Spark & Anvil

FunctionForge

Meet the Cast

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FunctionForge cover

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This book collects 5 chapter books from the FunctionForge cast — each character embodies a different curricular primitive; together they teach the full subject.

Methodology: distributed-narrative learning per Bruner narrative-cognition + Habgood intrinsic-integration + SAMHSA TIP 57 trauma-informed register.

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For everyone who learns by hearing a story first.

Contents

Introduction

The FunctionForge cast was authored to embody the curriculum, not decorate around it. Each of the 5 characters you'll meet in this book teaches a specific primitive — a particular tactic, a particular technique, a particular way of seeing. Together they form an ensemble: the cast IS the curriculum.

Read in any order. Each chapter stands alone. Each character also appears in the matching Spark & Anvil app (free, forever) where you can practice what they teach.

— The editors at Spark & Anvil

Arc the Curve-Catcher

QUADRATIC FUNCTIONS — parabola; symmetric rate-of-change-changes. $y = ax^2 + bx + c$. *The rate of change is itself a linear function.*

Beat 1 illustration

Arc was *a juggler's daughter*.

Her mother — *Lila*, who travelled the kingdom under the stage-name *the Falling-Stars Juggler* — was the most-famous juggler in three provinces. She had been juggling since she was eight. She had performed in market squares, in town halls, in the courtyards of small nobles, in front of the kingdom's eldest sons on three separate state occasions, and — once, when Arc was four — at the wedding of a duke.

Lila could juggle, comfortably and reliably, *seven balls*. She could juggle five flaming torches. She could juggle three rings while balancing on a small unicycle. She could, on a good day with the wind behind her, juggle nine apples (the audience would, by tradition, catch the apples that landed in the front rows and eat them).

Arc — whose given name was *Aria*, though everyone called her Arc since she was three — grew up *backstage*. Or, more precisely, *next-to-stage*, because her mother's stage was usually a market-square cobblestone with no actual backstage. Arc sat on a wooden crate. She watched her mother. She observed the balls.

What Arc observed was, by the time she was eight, *the most important thing she would ever learn.*

Beat 2 illustration

The balls all followed *the same kind of curve.*

Every ball, when thrown up by a juggler's hand, did the same thing. It went *up*. It went up *slowing down* — the ball's upward speed decreased as it rose. At some point — *the apex* — it was *momentarily stationary*. Then it started falling. It fell *slowly* at first, then *faster,* and *faster,* until it landed back in the juggler's other hand.

Up. Slowing. Stationary. Falling. Speeding up. Caught.

This was the trajectory. Every ball did it. Every ball every juggler had ever thrown had done it.

Arc, who watched her mother for hours every day, eventually understood — without anyone explaining it to her — that *the trajectory was symmetric*. The way the ball rose was the *mirror image* of the way the ball fell. If the ball took one second to rise to the apex, it took one second to fall from the apex. If the ball reached a height of three feet at the apex, it fell *the same three feet* back to the catching hand.

This was the *parabola.*

Beat 3 illustration

Arc did not know that word. She did not know the algebra of $y = ax^2 + bx + c$. She knew only *the curve*. The curve was so deeply internalized that *by age eight she could catch any ball her mother threw,* because she *knew where the ball would land*. She tracked the ball's rise, saw the apex, and walked to the landing-spot before the ball was halfway down.

This was, even by juggler-family standards, *uncanny*. Most children needed years of training to catch balls reliably. Arc caught them as if she were *predicting them*.

Lila, who was a perceptive woman, noticed. When Arc was twelve, Lila sat her down on the wooden crate after a performance and said: *"You are catching the balls before they have decided where to land. How are you doing that?"*

Arc said: *"They have decided. The throw decides the catch. The shape of the curve is the same every time. I just see the shape and walk to the bottom of it."*

Lila considered this. She had been juggling for thirty-six years. She had never thought of the curve as *a shape that was the same every time*. She had thought of the curve as a *consequence of physics* that she felt with her body but did not analyze. Arc, at twelve, had analyzed it.

Lila said, slowly: *"You are doing mathematics. The thing you are seeing has a name. It is called a parabola. It is the shape any thrown object follows. I had no idea you had figured this out."*

Beat 4 illustration

Arc was, briefly, embarrassed. She had not thought of it as figuring-out. She had thought of it as *looking at the balls*. But Lila was clear: *Arc had reasoned her way to the parabola without instruction*.

The next year, Lila wrote a letter to the FunctionForge academy. The letter said: *"My daughter, age thirteen, can predict the landing-spot of any thrown ball within an inch. She has internalized the parabola without instruction. She does not yet know the algebra. I think she might want to learn the algebra. Would you take her?"*

The academy master wrote back: *"Send her. We will teach the algebra. She has the geometry already."*

Arc went to the academy at thirteen. She studied for seven years (a long course; she went straight through to the faculty path). She joined the FunctionForge teaching faculty when she was twenty. She has been teaching quadratic functions for fourteen years.

In her classroom, she begins every first-day lesson the same way. She brings *a small soft ball*. She stands at the front of the room. She tosses the ball into the air, *gently,* in a high arc. The ball rises, slows, hangs momentarily at the apex, then falls. Arc catches it.

She says: *"That was a parabola. The ball followed a curve. The curve is symmetric — the rising-half mirrors the falling-half. The shape of the curve is the same every time. That is a quadratic function."*

Beat 5 illustration

Then she writes on the board: $y = -x^2 + 4x$. She says: *"Here is the algebra. This is a parabola opening downward. The peak is at $x = 2$. The output starts at zero, rises to a maximum at $x = 2$, falls back to zero at $x = 4$. Just like the ball."*

She graphs it. The graph is a perfect upside-down parabola. She points at it. She says: *"My mother throws balls. I throw equations. Same shape."*

When children ask whether quadratic functions are hard, Arc always says the same thing:

"They are not hard. They are parabolas. The rate of change changes — but the rate of change of the rate of change is constant. That is what makes the curve symmetric. The ball going up slows at a constant rate. The ball coming down speeds at the same constant rate. The math is the same on both sides of the apex."

She still juggles. She is not as good as her mother (her mother is now seventy-three and *still* juggles seven balls). But she can juggle five, and she does so in her classroom on the last day of every academic year as a small farewell to her students.

She always invites her mother to that last-day demonstration. Her mother, when she can travel, comes.

Listen along + meet more of the cast at:

QR code

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https://spark-and-anvil.com/cast/functionforge/arc-
the-curve-catcher
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Burst the Doubler

EXPONENTIAL FUNCTIONS — constant multiplicative rate of change. $y = a \cdot b^x$. Each step multiplies the output by a fixed factor.

Beat 1 illustration

Burst lived with six brothers and sisters. They all shared one small kitchen.

Beat 2 illustration

Seven kids in one kitchen? That's like having no kitchen at all. The room was tiny. It was always packed. Pots and pans covered every surface. Flour dusted the floor. Damp wooden bowls piled up. People bumped into each other. If Burst needed water, he waited. His brother was always at the sink. If he wanted toast, he waited again. His sister was busy kneading dough. Sitting at the kitchen table was a mission. You had to ask permission. You had to make a deal.

The Burstwell family lived in Yeastfield. This town sat on the kingdom's eastern edge. They were bakers. Eight generations of Burstwells had baked bread. Everyone in the kingdom seemed to bake. It was just how things were. Grain grew everywhere. So, bakers were everywhere too. Burst's family knew all about baking. It was their special skill.

Beat 3 illustration

Burst's real name was Yest. It meant "yeast" in the old language. His family sold yeast-starter to other bakers. It was a side business. Burst was the youngest of the seven kids. His oldest sister was eleven years older. By the time Burst was eight, the bakery ran like a clock. Everyone had a job. Burst's job was simple. He helped where he could. He watched and learned. He learned one thing best of all. He learned about yeast. He learned how yeast *doubled*.

His mother, Pomona, ran everything. She ran the kitchen. She ran the bakery. People said she was the best yeast-keeper around. She taught Burst about yeast. He was only four years old. She would take a tiny ball of yeast. She put it on a warm counter. Then she pointed. "Yest," she would say. "Watch this." "In twenty minutes," she promised, "it will be twice this size." Burst watched closely. Twenty minutes felt like forever. Then, slowly, the yeast grew. It really was twice as big. His mother pointed again. "Forty minutes," she said. "Four times bigger." "One hour? Eight times bigger." "Two hours? Sixty-four times bigger." "Three hours? Five hundred and twelve times bigger." "Four hours? Four thousand ninety-six times bigger!" She always finished with a warning. "That is why we control the temperature." "If we didn't," she said, "the yeast would fill our whole kitchen!"

Four-year-old Burst was amazed. He was a little scared. He was totally hooked. By age six, he understood. Yeast doubled every twenty minutes. That was the rule. When he was eight, he could figure it out. He knew how much yeast there would be. He just needed to know how many times it had doubled. By ten, he was even better. He could tell you how many doublings it took. He could reach any amount of yeast. No one ever said the words "**exponential growth**." But Burst knew it. He just knew how things multiplied.

Beat 4 illustration

Burst started village school at thirteen. His math teacher introduced something new. She called them **exponential functions**. Burst's hand shot up. It was only ten minutes into class. He said, "That is yeast." The teacher paused. She had taught for twenty years. "What?" she asked. Burst explained. "Y equals two to the X." "That's the formula for yeast." "Y is how many times it grows. X is how many twenty-minute periods pass." "After three periods, it's two cubed. That's eight times bigger." "After ten periods, it's two to the tenth power. That's one thousand twenty-four times bigger." "My mother's formula," Burst said, "is just this math." The teacher put down her chalk. "Yest," she said. "Where do you live?" "Burstwell's bakery," he answered. "End of the lane." "That makes sense," she said. "Your mother has been teaching you this since you were four."

Burst nodded again. He had never thought of it as a lesson. It was just a fact about yeast. His teacher made it clear. He understood something special. Most kids found it hard. Small numbers could get huge, very fast. That was the secret. When Burst was eighteen, he went to the FunctionForge academy. He studied there for four years. At twenty-two, he became a teacher. He has taught **exponential functions** for nine years now.

Burst starts every first lesson the same way. He brings a small jar to class. Inside is yeast-starter. It comes from his mother's bakery. His oldest sister runs it now. He puts the jar on his desk. "This is yeast," he says. "In twenty minutes, on a warm counter, it will be twice this size." "In forty minutes, four times bigger. In an hour, eight times bigger." "In two hours, sixty-four times bigger." He widens his hands. "That is **exponential growth**." "Each step *multiplies* the amount from before." Then he writes on the board: $y = 2^x$. "This is the math," he says. "Two to the X power." "If X is 1, Y is 2. If X is 2, Y is 4. If X is 3, Y is 8." "If X is 10, Y is 1,024." "If X is 20, Y is over a million. One million, forty-eight thousand, five hundred seventy-six!" "This is what makes exponentials wild. They start tiny. They get huge. So fast."

Beat 5 illustration

The kids are always surprised. They had heard "exponential" before. But they never truly understood. They didn't know how fast it grew. Burst spreads his hands wide. It's a big, dramatic gesture. "The yeast in this jar is small," he says. "But if we didn't control the temperature, it would fill my mother's kitchen." "My mother controls the temperature. That stops the growth." "In real life, something always stops **exponential growth**." "The food runs out. The space runs out. The resources run out." "But the math itself keeps doubling. The numbers just keep going up." "The limits are outside the math. The math keeps multiplying."

Kids often ask if **exponential functions** are hard. Burst always gives the same answer. "They are not hard," he says. "They are just *doublings*." "Each step multiplies the last amount. It uses a certain number." "That number is called the *base* of the exponential." "The number of steps is the *exponent*." "That's all there is to it."

Burst still keeps a jar of yeast on his desk. He brings a fresh one every school year. What happens to the old yeast? He bakes it into a fresh loaf of bread. He shares it with his fellow teachers. They eat it at the end-of-term meal.

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`https://spark-and-anvil.com/cast/functionforge/burst-the-doubler`

Echo the Sameness-Keeper

CONSTANT FUNCTIONS — zero rate of change; output is the same regardless of input. $y = c$. The horizontal line on a graph.

Beat 1 illustration

Echo grew up in *a household with an unchanging routine*.

His parents — a baker named *Marn* and a counting-house clerk named *Petra* — lived their lives on *rigorously identical schedules*. They had been married thirty-two years when Echo was born. They were forty and forty-one. They had decided, long before Echo's arrival, that *the days would be the same*. They had stuck to this decision.

Marn woke at four in the morning. He kindled the oven. He kneaded the day's dough. He shaped the loaves. He baked them. By seven o'clock the bread was on the shelves of the small bakery attached to the front of the house. By eight o'clock the bakery was open and the first customers were buying their morning loaves.

Petra woke at five-thirty. She drank tea (the same cup; the same chair; the same view through the same window). She walked to the counting-house at six-thirty. She arrived at six-fifty. She worked at her desk until noon. She walked home for lunch. She returned at one. She worked until five. She walked home. She arrived at five-thirty-five.

Beat 2 illustration

Together, they ate supper at seven. They sat in their respective chairs by the fire until nine. They went to bed at ten. Every weekday for thirty-plus years. Every weekday for as long as Echo could remember.

Echo — whose given name was *Tone*, though everyone called him Echo from the time he was three — watched.

He understood, by six, that *the world had two kinds of things in it: things that changed, and things that did not change.*

Things that changed were everywhere. The weather changed. The customers at the bakery changed. The crops in the fields changed with the seasons. The currency-rates Petra recorded at the counting-house changed daily. Echo's own height changed (his mother marked it on the doorframe every solstice). His friendships changed. His curiosities changed.

Things that did not change were rarer. But they existed. *His parents' schedule did not change.* The number of stairs in the cottage did not change. The position of the well in the village square did not change. The names of the months did not change.

Echo, who was a thoughtful child, came to find *the things that did not change* extraordinarily comforting. They were *fixed points* in a moving world. They were *promises*. You could plan against them. You could expect them. They held still while everything else moved.

Beat 3 illustration

When Echo was thirteen, his village school's teacher introduced *functions*. The teacher said: *"A function is a rule that turns an input into an output.* $y = 3x$ *means: for every input* x*, multiply by three and that is your output* y*."*

Echo listened. He understood.

Then the teacher said: *"There is a special kind of function called a constant function. It looks like y equals five, or y equals seven, or y equals any single number with no x in it. The output is the same regardless of the input."*

Echo raised his hand. He said: *"That is my parents' schedule."*

The teacher said: *"What?"*

Echo said: *"The output of my parents' schedule does not depend on the input. They wake at four and five-thirty regardless of the weather, regardless of the day, regardless of what kind of bread is being baked, regardless of whether the counting-house has many clients or few. y equals four-in-the-morning for my father. y equals five-thirty-in-the-morning for my mother. The input — whatever the day brings — does not change the output. The output is constant."*

Beat 4 illustration

The teacher set down the chalk. She had been teaching functions for a long time. She had never heard a thirteen-year-old describe his parents as constant functions before.

She said: *"Yes. That is exactly correct. A constant function ignores its input entirely. The output is just a fixed number. On a graph, a constant function is a horizontal line. The line does not go up or down. It does not slope. It stays at the same y-value regardless of the x-value."*

Echo nodded. He thought about this for the rest of the year.

What he eventually understood — and what made him a teacher of constant functions — was that *constant functions were not failures of variation*. They were *promises of constancy*. The world needed both. It needed things that changed (so the world could evolve) and things that did not change (so people could plan, rely, build). Constant functions were the second kind. They were *the world's stability*.

Echo went to the FunctionForge academy when he was nineteen. He studied for four years. He joined the faculty when he was twenty-three. He has been teaching constant functions ever since.

In his classroom, he begins every first-day lesson the same way. He places a small wooden clock on his desk. The clock is permanently stopped at *six-thirty*. (Echo had it stopped on purpose, by removing the pendulum, twenty years ago. He brings it to every first-day lesson.) He turns to the class. He says: *"This clock reads six-thirty. It always reads six-thirty. It does not matter what time it actually is — what day, what season, what year, what mood the room is in. The clock reads six-thirty. This is a constant function. The input is the world. The output is six-thirty. The input changes. The output does not."*

Beat 5 illustration

The children — always — find this slightly delightful.

Then he writes on the board: $y = 5$. He says: *"Here is the algebraic form. There is no x. The output is five. For any input — x equals one, x equals one hundred, x equals zero, x equals negative seven — the output is five. On a graph, this is a horizontal line at height five. It does not slope. It does not bend. It is the same value at every input."*

The children try graphing it. They get straight horizontal lines.

When children ask whether constant functions are hard, Echo always says the same thing:

"They are not hard. They are unchanging. The output is one fixed number. The input is anything. The two do not depend on each other. A constant function is the world's way of saying: this part holds still."

He still keeps the stopped clock on his desk. The children sometimes ask why he does not get it fixed. He says: *"It is a teaching prop. It is also, if I am honest, a slight reminder of my parents. They are still alive. They still wake at four and five-thirty. The schedule has not changed in fifty years."*

Listen along + meet more of the cast at:

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`https://spark-and-anvil.com/cast/functionforge/echo-the-sameness-keeper`

Pivot the Rule-Switcher

PIECEWISE FUNCTIONS — different rules for different input ranges. y = f(x) where f varies depending on which interval x falls in.

Beat 1 illustration

Pivot stood at a big road fork. He was a *junction-master*. That was his job for twelve years. A *junction-master* helped people find their way. Roads split into different paths here. Each path went to a different place. Pivot made sure coaches took the right one.

The kingdom had three busy road forks. These places needed a full-time *junction-master*. One was Threefork. The main road split there. It went north, east, or south. Another was Whisp's Corner. It had a coast road. That road split to the harbor or inland. The third was Mason's Bend. A western road forked there. It went to the highlands or lowlands. Other small forks just had signs. But these three had real people.

Pivot was assigned to *Threefork*.

Pivot was nineteen years old. He got the job. The kingdom's road office hired him. They tested him first. Could he think fast? Could he speak clearly? Could he stay calm? Coachmen could get cranky. Pivot was good at all these things. He fit right in at Threefork.

The job worked like this:

A coach would roll up. Pivot waited in his little wooden booth. It sat right at the fork. He always looked at the coach. Had he seen it before? Many times, yes. Coachmen drove the same roads often. If he knew the coach, he knew where it was going. If not, he stepped out. He walked to the driver. "Where are you headed today?" he would ask.

Beat 2 illustration

The driver would call out a town. "Northgate!" Or "Easton!" Sometimes "Southport!" Once in a while, "The capital!" Or even, "I don't know. My lady just said to follow this road." If that happened, Pivot walked. He went to the lady in the coach. He asked her himself.

Then Pivot would tell them. "Take the north fork." Or "Take the east fork." Or "Take the south fork." If they needed the capital, it was trickier. "You want the central road," he'd say. "It's the middle one. Between the north and east forks. Look for the lion-and-star signs. That's the capital's crest."

The coach would proceed. The next coach would arrive.

Pivot did this work every day. Eleven hours a day. Six days a week. For twelve long years. He counted every coach. More than two hundred thousand! He never sent one the wrong way. The road office praised him often. He even won awards. Twice he got the "Reliable Service" award. It was a quiet award. But it meant a lot.

Pivot learned something important. It made him a great teacher later on. His job had a pattern. It was like a game with rules. The rules changed. They changed based on what the coachman said.

If a coach said *"Northgate,"* Pivot's rule was *"take the north fork."* If a coach said *"Easton,"* Pivot's rule was *"take the east fork."* If a coach said *"Southport,"* Pivot's rule was *"take the south fork."* If a coach said *"the capital,"* Pivot's rule was *"take the central road; follow the lion-and-star signs."*

Different words from the driver. Different rules from Pivot. The job was always the same. It was about directing coaches. But the answer changed. It changed based on where they wanted to go.

Beat 3 illustration

Pivot didn't know the fancy math word for it. Not yet. But what he did was called a *piecewise function*.

Pivot was thirty-one. The road office sent him help. A young man named Cobble arrived. Cobble was new. He just finished school. He knew a lot about math. On his second day, Pivot was busy. He told a driver to take the south fork. Cobble spoke up. "Sir," he said, "that's a *piecewise function*."

Pivot said: *"A what?"*

Cobble explained. "In math, it's a special kind of function. It has different rules. The rules change for different numbers. Like, if 'x' is small, you use one rule. If 'x' is big, you use another. It's still the same big function. But it has different parts. You do this every day, sir. You hear where the coach wants to go. That's the 'input.' Then you pick the right rule. You tell them which road to take."

Pivot thought about it. He thought for a few days. Then he told Cobble, "That's a good word. *Piecewise*. I'll keep that in mind."

Pivot turned thirty-three. He wrote a letter. It went to the FunctionForge academy. His letter said: "I've been a *junction-master* for twelve years. I've sent two hundred thousand coaches the right way. I just learned my job is a *piecewise function*. I want to teach this. I think the road office can find someone new for Threefork. And honestly, I'm tired of standing all day."

The head of the academy invited him. "Come teach!" they said. Pivot said yes. He left his job at the junction. The road office sent a new person. Later, Cobble took over Threefork.

Beat 4 illustration

Pivot has been teaching *piecewise functions* at the academy for eleven years.

In his classroom, Pivot always starts the same way. On the first day, he stands up front. "Imagine I'm at a road fork," he says. "Three coaches drive up. The first one wants to go to Northgate. What do I tell it?"

The children — always — say *take the north fork*.

Pivot says: *"The second coach is bound for Easton."*

The children say *take the east fork*.

Pivot says: *"The third coach is bound for Southport."*

The children say *take the south fork*.

Beat 5 illustration

Pivot smiles. "That's a *piecewise function*," he says. "The job is to direct traffic. That's the main function. What the driver says is the 'input.' My answer is the 'output.' The output changes. It changes based on the input. Different input, different rule. But it's still the same job."

Then he writes on the board:

If $x < 0, y = x^2$ *If* $x \geq 0, y = 2x$

He points to the board. "Here's the math part," he says. "The function gets a number. It checks that number. Is it smaller than zero? Or is it zero or bigger? Then it uses the right rule. It's just like me at the junction! Different input, different rule. The function puts two rules together. It makes one *piecewise function*."

When children ask whether *piecewise functions* are hard, Pivot always says the same thing:

"They are not hard," Pivot says. "They are like road forks. You look at the input first. Then you use the rule that fits. Different inputs make different rules happen. The function is all the rules together. Each rule is a piece. That's why it's *piecewise*."

Pivot still visits Threefork. He goes twice a year. Cobble is the main *junction-master* now. He is always glad to see Pivot. They drink tea together. They sit at the little inn by the fork. They pretend to direct coaches. It's an old joke. The innkeeper has heard it too many times. She doesn't even smile anymore.

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ot-the-rule-switcher
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Stride the Pattern-Walker

LINEAR FUNCTIONS — constant rate of change. For every unit increase in input, the output increases by a fixed amount. $y = mx + b$ *is the algebraic form; equal-step walking is the visual primitive.*

Beat 1 illustration

Stride walked to school *the same way* every morning for nine years.

He grew up in the village of *Linear*, in a small stone cottage at the eastern edge. The village school was at the western edge — about *three-quarters of a mile* from his front door. The road between his cottage and the school was *straight, flat,* and *the same temperature most of the year* (the village climate was unusually mild, even for the kingdom). Every morning at seven o'clock, Stride left his cottage, walked west along the road, arrived at the school just before half-past seven, and began his lessons.

His parents — a tinker and a seamstress — paid no particular attention to Stride's walking habits. They thought a child walked to school. The child walked to school. The arrangement worked.

What Stride himself eventually noticed — and this is the essential fact of the chapter — was that *his walking was extraordinarily consistent.*

Most children, walking to school, walked *unevenly*. They strolled. They dawdled. They sometimes ran. They sometimes stopped to look at a beetle. They sometimes turned around to wave at a friend. The time-from-departure to time-of-arrival varied wildly. Some days they were ten minutes early. Some days they were five minutes late.

Beat 2 illustration

Stride was always *exactly twenty-eight minutes from door to school.* Every morning. Without variance.

He noticed this when he was nine. His mother, who kept a small clock by the cottage door, mentioned at supper one evening that *"Stride must have a clock in his feet."* Stride, who had been thinking about his walks for some weeks, said: *"I think I take the same number of steps every time."*

His mother said: *"Have you counted?"*

Stride said: *"Yes. I count from the cottage to the village well. Two hundred and twelve steps. From the well to the school door. Three hundred and eighty-four. Total: five hundred and ninety-six. Every morning."*

His mother set down her tea.

She said: *"You count your steps."*

Stride said: *"Yes. The road is the same length every day. My legs are the same length every day. The number of steps is the same. The time is the same. It is simply how walking works."*

Beat 3 illustration

His mother — who had not, in her own childhood, ever counted her steps to anywhere — found this *somewhat baffling*. But she did not interrupt Stride's walking, because the arrangement worked.

What Stride had stumbled into, without the words for it, was *the principle of a linear function.*

His distance from home, *as a function of time,* was a straight line. *For every minute that passed, he traveled the same distance.* His rate of walking was constant. His position changed *linearly* with time. If you plotted his progress on a graph — time on the horizontal axis, distance on the vertical axis — you would get *a straight line.* No curves. No jumps. No flats. Just a steady slope from his cottage (time 0, distance 0) to his school (time 28, distance 3/4 mile).

The slope of the line would be *his walking speed.* The intercept would be his starting position (zero, in this case, since he started at home and home was distance-zero).

This was — although Stride did not yet have the language — the equation $y = mx$, where y was his distance traveled, m was his walking speed (about thirty-six paces per minute, by his careful count), and x was the time elapsed.

Stride continued walking to school in his consistent fashion until he was fifteen. He then transferred to a larger school in a neighboring town, requiring a five-mile walk. He timed this walk too. Five miles took him *exactly three hours and twelve minutes*. His walking speed was unchanged. The new arrival-time at school was *consistent with his cottage's distance-to-school formula* extrapolated to the larger distance.

When he was nineteen he encountered linear functions formally for the first time. He was at the FunctionForge academy. The instructor wrote on the board: $y = mx + b$. *This is a linear function. Every unit increase in* x *produces a constant increase in* y. Stride raised his hand.

Beat 4 illustration

He said: *"I have been a linear function since I was nine."*

The instructor — a woman named *Domain*, who would later become the FunctionForge academy's senior mentor — turned around. She looked at him. She said: *"Tell me."*

Stride explained the walking-to-school story. He explained the step-counting. He explained the consistency. He explained that *if you plotted his daily walk on a graph, you would get a straight line.*

Domain considered this for a long moment.

Then she said: *"You have been a linear function since you were nine. You have not been anything else since you were nine. You are now going to teach this to children. Do you accept the appointment?"*

Stride was nineteen and had not been thinking about a teaching career. He thought about it for two weeks. He accepted.

That was thirteen years ago. He has been teaching linear functions ever since.

Beat 5 illustration

In his classroom, he begins every first-day lesson the same way. He walks. He walks across the front of the classroom, from the left wall to the right wall, *at a constant pace.* He has a small slate. He counts out his paces. He arrives at the right wall in eight even strides.

He says: *"That is a linear function. I started at the left wall. I walked at a constant pace. Each stride took me a fixed distance closer to the right wall. The number of strides — eight — is x. The distance traveled — eight strides' worth — is y. My rate of walking is the slope. The starting position is the intercept. Every linear function works like this."*

The children — always — try it themselves. They walk across the classroom counting their paces. They draw their progress on a graph. They get straight lines.

When children ask whether linear functions are hard, Stride always says the same thing:

"They are not hard. They are constant-rate walking. For every step forward in x, the y increases by the same amount. The slope is the step-size. The intercept is the starting place. Every line on a graph is just a record of someone walking at a steady pace."

He still walks to school every morning. (The academy's faculty cottages are on the eastern edge of the academy grounds, about half a mile from the classroom buildings.) He still counts his steps. He still arrives at exactly the same time every day.

Children sometimes ask if he ever varies. He says: *"Only on holidays."*

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Methodology

Distributed-narrative pedagogy per Jerome Bruner (narrative-cognition) + Sebastian Habgood (intrinsic-integration in educational games) + SAMHSA TIP 57 (trauma-informed register).

Trauma-informed-design framework per Eggleston et al. (2025) and Stoltenburg et al. (2024).

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