storytelling Math” series.

### Grades 3–5

*Seven Golden Rings: A Tale of Music and Math.* By Rajani LaRocca. Illustrated by Archana Sreenivasan. (Lee & Low Books, 2020)

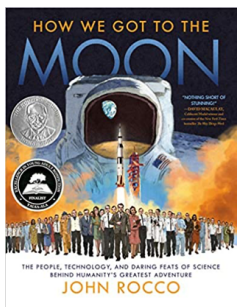


With only one rupee and the remaining portion of his mother’s wedding necklace—a chain of seven golden rings—Bhagat journeys to the city where he can sing during a week of auditions for a place in the rajah’s troupe. When he arrives at the inn, he needs one of the rings to exchange for one night. The goldsmith charges one rupee to break a link, but what if he needs to stay two nights? Or more nights? Can Bhagat think of a

way to separate the chain to pay for up to seven nights, using only one rupee? This story is a puzzle, but Bhagat as well as his mother end up living in the rajah’s palace when Bhagat becomes not the rajah’s singer, but the rajah’s thinker. Looking at mathematical problems from various perspectives is pleasantly presented, along with an author’s note beginning with an explanation of base ten and proceeding to computer bits and bytes.

## Grades 6–8

*How We Got to the Moon: The People, Technology, and Daring Feats of Science Behind Humanity's Greatest Adventure.* By John Rocco. (Crown Books for Young Readers, 2020)



In 264 pages, John Rocco has explained and shown fascinating and meticulous details about the beginning of the space race in 1957, to the end of the last Moon mission in 1972. Along with visuals on every page, there is information you've wondered about, and much you haven't thought of yet but now can't stop reading. There are lists, text boxes, graphs, problem-solution text structures, experiments, diagrams, and additional unique presentation styles. What were some of the distinctive features of the Lunar Module—the first spaceship to land two people on the Moon—and what was its size and weight? Why is the first microcomputer, the Apollo Guidance Computer, considered the great-grandfather of the modern smartphone? How many stitches, by hand, were required for the seams in spacesuits? How could the slow and large-size “bigger than a school bus” computers in 1961 (Rocco, p. 111) be reduced to the size of one cubic foot? Who figured out how to send a television signal from the Moon so people on Earth could watch Neil Armstrong take his famous Moon walk, how long did the signal take to get from Moon to Earth, and what was its path? People, machines, launches, landings . . . mathematical marvels.

## Grades 9–12

*Grasping Mysteries: Girls Who Loved Math.* By Jeannine Atkins. (Atheneum Books for Young Readers, 2020)



Included are chapters for each of seven women who lived between 1750 and 2020, and who made significant scientific contributions based on their love of mathematics. Caroline Herschel discovered comets. Marie Tharp, who lived in numerous places as a child including Bellefontaine, Ohio, and graduated from Ohio University, used mathematics for her work in mapping the ocean floor. Florence Nightingale, Hertha Marks Ayrton, Katherine Johnson, Edna Lee Paisano, and Vera Rubin used mathematics to make contributions to hospitals, electrical inventions, NASA, statistics for the U.S. Census Bureau, and dark matter, respectively. Beginning with their childhoods, author Atkins has created biographical-based stories of their lives, using verse to breathe humanity into what is known about them. In a “Behind the Verse” section at the end, Atkins provides her perspective on the writing of this book, followed by brief information about each of the women, as well as bibliographies for each.

## 2021 Mathical Honor Books

In addition to the Mathical Book Prize winners, the 2021 committee selected Honor books for each grade level group.





Fig. 1: 2021 Mathical Honor Books.

## PreK

- *One is a Piñata: A Book of Numbers*. By Roseanne Greenfield Thong. Illustrated by John Parra. (Chronicle Books, 2019)

## Grades K–2

- *Billions of Bricks: A Counting Book about Building*. Written and illustrated by Kurt Cyrus. (Christy Ottaviano Books/Henry Holt, 2016)
- *Bird Count*. By Susan Edwards Richmond. Illustrated by Stephanie Fizer Coleman. (Peachtree, 2019)
- *Counting the Stars: The Story of Katherine Johnson, NASA Mathematician*. By Lesa Cline-Ransome. Illustrated by Raúl Colón. (Simon & Schuster, 2019)

## Grades 3–5

- *Numbers in Motion: Sophie Kowalevski, Queen of Mathematics*. By Laurie Wallmark. Illustrated by Yevgenia Nayberg. (Creston, 2020)
- *Pass Go and Collect \$200: The Real Story of How Monopoly Was Invented*. By Tanya Lee Stone. Illustrated by Steven Salerno. (Christy Ottaviano Books/Henry Holt, 2018)

## Grades 6–8

- *Can You Crack the Code? A Fascinating History of Ciphers and Cryptography*. By Ella Schwartz. Illustrated by Lily Williams. (Bloomsbury, 2019)

## Grades 9–12

- *David Blackwell and the Deadliest Duel*. By Robert Black. (Royal Fireworks Press, 2019).
- *It's a Numberful World: How Math is Hiding Everywhere*. By Eddie Woo. (The Experiment Publishing, 2019)

## But Wait, There's More!

You will also find resources on the *Mathical* website:

- *Mathical Book Prize flyer*. This two-page comprehensive booklist, showing thumbnail cover images of all Mathical Book Prize Winners and with titles and authors arranged by grade-level categories, is downloadable. A list of titles and authors of all Honor books is also arranged by grade-level categories. Titles and authors of the Hall of Fame books are listed.
- *Grade level flyers*. Similar to the comprehensive booklist, there are two-page flyers featuring the Winner and Honor books for each grade level category, plus the appropriate Hall of Fame Titles for each grade level category.
- *Hall of Fame titles*. Not to overlook classic books for young people with notable reading and mathematics content, a list that currently names eight books is available on the main page of the website and included on the comprehensive booklist. Examples are Eric Carle's *The Very Hungry Caterpillar*, two "Alice" books from Lewis Carroll, Norton Juster's *The Phantom Tollbooth*, and Madeleine L'Engle's *A Wrinkle in Time*. The titles most applicable to the various grade levels are included on the grade-level flyers also.
- *Math Storybook Guides for Early Childhood*. Prepared by the Development and Research in Early Math Education (DREME) network, guides for some of the PreK and Grade K–2 books are linked to the *Mathical* website. A link to the DREME website will take you to additional mathematics resources for classrooms and families.
- *Exploring Math through Stories Reading Guides (PreK–12)*. These are free downloadable guides, currently available for one or more Mathical books in each grade level category. This set of guides has been prepared by First Book, the non-profit social enterprise that provides free books and materials to educators and children in need, and the Mathematical Sciences Research Institute (MSRI).
- *Videos*. View short videos of the authors reading from their Mathical Prize Winning books.

## Who Organizes and Selects the Mathical Books?

The Mathematical Sciences Research Institute (MSRI) awards the Mathical Book Prize. MSRI is non-profit with a number of public programs and can be found at <https://www.msri.org/web/cms>. For the Mathical Book Prize, MSRI works in coordination with the Children's Book Council (CBC), and partners with the National Council of Teachers of English (NCTE), and the National Council of Teachers of Mathematics (NCTM).

The Mathical Book Prize book selection panel is composed of teachers, librarians, children's literature specialists, mathematicians, early childhood experts, professors, authors, and other math and reading experts. Every year so far, one or more teachers from Ohio have served on the Mathical jury! Find out who they are on the *Mathical* website.

## Incorporating Mathical Books in Mathematics Instruction

Including literature with mathematics content and connections goes beyond augmenting computational understandings. Math-related literature can enhance the lives of young people in meaningful ways.

### Real world connections

How many times have students expressed that mathematics will never be useful in real life? I'll wait while you count. Math is the object of jokes, such as the one floating around about how parallelogram study is more important than learning to figure income taxes, since that information is so valuable during parallelogram season. Mathematics has been a meme even before the term "meme" was invented. This is a major reason books like the ones featured by the Mathical Book Prize are vital. Story contextualizes and develops mathematics within real-world situations (Golden, 2012). While it may not be necessary to think about, for example, how to break the chain of golden rings like Bhagat did in *Seven Golden Rings*, the story emphasizes that thinking about a mathematical problem from various perspectives is rewarding—and actually, fun. Mathematics perspectives are also shown to be used even by very young children, like in *Lia & Luís: Who Has More?* As a child, did you ever measure a piece of cake when you had to split it with someone? As a mathematics instructor, it's easy to see mathematics in everyday life, but sharing math stories assists your students in realizing how math is part of everyday life and helps in recognizing mathematics in the world—the purpose of Mathical Book Prize.

### Inclusion and Social Justice

A significant reason to share Mathical Book Prize titles and similar books is to emphasize inclusion in the mathematics classroom. When young people see themselves and others like them in the books they read, they can feel validated. Rudine Sims Bishop, formerly at The Ohio State University, created the metaphor of mirrors, windows, and sliding glass doors (Bishop, 1990) which is used to suggest how readers view worlds, book characters, and themselves when they read. As educators, we must provide books in all subject areas that facilitate students situating and seeing themselves, including in mathematics. Inclusion is evident in many of the the Mathical selections. For example, persons or characters of color, or under-represented identities, are part of each of the 2021 Mathical Book Prize winning titles, whether it be the author, illustrator, fictional character, or actual person in the book. Examples include *Grasping Mysteries: Girls Who Loved Math*, with stories based on the mathematical accomplishments of real women from various times and places in the world, one being statistician Edna Lee Paisano who was Nez Perce and Laguna Pueblo. Among the many individuals John Rocco included in *How We Got to the Moon* are persons of color, and the book can be examined from a sociopolitical perspective considering the time frame of that portion of the space race. Brittney Morris' book *SLAY* (Simon & Schuster, 2019), the 2020 Mathical Prize Winning novel for grades 9–12, is a story of Kiera, a Black female student in a high school with a predominately White student body, and Kiera is secretly the developer of a popular video game. Racism, and a tragedy, are involved in this complex novel, inviting discussion of social justice issues. Using young adult literature in the mathematics classroom is strongly supported by Rezvi, Han, & Larnell (2020) to "encourage teachers and other scholars to analyze with young readers the issues of identity and belonging, stereotyping and discrimination, and the potential for productive identifying as a mathematical doer and learner" (p. 590). Further, they "maintain that confronting and challenging the current tropes associated with school mathematics is necessary if we are truly committed to the idea that all students are capable of owning, doing, and seeing themselves as mathematicians" (p. 592). Books for young people of all ages are increasingly inclusive, making it imperative that

literature with current sociocultural approaches be incorporated in all subject areas, including mathematics.

## Go Mathical!

In addition to reading about the Mathical Prize Winner and Honor books, the *Mathical* website has further advantages and ways you can get involved.

- Check out the “News & Blog” in the “News” menu for videos of author readings, information about the National Math Festival, and announcements about Mathical books from NCTE and NCTM, plus other Mathical news.
- Recommend books for the Mathical committee to consider! There is a “Suggest Books” page in the “Award Winning Books” menu. This is a terrific opportunity for teachers and students, and certainly encourages book groups, books discussions, and of course critical reading and thinking.
- MSRI, in partnership with *School Library Journal* (SLJ), awarded 25 grants of \$700 in 2020, and again in 2021, to Title I schools in the U.S. for the purchase of books from the Mathical lists. Check the *Mathical* website for past awardees and grant information.
- Sign up for the mailing list!

Adding books to mathematics is an equation that will always provide the correct answer, and you and your students can construct the proof! *Mathical* is practical, critical, and fantastical!

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