Story Time STEM: Nurturing Children's Joy and Wonder through Shared Reading Experiences

ALLISON HINTZ, ANTONY T. SMITH, KRISTIN GRAY, ERIN GANNON, ASHLEY WISHART

Mr. Barber and a group of 6-year-olds gather on the carpet to discuss The Cookie Fiasco, by Dan Santat and Mo Willems. The children excitedly share their ideas for how the four characters in the story might solve the dilemma of equally sharing only three cookies:

Juliet: You could take two cookies and cut them in half and take the other cookie and cut it in half again. Each animal gets two pieces!

Alice: You could cut each cookie into four pieces and hand them all out. You get one, you get one, you get one, you get one. You keep passing them out. Every animal gets
three pieces.

Mateo: I don’t know... but if you had one cookie, you could cut it into four pieces and each animal gets one of the four or... um, a quarter!

While offering ideas, children sketch their strategies onto paper on clipboards using pencils. Mr. Barber kneels next to the children, glancing across their strategies and asking questions about their thinking.
The discussion culminates with the group collectively studying the drawings, making connections between ideas, and exploring new questions.

James: Alice and Mateo both cut the cookies into four pieces! You could cut Juliet’s pieces here again (James draws a line with his finger to bisect one of the halves), and then there would be four pieces in that cookie too.

Taima: I don’t know how to say how much each character gets. I can say two pieces, but the pieces are different sizes. This one is bigger and this one is, um... skinnier. Does that matter?

Exploring children’s literature as mathematicians and scientists

Children’s literature is an engaging context for complex and sophisticated STEM (science, technology, engineering, and mathematics) thinking to emerge. By experiencing stories as mathematicians and/or scientists, young children engage in STEM practices such as reasoning and problem solving through discussion within the context of stories and the accompanying illustrations (O’Neill 2011). This approach to literature is based on the widely adopted practices of shared, repeated read alouds, which weave together interest in a story, decoding and fluency practice, choral reading of a text, and lively discussion of a story’s events (Fisher et al. 2004; Block & Lacina 2009; Hoffman 2011). Through these practices, children better understand books and make meaningful connections to their own lives (Sipe 2002).
In this article, we share ideas for how to integrate math, science, and literacy during shared reading. These ideas are inspired by our research project Story Time STEM, a collaborative effort by a team of preschool and elementary grade teachers, children’s librarians, instructional coaches, and university-based educators. Our studies focus on engaging young children in meaningful discussions of STEM concepts and practices that celebrate and foster children’s joy and wonder and build their knowledge of mathematics and science.

Three categories of STEM opportunities in children’s books

We have found several ways that science and math are embedded in a wide range of children’s literature. Here, we share our approaches to three categories of books: text dependent, idea enhancing, and illustration exploring.

Text dependent books

This first category is a teetering pile of “math-y” and “science-y” books. These are the books where mathematics or science are central to the story. We call these text dependent books because it would be challenging to read and understand them without also exploring the math and science ideas they examine.
Children are constantly making sense of their world, and stories are a playful space to see STEM in action.

An example of a text dependent book is *Splash!*, by Ann Jonas. This story takes place by a backyard pond where some animals—turtles, frogs, and dogs—jump into and out of a pond while other animals—catfish and goldfish—swim in it. Additional creatures come and go: a dragonfly, a robin, a girl—even a house cat ends up in the pond, much to its dismay! With each turning page, the number of animals in the pond changes and the reader is repeatedly asked, “How many are in my pond?” Young mathematicians may count the animals by ones (or, as we have heard children do, note how the numbers change from illustration to illustration), think relationally about quantities, and practice addition and subtraction. Young scientists may observe the plants and animals in the pond in different ways. They might use the illustrations as models of real ponds in order to think about the relationships between various animals and water, or they might discuss the differences between human-made ponds and natural ones. Stories like *Splash!* are inherently mathematical and scientific.

We have discovered a wide range of exciting text dependent books, including *One Is a Snail, Ten Is a Crab: A Counting by Feet Book*, by April Pulley Sayre and Jeff Sayre, and *The Most Magnificent Thing*, by Ashley Spires.

**Idea enhancing books**

With idea enhancing books, the story offers opportunities to discuss math and science and may deepen a child’s understanding of the story. Here is an example of a discussion that took place during a shared reading of *Who Sank the Boat?*, by Pamela Allen, with 3- and 4-year-olds in a preschool setting.

In *Who Sank the Boat?*, a cow, a donkey, a sheep, a pig, and a tiny mouse go for a rowboat ride in the bay. As each animal gets into the rowboat, readers are asked, “Do you know who sank the boat?” The boat tilts, it balances, it levels, and it sinks! As he reads, Mr. Elijah, a preschool teacher, pauses several times to pose open-ended questions, and the children make observations and conjectures about important math and science ideas.

Mr. Elijah: How many animals do you see? How do you see them?
Liam: I see 1, 2, 3, 4, 5! (Liam points one by one to each animal on the page.)

Mr. Elijah: Does anyone see the animals in a different way?

Ashanti: I see 2 (Ashanti circles two animals with her finger), 3, 4, 5. I see five too!

Mr. Elijah: (He pauses a few pages later.) The donkey is balancing her weight. Let’s balance our bodies!

Several children speak at once as they each stand on one foot, tilting from side to side.

Group of children: Whoa! I am balancing. I am not tipping over... yet!

Mr. Elijah: (He pauses near the end of the story.) Why do you think the boat sank?

Mateo: Too many big animals! It was crowded.

Liam: It was the mouse!

Sidra: I don’t think it was just the mouse, I think it was all the animals together!

This shared reading experience helped the children develop math and science concepts and skills, including some essential skills described in Common Core State Standards (CCSS 2010) and the Next Generation Science Standards (NGSS 2013). For example, the
story context was a source of inspiration for young children to engage with the intersecting practices of literacy, math, and science, such as constructing viable arguments, critiquing the reasoning of others, and citing textual evidence to support conclusions drawn from the text (CCSS 2010). In addition, children also engaged in arguments from evidence (NGSS 2013). The story also inspired exploration of the interdisciplinary concepts of cause and effect, balance, and buoyancy. Two more of our favorite idea enhancing stories are *The Very Hungry Caterpillar*, by Eric Carle, and *The Rainbow Fish*, by Marcus Pfister.
Illustration exploring books

In *illustration exploring* books, the math or science is not explicit; however, the illustrations include details that may invite a child or adult to pause to notice something about the picture that is mathematically or scientifically interesting. For example, children who are learning to count items in sets may count footprints by twos on the
pages of *The Snowy Day*, by Ezra Jack Keats. Children who are learning about force and motion may pause while reading *Jabari Jumps*, by Gaia Cornwall, to marvel at the depth of Jabari’s dive into the pool from the high diving board. These observations may happen while enjoying the story and then quickly moving on, or when returning to an illustration after reading and making a connection to mathematics or science that children are currently thinking about in their lives. Once they start looking for connections, intentional teachers often realize that nearly every story offers opportunities to engage young children as mathematicians and scientists. Children are constantly making sense of their world, and stories are a playful space to see STEM in action.

Planning STEM-focused read alouds

We suggest a few simple steps to prepare for conducting shared reading experiences through a math or science lens. The first step is to pre-read the story and anticipate what children may notice. The second step is to select a few places in the story to pause and ask an open-ended question to engage children’s thinking. (See “Guiding Questions” above for examples of open-ended questions that can be used with most stories.) The third step is to gather supplies for an after-reading interactive experience that will extend children’s thinking. For example, after reading *Who Sank the Boat?*, we have seen educators invite children to a water station where they design their own foil boat and investigate how many small plastic animals can fit inside of it (and how to distribute them!) before it sinks.
The power of discussing STEM ideas through literature

Whether or not mathematics or science is explicit in children’s literature, we have found power in approaching all stories with a math or science lens. We have been amazed by the ways that shared reading—a staple in early childhood—is a playful and productive context for supporting young readers, mathematicians, and scientists. As Ashley, a kindergarten teacher and an author of this article, said, “Children have an intuitive desire to engage in playful conversations about stories and characters. Embedding mathematical and scientific discussions within stories engages all students—and opens up opportunities for their identities as mathematicians and scientists to emerge, to be inspired, and to be nurtured!”

When we leverage children’s interest in and excitement for stories and use story contexts as playful spaces to make sense of their world, children can engage in sense-making discussions about complex and sophisticated STEM ideas. We encourage everyone to give the Story Time STEM shared reading approach a try, inviting children to experience wonder and joy for stories as mathematicians and scientists. Through shared reading experiences, young children’s thinking can be celebrated, and we can nurture a vibrant culture of mathematics and science that expands from storybook pages to the world around us.

Children’s Books Mentioned in this Article

*The Cookie Fiasco*, by Dan Santat and Mo Willems (2016)

*Jabari Jumps*, by Gaia Cornwall (2017)

*The Most Magnificent Thing*, by Ashley Spires (2014)

*One Is a Snail, Ten Is a Crab: A Counting by Feet Book*, by April Pulley Sayre and Jeff Sayre, illus. by Randy Cecil (2006)

*The Rainbow Fish*, by Marcus Pfister (1992)

The Snowy Day, by Ezra Jack Keats (1976)

The Very Hungry Caterpillar, by Eric Carle (1987)


References


Photographs: Juliet's Strategy, Mateo's Strategy, Alice's strategy, and Guiding questions courtesy of the authors; all others © Getty Images

**Audience:** Teacher  
**Age:** Early Primary, Kindergarten  
**Topics:** Other Topics, Technology and Media, STEM, Subject Areas, Literacy, Reading

---

**ALLISON HINTZ**  
Allison Hintz, PhD, is an associate professor in the School of Educational Studies at the University of Washington, Bothell. Allison studies mathematics education, specifically planning for and facilitating discussions that center on children’s mathematical ideas. ahintz@uw.edu

---

**ANTONY T. SMITH**  
Antony T. Smith, PhD, is associate professor in the School of Educational Studies at the University of Washington, Bothell, where he teaches courses in literacy curriculum and instruction. His research focuses on making connections between reading, math, and science. smithant@uw.edu

---

**KRISTIN GRAY**  
Kristin Gray is director of K–5 Curriculum and Professional Learning at Illustrative Mathematics. She is a National Board certified, 22-year veteran mathematics teacher and coach. kgray0229@gmail.com

---

**ERIN GANNON**  
Erin Gannon, MEd, is a reading specialist and fifth-grade ELA teacher at Shields Elementary School, in Lewes, Delaware. Erin studies literacy education, specifically how young readers interact with the content of texts and consider strong author moves. erin.gannon@cape.k12.de.us

---

**ASHLEY WISHART**
Ashley Wishart is a third-grade teacher in the Northshore School District of Woodinville, Washington. As a current graduate student, Ashley is researching the impact of using math journals as a metacognitive support for students while solving multiplication and division story problems. awishart@nsd.org