

# Storytelling and Mathematics

Serena Retson, Isobel Blakeney, and Jennifer Stevens

## Benefits of Teaching Math Through Stories (Oral & Written): (Monroe & Terrell, 2018)

- Stories spark student curiosity, increasing math engagement and motivation.
- By having multiple access points, stories are a non-threatening way to introduce math concepts, which reduces math anxiety.
- As stories engage students in math problems through a particular context, students can engage their prior knowledge surrounding that context to support their learning of a mathematical concept.
- Having students think about math in an authentic way results in an improved conceptual understanding of math concepts.
- By engaging in mathematical stories as a class, students get additional practice with problem-solving and develop critical thinking skills.
- Selecting stories from diverse cultural backgrounds makes math learning accessible to students from all backgrounds and increases cross cultural understanding (Carter & Sallis, 2016)

The results of these benefits is an improvement in math achievement.



## Value of Student Created Math Stories: (Roberts & Stylianides, 2013)

- Stories can be used as 'cognitive tools' to construct meaning.
- When students create math stories, they are forced to go into the details of the math (Borasi et al., 1990).
- Teachers gain a better understanding of student learning needs through reading/hearing their narratives surrounding a math concept.
- Interaction with narrative ensures students know how to work with the concepts they are learning.
- Students have the opportunity to base their mathematical understanding within their own cultural context (Celadon-Pattichis et al., 2018).

## Instructional Strategies for Teaching Math Through Storytelling: (Monroe & Terrell, 2018)

- Connect math to diverse contexts, which shows students how mathematical problem solving can benefit them in their daily lives.
- Have students engage in problem-solving by identifying the problem, creating a plan of action for solving the problem, and determining a solution to the problem.
- Create the conditions under which students can engage in mathematical investigations and seek out answers to their own questions.
- Allow students to practice their mathematical skills in a variety of contexts.

## General Criteria for Selecting a High-Quality Mathematics Story: (Monroe & Terrell, 2018)

- Select worthwhile stories, not merely math concepts amongst colourful illustrations.
- The mathematical connection should flow naturally from the story.
- Stories should force students to engage in problem-solving and express evidence for their solution.
- Stories should grow students' understanding of a particular math concept.
- Stories from diverse cultural backgrounds should be included.
- Stories should allow students to explore and consider alternative strategies for solving a math problem.

## Considerations for Educators Creating a Mathematics Story (Bittel, N & Bittoni, M., 2014)

1. Intended Audience: language should be appropriate for the target group
2. Learning Purpose: story can *explain, formulate, introduce, or accompany* a topic
3. Learning Goal: how can learners engage with the story?
4. Story Structure: typically includes a beginning, action/conflict, and resolution

### Objective

The objective of this activity is to encourage students to explore a math concept by having them create a story which will uncover their mathematical thinking and understanding. Scaffolding will be provided in the format of written prompts that include a protagonist, setting, and equation that need to be woven into a story.

This activity can be used to: explain, formulate, or introduce a math concept, or accompany another math concept. The learning goal should reflect a specific curriculum expectation, and be targeted to the students' grade-level.

Extension: Think of an activity learners could do to engage with their story i.e. share their stories with classmates, act them out, consider wider applications within the math curriculum as well as across curricular areas.

### Materials

Category bins with an assortment of cut up pieces of paper listing:

- Settings
- Math concept
- Protagonists
- Story writing template

### Procedure

1. Read or tell a story at an appropriate level for your students, which explores a math concept relevant to your math instruction (see Appendix A for ideas). Encourage students to engage with the story by having them ask questions, make inferences, imagine solutions, and solve problems.
2. Students select a paper slip from each of the three bins: setting, math concept, and protagonist (see Appendix B for ideas, although the math concepts should be adjusted for the learning goals of your lesson).
3. Working in pairs or alone, students will use the information on their selected slips to create a story (i.e. setting: forest, math concept:  $2n+1= y$ , and protagonist: Berty the dog). Students may choose to write their story (making a picture book, novel, comicbook, etc.) or develop an oral story (videotape themselves telling the story, tell the class in person, act out the story, etc.). In this way, students with literacy difficulties will still benefit from the math learning of the activity.
4. Students are encouraged to follow a story structure, including a beginning, action/conflict, and resolution using the template provided (see Appendix B for template and Appendix D and E for story examples).
5. The teacher should circulate around the room, listen to students' math talk as they develop their stories, ask prompting questions, and clarify misunderstandings.

### Assessment

*For learning:* The teacher should make note of students' existing misconceptions during the discussion following the reading/telling of the initial story.

*As learning:* While students are writing their math stories, the teacher should walk around listening and taking anecdotal notes regarding the types of math talk that is occurring.

*Of learning:* The teacher should revisit students' math stories and assess their understanding of the math concept. The teacher should then plan future instruction to meet students learning needs.

# Appendix A - Culturally Diverse Math Stories

Serena Retson, Isobel Blakeney, and Jennifer Stevens

Cultural differences exist in the way math is accessed and conceptualized. Storytelling can act as a bridge between western mathematics instruction and diverse cultural understandings, making math learning more accessible to all (Lawson & Schiro, 2004).

Title	Grade Level	Math Theme
<i>Senefer</i> - Beatrice Lumpkin	Primary	Addition and Algebra
<i>Baby Goes to Market</i> - Atinuke Angela Brooksbank	Primary	Subtraction
<i>Handa's Surprise</i> - Eileen Browne	Primary	Subtraction
<i>My Rows and Piles of Coins</i> - Tololwa Mollel	Primary	Multiplication
<i>Two of Everything</i> - Lily Hong	Primary	Multiplication and Algebra
<i>The Two Foolish Cats</i> - Yoshiko Uchida	Primary	Division and Measurement
<i>Dumpling Soup</i> - Jama Kim Rattigan	Primary	Measurement
<i>Shota and the Star Quilt</i> - Margaret Bateson-Hill	Primary	Geometry
<i>Anno's Magic Seeds</i> - Mitsumasa Anno	Primary	Data Management
<i>The Warlord's Messengers</i> - Virginia Walton Pilegar	Primary/Junior	Addition/Subtraction
<i>One Wide River To Cross</i> - Barbara Emberley	Primary/Junior	Multiplication
<i>One grain of rice</i> - Demi	Primary/Junior	Growing Patterns
<i>Working Cotton</i> - Sherley Anne Williams	Primary/Junior	Time
<i>Grandfather Tang's Story</i> - Ann Tompert	Primary/Junior	Spatial Sense
<i>This Is How We Do It</i> - Matt Lamothe	Primary/Junior	Data Management
<i>Nine-in-One Grr! Grr!</i> - Cathy Spagnoli	Junior	Multiplication and Algebra
<i>Fat Gopal</i> - Jacquelin Singh	Junior	Estimating
<i>Migrant Child's Dream</i> - George Rivera	Junior	Estimating
<i>The Librarian Who Measured The Earth</i> - Kathryn Lasky	Junior	Measurement and Geometry
<i>The Librarian Who Measured The Earth</i> - Kathryn Lasky	Junior	Measurement and Geometry
<i>Pablo's Tree</i> - Pat Mora	Junior	Geometry
<i>If the Word Were a Village</i> - David J. Smith	Junior	Data management

# Appendix B - Activity Prompts

Serena Retson, Isobel Blakeney, and Jennifer Stevens

Setting	Protagonist	Math Concept
Desert	Berty the dog	$2a + b = c$
Basketball game	Maria the seagull	Estimation
Doctor's waiting room	Hamish, a fly with a keen sense of hearing	Prime Numbers
Beneath a trap door	Alex, a cheerful postal worker	$\frac{3}{4} > \frac{4}{5}$
Gumball making factory	Arjun, a baker with a love of cookies	Measurement using non-standard units
Boat	Andree, a skip rope champion	Length x Width = Area
Hot air balloon	Aitana, a photographer	$\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$ , And full rotations
All you can eat buffet	Nia, a girl with a dream of flyig	An ABA pattern
Playground	Mick, just an ordinary guy with a deep fear of centipedes.	Mean = 10 Median = 7 Mode = 6
Forest	Pamela, a homing pigeon with an important message	Placing decimals on a number line

# Appendix C - Story Writing Template

Serena Retson, Isobel Blakeney, and Jennifer Stevens

Group Members: \_\_\_\_\_

Setting: \_\_\_\_\_

Protagonist: \_\_\_\_\_

Equation: \_\_\_\_\_

Beginning:

---

---

---

---

---

Conflict/Action:

---

---

---

---

---

Resolution:

---

---

---

---

---

# Appendix D - Example Stories

## The Adventures of Bert the Dog

setting: forest  
math concept:  $2n+1=y$   
protagonist: Bert the dog

Bert the dog was very concerned about his best friend the Gingerbread Man. The Gingerbread Man had recently narrowly escaped an attack from Percy the Dragon, who thought it would be fun to burn him. Percy had discovered this joy by burning Tweedle Dum and Tweedle Dee and wanted to add the Gingerbread Man to his count.

While the Gingerbread Man had made it out uncharred, he had lost two of his buttons and an eye. Unable to wear his clothes and see clearly, the Gingerbread Man asked Bert if he would seek out the Fairy Godmother to get him new buttons and an eye.

Bert set off into the enchanted forest. He used the Gingerbread Man's map to locate the Fairy Godmother's summer home. He climbed two hills and then followed a stream deep into the forest.

"Why Bert, how nice to see you!" Exclaimed the Fairy Godmother, as she saw Bert sniffing her way down the path. Come join me Bert, I have two glasses of water and a nice big dog bone for you. Bert joined the Fairy Godmother and over his bone explained her mission.

"Well of course we must get buttons and an eye for your friend!" Exclaimed the Fairy Godmother. She gave Bert two chocolate covered blueberries and one white chocolate chip.

Bert thanked her for her help and dashed back to his friend, following the stream and bounding down two hills. He found the Gingerbread Man on Drury lane and delivered the gifts from the Fairy Godmother.

The Gingerbread man tried to put the chocolate covered blueberries on but they just would not stick. "Oh no Bert, what will we do? My buttons will not stick! And what about my eye? What if I never see again?"

Bert had nearly forgot, the Fairy Godmother's other instructions. He ran around the Gingerbread Man two times and gave his friend a big lick. When the Gingerbread Man tried again, the buttons and eye stuck right on. To celebrate the two friends planned their next two adventures and Bert ate another very yummy bone.

Note: This story was developed by someone who had exposure to fairy tales. We would anticipate that someone with different cultural references would develop a very different story.

## Sharing Worms

setting: forest  
math concept: prime numbers  
protagonists: two bluebirds

Brother and sister bluebirds, Lola and Sammy, are finally old enough now that their mom will let them leave the nest on their own. They are ecstatic at their new found independence and are constantly flying around, doing tricks, meeting other birds and exploring the neighbourhood each day.

Their mom decides enough is enough, it is time that Lola and Sammy take some responsibility and do something helpful for their family while she looks after their 2 little brother birds, and 1 little sister all day. She instructs them to go find enough worms for dinner so that everyone gets an equal number to eat. They leave immediately, on a mission to collect the most delicious worms.

Sammy thinks about his family, his three little siblings, his mom, herself and his sister Lola, he remembers what his mom says: "enough worms for everyone to have an equal number for dinner" Got it, he thinks to himself.

They fly around all day long searching for the perfect worms, Lola and Sammy are each carrying 6 worms when Lola spots the biggest, juiciest worm that she has ever seen and her mouth starts watering she starts flying towards it. Sammy says "wait! We have an equal number, what will happen if we get one more?"

Lola reminds him, "Sammy, don't you think that more is better!?" Sammy thinks for a second and then agrees, the more food the better, he forgets what his mom has said.

When they get home they are so excited to show their family the amazing dinner that they have brought back. Their siblings are starving, and their mom proudly watches as Lola and Sammy start dividing the worms up. But wait, everyone has two and there is still one left over. How could this happen?

Fairness is so important in their family, Ok she thinks, "maybe I can just divide the worms up equally for our little siblings, they are the ones that fight the most when things aren't equal, and they need the most food. I will go back out to find our dinner later."

So she starts giving 3 to each, then she adds one more. Each little sibling has 4 worms and there is STILL not an equal number. How is this possible? 13 can't be divided by 3, or by 6? Their mom tells them it is ok, one will be left over, but think about what they have learned for next time.

Sammy knew he had a bad feeling about the 13th worm.

## References

- Bittel, N., & Bettoni, M. (2014). *From complex maths to simple stories: A knowledge management approach to education*. Kidmore End: Academic Conferences International Limited. Retrieved from <http://myaccess.library.utoronto.ca/login?url=https://search-proquest-com.myaccess.library.utoronto.ca/docview/1673123830?accountid=14771>
- Borasi, R., Sheedy, J., & Siegel, M. (1990). The Power of Stories in Learning Mathematics. *Language Arts*, 67(2), 174-189. Retrieved from <http://www.jstor.org/stable/41961719>
- Celadon-Pattichis et al. (2018). Asset-based approaches to equitable mathematics education research and practice. *Journal for Research in Mathematics Education*, 49(4), 373-389.
- Lawson, Doris & Schiro, Michael.(2004). *Oral Storytelling and Teaching Mathematics: Pedagogical and Multicultural Perspectives*. California: Sage.
- Monroe, E. E., & Terrell, A. (2018). *Deepening Students' Mathematical Understanding with Childrens' Literature*. Reston, VA: National Council of Teachers of Mathematics, Inc.
- Roberts, N., & Stylianides, A. J. (2013). Telling and illustrating stories of parity: a classroom-based design experiment on young children's use of narrative in mathematics. *ZDM*, 45(3), 453-467.