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By Eric Yoder and Natalie Yoder

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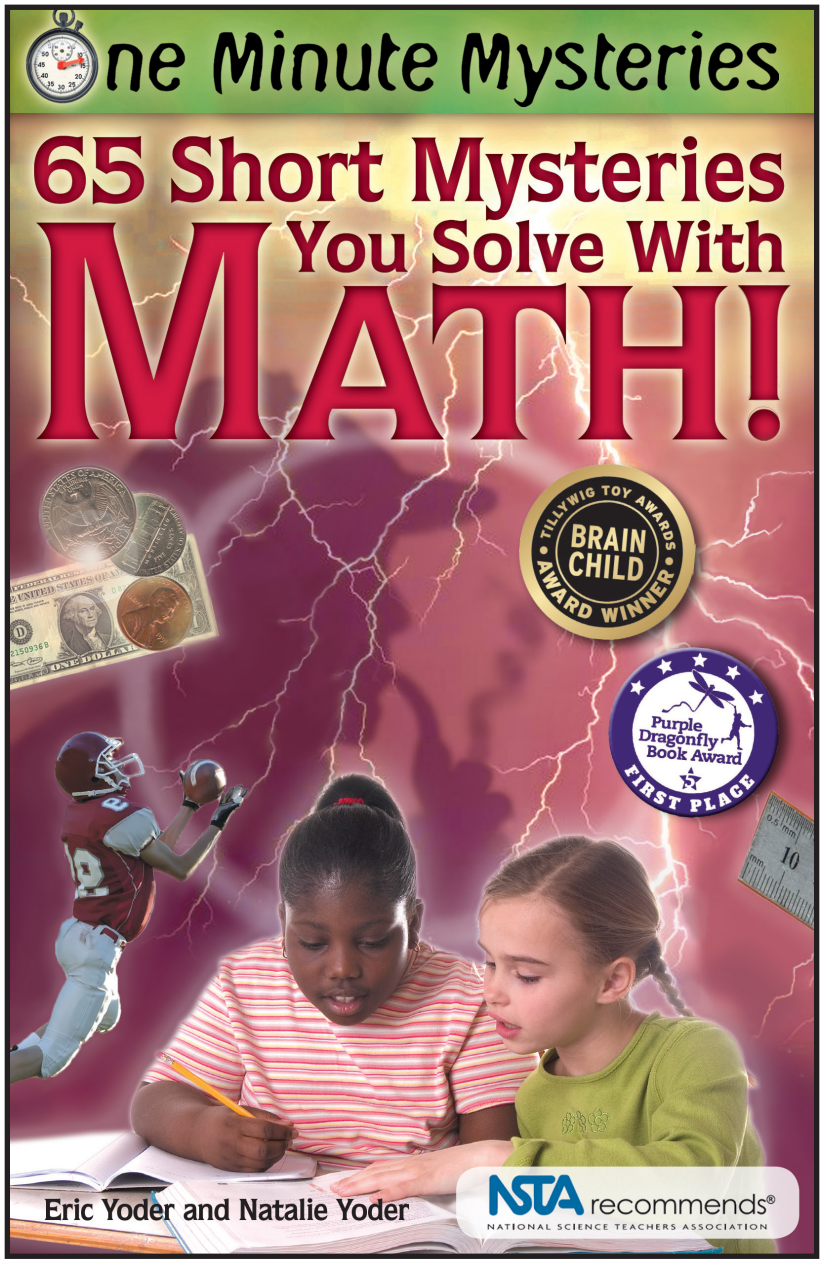

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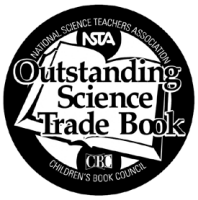

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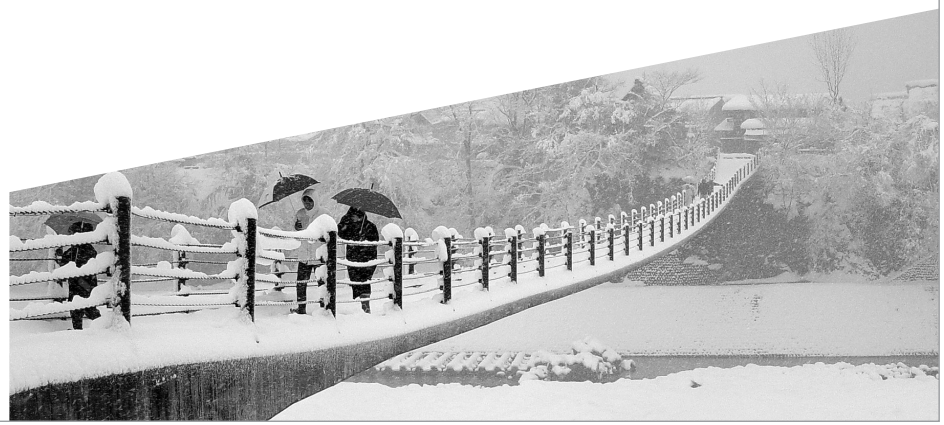


Heavy Toll

"A speeding ticket? What?" Suzy's father said as he opened the day's mail.

"What's the matter, Daddy?" Suzy asked.

"Well, Suzy, this ticket says that we were speeding on the toll road we took when we were driving back from the state science fair last weekend," he explained.

As drivers entered the road they got a receipt showing the time and exit number. The exit numbers were also mileage markers. When they got off the road, drivers had to pay different amounts depending on how far they went.

"Are you sure they're right?" Suzy asked. "What does it say?"

"Well, it says that we got on at exit 64 at 12:13 p.m., then got off the road at exit 148 at 1:33 p.m.," he said. "And it says the speed limit was 55 miles an hour—I thought it was 65. How can they know if we were speeding?" he asked. "I didn't see any police cars."

"It's too bad, but they're right," Suzy said.

"How do you know?" he asked.

Pancake Mix-Up

"Mooommm!" Meg yelled from the kitchen. "Can you please come down here?"

Meg's family and two other families had rented a house at a ski resort for a long weekend. Each family was going to cook and clean up for one of the three days. It was the morning of Meg's family's day.

While Meg's mother finished getting dressed, Meg went into the kitchen and started preparing the pancake mix. They had brought individual-sized serving packages of mix. They also had several boxes of cereal and bread to make toast, but everyone said they wanted pancakes.

"I'll be there in a minute, Meg. What's the problem?" her mother called.

"I have everything ready to make the pancakes. But each of these packages needs two-thirds of a cup of milk, and there's no two-thirds measuring cup in this kitchen," Meg called. "All they have is a three-fourths measuring cup. Can I just estimate?"

"Not if you want the pancakes to be any good," her mother replied.

"Never mind," Meg said a moment later. "I have the solution."

"What did you do?" her mother asked as she walked into the kitchen.

1 Heavy Toll

"If we got on the road at 12:13 and got off at 1:33, that means we were on the road for one hour and 20 minutes, or 80 minutes," Suzy explained. "Since the exit numbers are mileage markers, the distance between exits 64 and 148 is 84 miles—148 minus 64. That means we went 84 miles in 80 minutes—that's more than one mile per minute, which is more than 60 miles per hour. So we were speeding, since the speed limit was 55 miles per hour.

"To figure it out exactly," she added, "84 miles divided by 80 minutes makes 1.05 miles per minute. Multiplying 1.05 miles per minute by 60 minutes in an hour to get miles per hour means we averaged 63 miles per hour."

"Well, we were going less than that for some of the time," her father said.

"Yes, but to average 63 miles an hour, we must have been going faster than that at other times," she said. "I hope that ticket isn't too expensive."

3 Pancake Mix-Up

"I did some math. It's a question of least common multiples," Meg told her mother. "First, I figured out how many times you'd have to fill each kind of measure to reach a whole number. With the three-fourths measuring cup, to reach a whole number you'd need to use the measure four times. Four times three-fourths is twelve-fourths, which reduces to three. So filling that measure four times gives us three cups of milk.

"Each package of mix required two-thirds of a cup of milk. If we had a two-thirds measuring cup, you would need to fill it three times to get a whole number. Three times two-thirds is six-thirds, which reduces to two. So, filling a two-third measuring cup three times would give us two cups of milk," she continued.

"All I had to do then was find the least common multiple of three and two—the smallest number that is a multiple of both. That's six. Since I would need to fill the three-fourths measuring cup four times to get three cups, I would need to fill it twice that many times, eight times, to get six cups. I did that and put the milk in the bowl. And since three fillings of a two-thirds measuring cup would give us two cups, to get six cups I would need three times that many, or nine, to get the right amount of mix. So I added nine packages of the mix. I hope everyone's hungry!"

8 Corralling the Problem

Nicole's little sister Valerie loved play sets. She had several of them set up in their family room, which her family called Valerie Land. There were houses, a petting zoo, a bakery, and lots of farm animals. She especially loved horses.

At her birthday party, she got several sets of horses, including one set that had 40 plastic fence pieces, each one inch long, that could be snapped together to make a straight line or right angles. After the guests went home, Valerie started to play with the fence.

"I hope this corral is big enough to hold all of my horses," she told Nicole.

Nicole knew that would be a challenge because Valerie had a lot of horses.

Valerie arranged the fence pieces into a rectangle that was much longer on two of the sides than on the other two, but she couldn't fit all the horse figures inside of it. "We don't have enough fence pieces," she said. "We need to buy more."

"Before we do that, let me try to help," Nicole said, starting to rearrange the pieces.

"What difference will that make?" Valerie asked. "We have the same number of pieces no matter what shape we make."

34 A Perfect 10

"What's the qualifying score for States again?" Alison asked.

"A 33.5," Emily told her.

The two gymnasts were at a sectional meet, which served as a qualifier for the state championships. Each was competing in all four events—vault, bars, beam, and floor—with a possible top score of 10 in each event. Both of them were trying to get at least the qualifying score.

They had been planning to be roommates at States if each qualified. After two rotations, bars and beam, Emily had a total score of 17.25, but Alison had just a 16.5.

"I'll never make it," Alison said glumly. "I guess you'll have the room all to yourself."

"You can do it," Emily said. "We still have floor and vault to go, and you do well on those. What's your average on them?

"An 8.75 on floor and 8.25 on vault," Alison said. "What's your average on them?"

"An 8 on each," Emily said.

"Well, one of us will only have to be average, but the other one will have to do better than average if we're going to share that room," Alison said.

"Which one, you or me?" asked Emily.

Corralling the Problem

"Let's arrange the fence pieces into a square," Nicole said. "We have 40 pieces, so a square would have 10 pieces on each side. The area of a square is the width times the length, 10 times 10, or 100 square inches.

"Let's say you make a rectangle that's as close as you can get to a square. That would be 9 pieces in one direction and 11 in the other. That gives an area of 99 square inches—9 times 11. That's not much of a difference, but 99 is smaller than 100. Or, a rectangle that's 8 pieces one way and 12 the other would have an area of 96 square inches—8 times 12. If you go all the way to a rectangle that's 1 piece one way and 19 pieces the other way, you have an area of only 19 square inches—one times 19. So a square is the shape that will enclose the most space. Let's see if all of your horses can fit into a square."

They did fit. As Nicole watched, she thought to herself, I didn't want to confuse her, but a square is actually a type of rectangle, since a rectangle is a four-sided object with all straight lines, four right angles, and opposite sides of equal length. A square is a kind of rectangle where all four sides are the same length. I used the word rectangle in the sense that people usually think about it, where one pair of sides is longer than the other pair.

A Perfect 10

At the end of the awards ceremony, the girls walked off the podium. Alison had finished with a 33.5 all-around score, exactly what a gymnast needed to advance to the state championships, while Emily had also qualified, with a 34.25.

Alison said, "After two events, I had a 16.5, which meant I needed a total of 17 on the last two events to make it—33.5 minus 16.5 is 17. My average scores on those events were 8.75 and 8.25, which added together make 17. So I knew I'd get a 33.5 if I got my average scores."

Alison continued, "After two rotations you had 17.25 points, which meant you needed 16.25 more points—33.5 minus 17.25 is 16.25. But your average on the last two events was 8 each, meaning an average total of 16—8 plus 8. You were the one who needed to do better than your average on the last two events to make it to States. I didn't want to say that and make you nervous. I'm glad you made it. We're going to have a great time there!"

46 Rows and Columns

"Man, how did those ancient Greeks build those temples? It's hard enough just drawing one," Lucas said as Deandre walked into the auditorium.

Their class was in a unit on ancient civilizations. Once they had gone through the unit, they were going to put on a play about it. Lucas and Deandre were in a group assigned to paint the backdrop, a piece of white cloth 10 feet high by 15 feet wide that was now lying on the stage.

Their teacher, Mr. Gage, had given them a poster, two feet high by three feet wide, of an ancient Greek temple for them to use as a model. Before starting to paint the backdrop, the students had decided to sketch on it with chalk, to give them a guide. They were using yardsticks to help make the lines straight.

"It does look wrong," said Deandre, who had been in the art room collecting paints while the others sketched. "The columns all are the wrong length or width, and the roof looks funny. Why don't all of you take a break and let me try it?"

The other students wiped off the chalk marks, then went back to the classroom for a while. When they returned, Deandre had filled the backdrop with a sketch of the temple that looked just right.

"How did you do that?" Lucas asked.

61 Ice Cream, Anyone?

"Welcome to Cora's Ice Cream Parlor," a lady said from behind the counter.

She was glad to fill up seats in her ice cream shop on a chilly day, but she hadn't counted on all these energetic middle school girls celebrating the end of their fall field hockey season.

"Sir, you phoned earlier to reserve 21 seats for your team, right?" she said to the coach, Mr. Lee. "We're all set up for you," she said, pointing to tables that had been set with spoons and empty bowls.

He had told the girls he would treat them to two scoops of ice cream each.

"Coach Lee," said Claire, one of the players. "You're always saying that each one of us is unique, aren't you?"

"Yes," he said slowly, not sure he wanted to know what was coming next.

"So, every one of us wants something different from anyone else," she said, and all the other girls started laughing.

"Boy, they're a picky bunch, aren't they?" Cora said. "I don't even have 21 different flavors, I only have 12. What can I do?"

Rows and Columns

"It's just a matter of extrapolating," Deandre said.

"Extrapolating?" Lucas repeated.

"Using figures you know to get figures you need to know," Deandre said. "The proportions on the backdrop were the same as those on the poster—a ratio of 2 in height for 3 in width. Since the backdrop is 10 feet high and the poster is 2 feet high, anything on the poster has to be made 5 times longer on the backdrop to keep the proportions the same, because 10 is 5 times larger than 2. So, a column that measured 10 inches tall on the poster, for example, had to be 50 inches tall on the backdrop. Now all we have to do is get going with the paints."

Ice Cream, Anyone?

"It's a matter of how many combinations are possible. To find that, you add the number of samples to each number below it," Claire said to Cora.

"I'm not following you," Cora said.

"For example, if you had three flavors, that would be 3 plus 2 plus 1, making 6 possible combinations," she said. "Say you have vanilla, chocolate and strawberry. To use all the possible combinations of two scoops, you'd have one bowl with vanilla and chocolate, a second with chocolate and strawberry, a third with vanilla and strawberry, and three more bowls that have two scoops of the same flavor. That's 6 different combinations for three samples. It works the same way with each additional sample flavor you add. With four flavors, you'd have 10 possible combinations—4 plus 3 plus 2 plus 1. With five flavors, it is 15 possible combinations—5 plus 4 plus 3 plus 2 plus 1. To get 21 possible combinations, you actually only need six flavors—6 plus 5 plus 4 plus 3 plus 2 plus 1 is 21."

"For that explanation, young lady," said Cora, "you get the first choice of flavors."

Glossary

Algebra: a form of mathematics used for solving equations in which letters (such as x and y) stand for unknown values.

Area: the size of a surface; the amount of space inside the boundary of a flat, two-dimensional object, such as a triangle or a circle. For a square or a rectangle, area is the width multiplied by the length of an object ($A=lw$). For a circle, $A=\Pi r2$, and for a square the formula is $A=s2$.

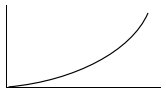
Average: a number that represents a typical amount or value. To calculate an average, add up all the numbers, then divide by how many numbers there are. For instance, to find the average of 2, 7, and 9 you would add the numbers: $2 + 7 + 9 = 18$. Divide by the quantity of numbers added (we added 3 numbers): $18 \div 3 = 6$. The average is 6.

Celsius: a temperature scale where water freezes at 0˚ and boils at 100˚. It is used to tell how hot or cold something is. Celsius is used in scientific results and in all countries that use the metric system.

Compound Interest: the term that describes interest calculated on the amount borrowed (the principal) and any previous interest. The total amount owed grows much more rapidly using compound interest than it does when using simple interest.

Division: splitting into equal parts or groups. We use the ÷ symbol, or, sometimes the / symbol, to indicate divide.
Example: $12 \div 4 = 3$ or $12/4 = 3$.

Exponential Growth: a quantity whose rate of growth becomes more rapid over time in proportion to the growing total number or size. On a graph, exponential growth will look like a curved line.



Extrapolation: an estimation of a value based on extending a known sequence of values or facts beyond the area that is certainly known.

Fahrenheit: a temperature scale where water freezes at 32˚ and boils at 212˚. It is used to tell how hot or cold something is. Fahrenheit is primarily used in the United States, while the rest of the world uses the Celsius scale to measure hot and cold.

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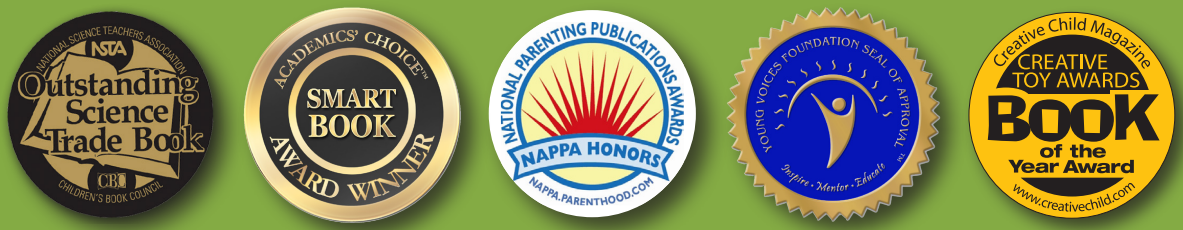

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