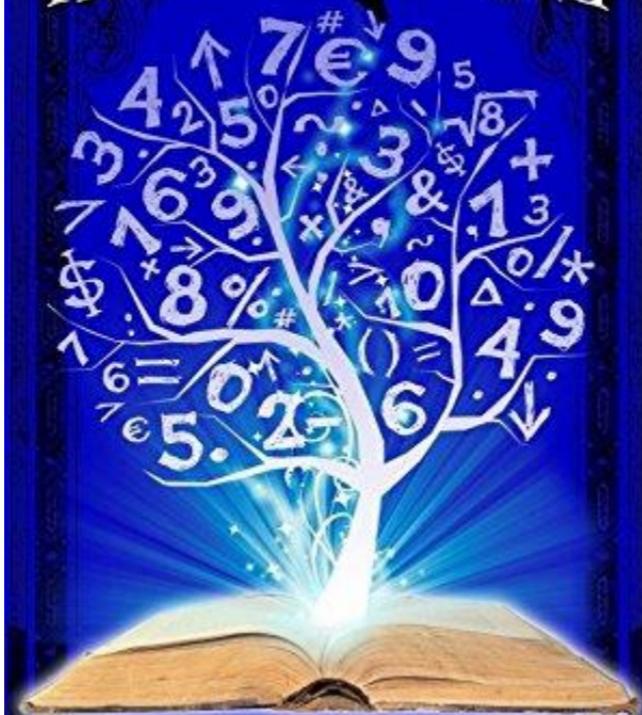


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Math & Magic in Wonderland



Lilac Mohr

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Preview

Lilac Mohr

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For Linnea, Elowen, Hallden, and Linden.

To four future mathematicians
Who, like very short magicians,
Have somehow gained admission
(Though I surely gave permission)
To the center of my heart.

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Letter from the Author

Dear Reader,

Have you ever wanted to learn something only to be told that you were too young to understand it? That's exactly what happened to me when I was in the second grade.

At the time, my hero was Maria Mitchell, a female astronomer who is best known for discovering a comet. I remember the day that I read in Maria's biography that she was able to do long division at the age of eight. I slammed the book shut and ran excitedly to my teacher's desk to ask her to teach me long division, too. The teacher rejected my enthusiastic request and explained that I would have to wait until the fourth grade. She also reminded me not to talk during 'silent reading time'.

I felt dejected but not defeated and decided that if my teacher refused to teach me long division, I would have to simply teach myself. It was not easy (since I didn't even know multiplication at the time), but with determination, I pressed through and mastered the skill on my own.

Why am I telling you this story? Now, years later, I still recall my teacher's rejection as the moment I realized that curiosity should not have age restrictions. I wrote this book with the intention of making the magic of math accessible to everyone regardless of age, gender, or background. All you have to bring on this journey is a love of learning.

I invite you now to join two exceptional girls on a grand adventure to Wonderland. Keep a piece of paper handy, so you can play along with our heroines. Each problem has a point value, and if you keep track of your score, at the end of the book you can see if you have what it takes to be crowned Math Royalty. I hope you enjoy this jaunt into the world of Math and Magic!

Sincerely,
Lilac Mohr

"My Princess," he said tenderly,
"two great powers are on our
side: the power of Love and the
power of Arithmetic. Those two
are stronger than anything else in
the world." (E. Nesbit)



1. Mrs. Magpie's Manual

Every heroine needs a trusty sword, thought Lulu as she ran her fingers across a toy sword, dreaming of its heroic exploits. The sword was made of floppy craft foam, rendering it a rather unconvincing weapon. To Lulu, however, a flaccid toy sword was as good as any other. “Want to play King Arthur?” she asked her sister.

There was no answer from Elizabeth, who was lying in bed, deeply engrossed in her book. Lulu, sword in hand and stomach flat on the carpet, crept toward the foot of her twin sister's bed. She lay there quietly for a moment, listening. Elizabeth turned a page and sighed. *Good*, thought Lulu, *I haven't been detected.*

Lulu, still lying on the floor, rolled sideways and slowly lifted the sword above her head. She then completed her ascent, carefully and deliberately rising- first on her knees, and then in a single flowing motion onto her feet. "I am the Lady of the Lake," she spoke in a ghostly voice, "here to present you with Ex Caliber." She gave a low curtsy and lowered the sword onto her sister's bed. The brilliance of this performance had been completely lost on Elizabeth who had not glanced up from her book.

"I'm doing some serious research here," said Elizabeth. "Did you know that there is a type of marsupial mouse that can breathe through its skin until its lungs are developed? It's the only mammal that can do so." She finally lifted her gaze away from the book and couldn't hide the look of surprise

that covered her face as she saw Lulu, attired in a sequin skirt and tiara, bowing before her bed.

“Aren’t we too old for these types of games?” Elizabeth laughed. Even though she and her sister were born only eight minutes apart, Elizabeth often felt like she had to be the more mature twin.

“Never!” Lulu replied emphatically. Suddenly a new idea flew into her head. “I know,” she said, sword waving. “We can be Celts, fighting Julius Caesar. Maybe Mother will let us paint our faces blue, again.”

“What? No way!” Elizabeth shook her head and tried to suppress a smile as she lifted the book in front of her face. “Besides, last time the paint didn’t wash off completely,” she added. “We looked like a pair of Smurfs for a week, remember?”

“I don’t suppose you’d want to be Odysseus?” asked Lulu, mischievously, eyeing a pink jump rope on the floor. “I can tie you to the bed so you will be immune to the lure of the enchanting sirens, played by me, of course.” She was well aware of the answer that would follow, so this was more of an attempt at comedic appeal.

“Not a chance,” Elizabeth snickered, her face still eclipsed by the book.

“You leave me no choice,” Lulu said gravely, “but to slay the Jabberwock by myself.”

“I think you’re getting your stories all mixed up-” Elizabeth began. This time, it was Lulu who was not paying attention. She had already sprung up on her feet, sword in hand.

Lulu waved the flopping sword as she skillfully stepped around the toys, books, and clothes that were strewn around the floor.

*“One, two! One, two! And through and through
The vorpal blade went snicker-snack!
He left it dead, and with its head
He went galumphing back.”*

She picked up a stuffed bear and galloped back to her bed with it. Elizabeth peeked up from her book just long enough to roll her eyes.

*“And hast thou slain the Jabberwock?
Come to my arms, my beamish boy!
O frabjous day! Callooh! Callay!”
He chortled in his joy.”₁*

Lulu was now on top of her bed dancing triumphantly. “Why aren’t the girls ever the ones slaying monsters?” she wondered aloud.

“Because we are too smart for that,” her sister replied sensibly. “Can you read or do something quietly for a bit. We’ll work on a play to perform after dinner. Maybe *Little Women*.” There was silence as Lulu pondered the offer.

“You can be Jo,” Elizabeth added enticingly.

“Deal,” agreed Lulu. She sat down on her bed, but it was hard to relax, her head still racing with dramatic play ideas. The only logical course of action was to recite the digits of Pi. Lulu had done this so often as a tactic for calming down, that the numbers simply came out instinctively. It was like singing a song she had heard a million times before. “Three point one, four, one, five, nine, two, six, five, three, five, eight, nine,” Lulu recited rhythmically. By the time she had spouted out the first one-hundred digits, Lulu’s mind was serene and ready to focus. *But focus on what?*

Lulu decided that writing the script for their play did not only count as a quiet activity but would

ensure that Elizabeth kept her word. She tip-toed to the windowsill to retrieve the colorful pens her sister had left there from that morning's nature sketching session.

Suddenly, the dark silhouette of a bird filled the window-frame. A large black-blue magpie had landed on the sill of the open window. Lulu found herself face to face with the elegant creature. The magpie cocked its head and stared at Lulu with its shining eyes. Before Lulu had a chance to exhale, the magpie picked up a pen in its claws and flew away on silent wings.

“Did you see that?” Lulu yelled out in surprise.

“What now?” asked Elizabeth, irritated.

“There was a magpie at the window just now and it looked at me with a sort of twinkle in its eye like it was sending me a message and then it stole a pen and we need to find it right away. Get your shoes on. Hurry!” Lulu was out of breath with excitement. She grabbed her backpack and began filling it with essential adventuring supplies – a calculator, ruler, compass, and protractor.

“Nice try,” said Elizabeth flatly, “but I would have heard it. Owls can fly silently, not magpies.”

“Please believe me. This is important,” Lulu pleaded as she shoved a stack of scratch-paper and a handful of pencils into her bag. Then she spotted it - a feather lying on the windowsill. Its edges were midnight black, and its center was creamy white. Lulu grabbed the feather and dropped it on the page of the open book in her sister’s lap. “Please believe me,” she repeated. “Come on.”

Elizabeth studied the black-and-white feather but did not make a motion to stand up. “A pen can be replaced,” she finally said. “You can even turn this feather into a quill pen if you want.”

But the pitiful look on her sister’s face soon changed Elizabeth’s mind. She slipped on her shoes. “If you’re after a wild-goose chase, Don Quixote, I’ll be your Sancho Panza.”

“A wild-magpie chase, you mean,” laughed Lulu, “and I promise not to slay any windmills.”

Lulu slung the backpack across her shoulders as she jetted downstairs and out the back door. Elizabeth followed.

“What’s the plan?” Elizabeth asked, squinting as her eyes adjusted to the bright sunlight.

Lulu, who rarely made plans and seldom followed the ones she made, looked around. To her great delight, she spotted the magpie sitting on a wooden fencepost in the park across the street. Without pausing to think, Lulu placed the magpie feather in her pocket and dashed toward the bird.

Elizabeth, driven more by obligation than enthusiasm, jogged behind her sister. She was astonished to see that instead of flying off at the sight of a girl rushing straight at it, the magpie waited until Lulu stopped right in front of the fence before flying off. Lulu, of course, was right at its heels, darting around park benches and leaping over shrubs.

The magpie alighted on a tall maple. Lulu was staring, mouth agape, at the crimson-clad tree-boughs when Elizabeth reached her. “I caught a glimpse of the pen it stole,” said Lulu. “It was the silver glitter gel pen - my favorite!”

“So what?”

“If that isn’t a sign, then I don’t know what is. I need to get that pen back,” Lulu continued excitedly.

“Are you going to climb the tree, Tarzan? What’s your plan?” Elizabeth wondered.

Lulu was already calculating which limbs would best support her body weight and did not reply.

“What’s your plan?” Elizabeth asked again.

“A man, a plan, a canal, Panama!” responded Lulu. She grabbed a branch and began climbing.

Elizabeth sighed and shook her head. She watched as her sister adroitly moved from bough to bough. Soon, however, Elizabeth’s artistic eyes caught the play of light and shadow among the leaves of the tree as they trembled in the autumn breeze. Before long, she had forgotten her sister and was completely engrossed in the leaves’ dance. She remembered a poem by W. H. Davies:

*What is this life if, full of care,
We have no time to stand and stare?*₂

Elizabeth took a deep breath. There was a subtle scent of smoke in the air. She was trying to recall the poem about autumn bonfires by Robert Louis Stevenson when a pen fell sharply on her forehead, narrowly missing her eye and putting an abrupt end to Elizabeth's reverie. A pair of tan legs dangled from the branch above her.

"The magpie dropped the pen," Lulu called out, jumping down onto the grass, "and you'll never believe what I found!"

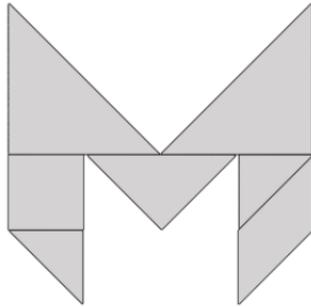
Elizabeth rubbed the sore spot on her forehead and through blurry tear-filled eyes saw that Lulu was holding a thick carmine-colored book in her hands.

"There was a hole in the tree, about half-way up. And this was inside," Lulu breathlessly explained.

"Oh no, are you hurt?" she asked, seeing her sister's face.

"I'm fine. Let's see what you found," replied Elizabeth bravely, not wanting to mar her sister's enthusiasm.

The twins leaned over the book. An elegant letter "M" was embossed in gold on its cover.



“Mrs. Magpie’s *Manual of Magic for Mathematical Minds*,” Lulu read aloud. Her heart fluttered. *Math and Magic? It’s as if this book was meant for me.*

“Actually, most authors avoid alliteration nowadays,” chimed in Elizabeth.

Lulu began laughing. “Authors actually avoid alliteration? Always?”

“Most of the time,” Elizabeth responded earnestly, oblivious to her own accidental joke. “I saw it in a list of top ten mistakes new authors make.”

Lulu, feeling there was no time to waste, eagerly opened *Mrs. Magpie’s Manual of Magic for Mathematical Minds* to a random page. It was completely blank. She tried a different location and it, too, was blank. She flipped frantically through the

book, but the result was always the same – blank. A crestfallen look washed across Lulu's face.

“Maybe it’s an empty diary or a geocache log that nobody has found yet,” speculated Elizabeth who was looking over her sister’s shoulder.

Lulu was not a girl who accepted defeat so readily. *I'll approach this puzzle using logic*, she told herself. *If the book is magical, then maybe uttering a magic spell would reveal the words.*

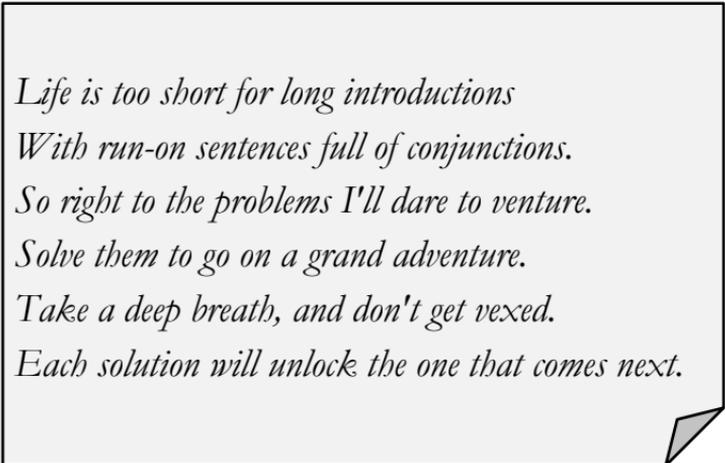
“Where to start? Where to start?” she said aloud, quickly running through the list of famous magic words, from “abracadabra” to “open sesame”, in her head.

“Starting at the beginning is usually a good idea,” suggested always-sensible Elizabeth.

Lulu turned to the first page of the book. *It wasn't empty!* Her hands began to tremble in excitement. They trembled so much, in fact, that reading the elaborate script was nearly impossible. There was only one thing to do. “Three point one, four, one, five, nine-” Lulu began.

“Why can’t you just count to ten to calm down like everyone else?” asked Elizabeth. “Give me that,” she reached for the book.

“I prefer Pi,” retorted Lulu, her hands clasping the book even tighter. In a clear voice, she read aloud:



*Life is too short for long introductions
With run-on sentences full of conjunctions.
So right to the problems I'll dare to venture.
Solve them to go on a grand adventure.
Take a deep breath, and don't get vexed.
Each solution will unlock the one that comes next.*

“Aha!” said Elizabeth, releasing her grip on the book, “That explains it.”

Lulu could only stare at the page dreamily. “A grand adventure,” she sighed.

“Keep reading,” pressed Elizabeth. She was skeptical that this book held any magical properties, but the draw of a good puzzle was irresistible.

*To reveal the problem on the following page,
Your first task is to determine my age.
In your world, a magpie's lifespan is twenty-three,
But things are quite different in this one, you see.
The number of years I have seen since my birth
Are a century more than twice a lifespan on Earth.*

Play Along: (2 pts.) Help Lulu and Elizabeth solve the first clue. How old is Mrs. Magpie? Keep reading for the answer.

“A century is 100 years, like 100 cents in a dollar and 100 centimeters in a meter,” Lulu reasoned aloud.

“Right,” agreed Elizabeth. She was thinking about how a centipede doesn’t really have one hundred legs but didn’t let her mind wander for long. “Mrs. Magpie must be a centenarian. But what does ‘*twice a lifespan on Earth*’ mean?”

“Maybe Mrs. Magpie lived and died on Earth before being transported to another world,” conjectured Lulu. “Or maybe,” she continued

before her sister could interrupt, “Mrs. Magpie lives on a planet with shorter years than Earth. Mercury, for example, takes only 88 days to orbit the sun, compared to Earth's 365 days. That would mean that approximately four years pass in Mrs. Magpie's world for every year on Earth. Hand me the calculator-”

“Hold your horses, Don Quixote,” said Elizabeth, relieved at finally getting a chance to be heard. “You promised not to jump to conclusions. The clue didn’t even mention Mercury. Let’s think through this logically.”

“I only promised not to mistake windmills for giants,” corrected Lulu, “but this is totally different.”

Elizabeth furrowed her brow, deep in thought. “I think we better use the information we were given,” she finally said. “The life expectancy of a magpie is 23 years. So double that number-”

“46”

“-and add 100.”

“Mrs. Magpie, you are one hundred forty-six years old,” Lulu shouted at the top of her voice, looking up into the tree.

“What are you doing?” asked Elizabeth, looking quickly around to make sure that she was the only witness to her sister’s shenanigans.

“I’m telling Mrs. Magpie our answer, of course.”

“Do you really think the bird we saw earlier wrote this book?” chuckled Elizabeth. “I don’t think it’s even in the tree anymore. How about writing the answer down like a normal person?”

Lulu, who would have been more insulted had she been *called* ‘normal’, grabbed the silver glitter pen and quickly wrote down “146-years-old”.

At once, the characters Lulu had just written began to glow. Lulu glanced over at Elizabeth, whose large eyes shone with a mixture of surprise, fear, and delight. *Good*, thought Lulu, *she can see it too*. Without hesitation, Lulu quickly flipped to the following page. It was no longer empty.

“That was almost too easy,” Elizabeth commented. She suddenly caught a glimpse of brown and white fur on the other side of the tree-trunk. “Was it a cat I saw?” Elizabeth peered behind the tree. “No, it was a squirrel,” she

answered herself, then hesitated. “But it can’t possibly be!”

Lulu looked up at the cute critter that was now sitting on the branch above them. Its body was dark gray, almost black, and its tail was white and fluffy. The two dark eyes on its chestnut brown head seemed to be staring at her with curiosity. “I’m pretty sure that’s a squirrel,” Lulu concluded.

“Of course it is. But this one is a Kaibab squirrel,” Elizabeth explained. “The only place they live is around the Grand Canyon. Something highly unusual is going on here.”

“So let me get this straight,” said Lulu. “We find a magical book, written by an anthropomorphic magpie, which will take us on a grand adventure, presumably to a different dimension... and you think a squirrel is ‘highly unusual?’” She shrugged and began reading the next clue.

Play Along

At the end of each chapter, you will get a chance to play along with Lulu and Elizabeth. Be sure to always work on a separate piece of paper, not directly in the book. Solutions are found in Appendix A.

1. (1 pt.) Assuming authors actually allow alliteration; make up your own silly sentence using words that begin with the first letter of your name.
2. (3-18 pts.) Lulu recites digits of Pi to calm down. Pi is a special number that represents the ratio between the circumference of a circle (the distance around it), and its diameter (the distance across the circle, through its center). The decimals of Pi go on forever without any pattern. You'll get a chance to explore Pi further in the fourth chapter. Just for fun, see how many digits of Pi (after the decimal point) you can memorize. Here are the first thirty:

Pi = 3.141592653589793238462643383279

Give yourself 3 points for every 5 digits you memorize.

3. (5-10 pts.) “A man, a plan, a canal, Panama!” is a famous palindrome, a sentence (or number) that reads the same both forwards and backward. There are two additional sentences that are palindromes hidden in this chapter. Give yourself five points for each one you find. Hint: One palindrome is spoken by Lulu and the other by Elizabeth.

4. It’s also fun to play with numeric palindromes (numbers that read the same forwards and backward):

a. (1 pt.) How many 2-digit palindromes (like 11 and 22) exist?

b. (2 pts.) How many 3-digit palindromes (like 101, 111, and 121) exist? Hint: You don’t have to write them all down - just look for a pattern.

5. If Mrs. Magpie is 146 years old in Earth years, what is her age in:

a. (2 pts.) Mercury years? (Four Mercury years pass for every Earth year.)

b. (2 pts.) Mars years? (Mars only completes half its orbit around the sun in one Earth year.)

Appendix A: Solutions

Chapter 1

1. To use alliteration, come up with words that start with the same letter.

2. Rajveer Meena from India recently recalled 70,000 digits of Pi, which took him ten hours. How did you do?

3. “I prefer Pi.” (said by Lulu) and “Was it a cat I saw?” (said by Elizabeth) are both palindromes. Can you make up your own palindrome sentence?

4a. There are 9 two-digit palindromes (11-99).

4b. There are 90 three-digit palindromes. The first (and last digit) can be from 1 to 9. For each of those nine options, there are 10 possible values for the middle digit. $9 \times 10 = 90$.

5a. On Mercury, Mrs. Magpie is $146 \times 4 = 584$ years old.

5b. On Mars, Mrs. Magpie is 146 divided by 2, which equals 73.

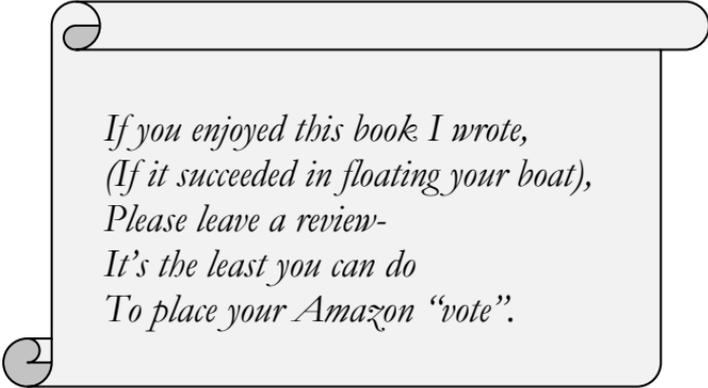
About the Author

Lilac Mohr is a software engineer, homeschooling mother of four, blogger, and entrepreneur. In 2012, she left her fourteen-year career in the high tech industry to home educate her children and create products that develop problem-solving skills. Lilac holds a B.S. degree in Computer Information Systems and an M.S. degree in Statistics.

Lilac's Blog: <http://learnersinbloom.blogspot.com>

On Facebook:

<http://www.facebook.com/learnersinbloom>



*If you enjoyed this book I wrote,
(If it succeeded in floating your boat),
Please leave a review-
It's the least you can do
To place your Amazon "vote".*

I hope you enjoyed this preview of *Math and Magic in Wonderland*. To continue Lulu and Elizabeth's adventure, please purchase the full version:

[Math and Magic in Wonderland on Amazon.](#)