



ProofQuest

Meet the Cast

STANDARD EDITION

Spark & Anvil

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This book collects 7 chapter books from the ProofQuest cast — each character embodies a different curricular primitive; together they teach the full subject.

Methodology: story-based learning, where the characters embody the ideas being taught, with a trauma-informed, emotionally-safe approach.

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This is Volume 1 of 2 of the *ProofQuest — Meet the Cast* series; each volume is a complete standalone book you can read on its own.

For everyone who learns by hearing a story first.

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Introduction

The ProofQuest cast was authored to embody the curriculum, not decorate around it.
Each of the 7 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*

Direct-Proof Dora

The **DIRECT PROOF** — start with the given premise, follow valid logical steps, arrive at the conclusion. The most-honest of the proof techniques. No tricks. No detours. Just the path.



The day Dora learned to trust the long way, she was nine years old and absolutely, completely certain she was right.

Her town, Stepwell, was holding its summer fair, and the prize question was painted on a board by the well: *Every number you make by adding two odd numbers together — is it always even?* First correct answer with a reason won the big ribbon. Dora scribbled a few sums on her hand. Three plus five is eight. Seven plus one is eight. Nine plus three is twelve. Even, even, even. She felt the answer light up in her chest like a lamp. *Yes. Obviously yes.* And because she was sure — because she could FEEL how right it was — she did not want to bother with the slow part. She wanted the ribbon now.

So she marched up to the judge and said, "It's always even. I checked three of them and they all worked, so it works for all of them." She said it fast, proud, certain. A shortcut. Skip the fussy middle; jump straight to the end.



The judge, a patient old baker named Mr. Fenn, tilted his head. "Three of them," he repeated. "Out of how many pairs of odd numbers are there, Dora?"

"Lots," Dora admitted.

"More than lots. There's no end to them." He wasn't unkind about it. "You checked three and jumped to *all*. That's a lovely-feeling jump. But a jump is not a bridge." He pointed to the far edge of the fairground, where a boy named Cass was grinning. "Cass made the same kind of jump this morning, on a different question. Ask him how it went."

Dora didn't want to ask Cass anything. She was RIGHT and she knew it. The answer was even. She could feel it. Why should she have to crawl through steps to prove a thing that was already obvious? The obviousness *was* the proof, wasn't it? She held onto that feeling all afternoon, the way you hold onto being right.



Cass found her by the ribbon board anyway. "Let me guess," he said. "You checked a few, they all worked, so you said 'always.'"

"Because it IS always," Dora said.

"Sure. This time." Cass didn't look smug now; he looked a little burned. "This morning the question was about a pattern in the fair's raffle numbers. I checked four. All four fit my rule. I was *so sure* — felt exactly like you look right now. I skipped to 'always' and told the judge." He winced. "The fifth number broke it. My rule was wrong the whole time. It just hadn't shown me yet. The checking that felt like enough — wasn't."

Dora opened her mouth to say her question was different, her feeling was realer. But a small cold thought had crept in: *his shortcut felt exactly as sure as mine does*. And his had lied to him. Feelings of certainty, it turned out, came free with both the true answers and the false ones. They didn't tell you which was which.



She went home that night bothered, and did the thing she had been too sure to do: she walked it. Slowly. One step at a time, refusing to skip.

What is an odd number, really? An odd number is an even number plus one — it's some pairs, with one left over. So any odd number could be written as "a bunch of twos, plus one." *Now take two of them.* The first is some twos plus one. The second is some other twos plus one. *Add them.* All the twos pile together — still made of twos, still splits into pairs — and then the two leftover ones, the plus-one and the plus-one, meet each other and *make another pair.* Nothing is left over. She stared at it. The two lonely leftovers had found each other and become even. That was WHY. Not "I checked three." Not "it feels right." A reason that held for every odd pair there could ever be, because she'd never once said "and the rest are probably the same." Every step followed from the step before it. No gap for a lie to hide in.

And here was the strange part: the answer was the same answer she'd blurted that morning — even. But it felt *completely* different now. Before, she'd been holding a guess that happened to be right, the way Cass had held one that happened to be wrong, with no way to tell them apart. Now she was holding something that couldn't turn on her. She'd checked every step, so there was no fifth number waiting to break it.



Dora went back to the fair the next morning and found Mr. Fenn. She didn't say "it's even" this time. She walked him through it — the twos, the two leftovers finding each other — step by step, no skipping.

"That," said Mr. Fenn, "is a proof. Yesterday you had an answer. Today you have a reason nobody can knock down." He gave her the ribbon. But Dora was barely looking at it. She was thinking about the difference between the two feelings — the fast, bright, hollow certainty of the jump, and the slower, heavier, solid certainty of the walk — and how alike they'd felt from the inside, and how much she never wanted to mix them up again.

She grew up to be a mathematician, and then a teacher, and she came to ProofQuest to show kids the **direct proof**: you start with what you truly know, you take one honest step at a time, and each step has to follow from the last — no jumping, no "probably the rest are fine." Kids always ask her the same thing she once believed: "*But if you already know the answer, why not skip to it?*"

And Dora, who has been that certain nine-year-old, smiles and tells them about the shortcut that lied. "You can skip," she says. "It even feels wonderful. It feels exactly as sure as the truth — right up until the fifth number shows up." She still isn't relieved by being right. She's relieved by being *unable to be knocked down*. That's a different, better feeling, and you only get it by walking the whole bridge.

Read it? Now hear Direct-Proof Dora's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/direct-proof-dora>

Induction Ida

*MATHEMATICAL INDUCTION — prove the base case (usually $n=0$ or $n=1$), then prove that *if* the claim holds for some k , it holds for $k+1$. The dominoes technique.*



- prompt: "Ida says it helps if you don't hurry. When you're nervous that something will be hard, does slowing down make you feel calmer, or more stuck?"

Once a year, in the town of Lattice — which is in the kingdom's southern hill region, three days' walk from the capital — the locals hold a festival called the Cascade.

The Cascade is one event. It lasts about thirty seconds.



On the day of the festival, at sunset, the mayor — who has, that year, the official honour — bends down and pushes over the first domino.

Everything else falls on its own.

The crowd cheers. The town puts up bunting. The bakery sells out of festival biscuits. Somebody hugs a stranger. The dominoes are swept up. Plans are made for next year. The whole town goes home.

This is the festival that made Ida the mathematician she became.

Her family — the Latticeford family, six generations of festival-domino-makers — had run the Cascade preparation for as long as anybody could remember. Ida grew up watching her mother set out long curves of dominoes in the town square. She grew up helping. By the age of seven she could lay a hundred dominoes by herself without knocking any of them over while she worked. (This is harder than it sounds. There is a particular knack to setting down the next domino without bumping the last one. You have to *not be in a hurry*.)



It was a great honour. It was also, for Ida, a great responsibility. She had spent the whole afternoon laying her share of the chain. She had checked it three times. She was, at twelve, the youngest first-pusher in seventeen years.

She bent down at sunset. She pushed the first domino.

It fell into the second. The second fell into the third. The third fell into the fourth.

Ida watched the chain unfold.

What she noticed, in those thirty seconds — and she noticed it with the kind of clarity that twelve-year-olds occasionally get and adults sometimes forget — was that she had only pushed *one domino*. The other nine hundred and forty-nine had fallen *on their own*. She had not touched them. She had not been near them. The whole chain — *all of them* — had toppled because the *first* one had toppled and because each one was *close enough to the next one* to knock it down in turn.



She walked home that night humming. (Her sister Sten, who was nine at the time and is now known as Strong-Induction Sten, did not understand why her older sister was humming, but Sten was also nine and had eaten three festival biscuits and did not care.)

Ida wrote down what she had figured out, in her own twelve-year-old handwriting, in a notebook her grandmother had given her. The notebook page said:

"To knock down all the dominoes, you only need to do two things:

- 1. Knock down the first one.*
- 2. Make sure each domino is close enough to the next one to knock it down too.*



She did not know yet, that night, that this principle had a name. She did not know that the principle was hundreds of years old. She did not know that mathematicians called it *induction* and used it to prove things about every natural number. She did not know that, in eight years, she would arrive at the ProofQuest academy and introduce herself by saying "*I am the dominoes person,*" and that the academy master would look up from his notes and say, "*Oh good. We have been waiting for you.*"

She just knew, that night in Lattice, that she had figured out something important.

She has been teaching mathematical induction ever since. She still goes home for the Cascade every year. She no longer pushes the first domino — that honour rotates — but she sets up her share of the chain. She still does not hurry.

And when children come to her class for the first time and ask, nervously, whether the technique called *induction* is hard, Ida always says the same thing:

"You knock down the first one. You show that each one knocks down the next one. That's all. The rest happens by itself."

Read it? Now hear Induction Ida's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/induction-ida>

Strong-Induction Sten

*STRONG INDUCTION — assume the claim holds for *all* values up to k (not just k), then prove it for $k+1$. The induction that gets to use everything already proved.*



- prompt: "Sten and Ida argue about whose way is 'the real one' and love each other the whole time. Have you ever felt that mix of stubbornness and warmth with someone in your family?"

Strong-Induction Sten is, as the chapter title suggests, the kind of person who inherits things.

He inherited his nose from his father. He inherited his height from his mother. He inherited his love of festival biscuits from his grandfather. He inherited his belief that *you should use everything you already have* from a series of older cousins who pointed out, repeatedly, throughout his childhood, that there was a perfectly good library at the end of the street.



Sten was, as the previous chapter mentioned, three years younger than his sister Ida. He grew up in the same town (Lattice), in the same family (Latticeford), in the same domino-festival tradition. He helped set up the Cascade every year. He pushed the first domino at fifteen, which was a great honour, and he too watched the whole chain fall, and he too noticed that he had only pushed one piece.

He thought: *Yes. I see why Ida likes this.*

But Sten also noticed, that day and other days, that his sister's domino technique had a particular shape. She *only used the previous one*. She knocked down domino k , and domino k knocked down domino $k+1$, and the rest happened by itself.

Sten thought, watching her work: *That's fine. But what about the dominoes she already knocked down?*

This will sound like a small thought. It was not small.



Ida's technique used the previous one. Sten thought: *Why not use all of them?*

He brought this up at the dinner table when he was sixteen.

Ida (who was nineteen and home from her first year at the academy) said: *"You can. It's allowed. It's just a different version of the technique. It's called strong induction."*

Sten said: *"How is that different?"*

Ida said: *"In ordinary induction, you only assume the case for k . In strong induction, you assume the cases for everything up to k . It's still valid. Some proofs need it. Most don't."*



Ida said: "Because it isn't always necessary."

Sten said: "It isn't always necessary, but it's never wrong. So I'd just use it."

Ida said: "You're allowed to. Most mathematicians don't, because it feels heavier."

Sten said: "It only feels heavier."

Their mother (who was excellent at deflecting domino arguments at the dinner table) suggested they pass the bread.



Sten teaches strong induction. He is the cast member who, when proving something about case $k+1$, gets to use *every previously-proven case*. This is occasionally exactly what a proof requires. There are theorems — about the structure of prime numbers, about the depth of certain trees, about the way certain recursive algorithms terminate — that cannot be proved by ordinary induction at all. They need strong induction. Sten teaches all of them.

He is, in person, mildly relaxed. He says "*obviously*" a lot, which is sometimes annoying but is usually accurate. He believes — and has said, more than once, in front of his sister — that strong induction is *just induction, but with more friends in the room*.

Ida finds this analogy slightly grumpy.

She finds it more grumpy because it is *correct*.

Sten and Ida are very close. They write letters when they are at different academies. (Sten now teaches at the southern branch; Ida at the central.) Their letters are warm and full of *next case* discussions. They send each other interesting recursion problems. They argue about whose technique is *more elegant* (Ida says ordinary; Sten says strong; neither has changed her or his mind). Their mother, who is now seventy-two and still runs the family domino business in Lattice, considers this argument the only thing her children ever fight about.

Read it? Now hear Strong-Induction Sten's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/strong-induction-sten>

Contradiction Cassius

*PROOF BY CONTRADICTION — assume the *opposite* of what you want to prove, follow the steps, arrive at a contradiction, conclude that your assumption was wrong.*



- prompt: "Cassius listens for what doesn't fit. When have you noticed something in an argument or a story that didn't quite add up — even before you knew why?"
 - prompt: "Proof by contradiction starts by assuming the OPPOSITE of what you want to be true. When have you imagined the opposite of your idea, just to see what would happen?"
 - prompt: "Cassius doesn't win by being loud. He wins by following the steps until the world contradicts itself. What is one steady step you've taken, even when the answer wasn't obvious yet?"

Cassius was a judge for twenty years. He worked in the third district, a hilly area with lots of small towns. And lots of small arguments. By his own count, Cassius heard ten thousand cases.

Ten thousand cases is a lot of listening.

After about two thousand of them, Cassius noticed something strange. The best arguments never started with "I'm right!" The best arguments started with, "Okay, let's pretend the other person is right."

The lawyer would walk down the path of the other person's story. They would follow it step by step. Patiently. Until the path *cracked*. Until it led to a place that made no sense. Until the story fell apart.



When that happened, Cassius could *hear* it. He had a special ear for it. He could hear a story crack the way a potter hears the exact moment her wheel slows down.

He would lean forward in his big chair. "I believe," he'd say, "your argument just broke."

Sometimes the lawyer would agree. Most of the time, they argued back. So Cassius would patiently walk them through their own story. He would show them the crack. Then they would see it. They would sit down. And Cassius would rule for the other side.

This way of winning has a special name. It's called **proof by contradiction**.

Cassius didn't know it had a name in math. Not until he was forty-eight. His nephew, who was a student at the big university, came for dinner.

His nephew explained the idea. "It's a math trick, Uncle Cassius. You pretend the thing you want to prove is *wrong*. Then you follow the steps. If you end up with something impossible, like two plus two equals five, you've won! It means your first idea was a mistake. So the thing you wanted to prove must have been right all along."

Cassius set down his fork. "That," he said slowly, "is what I've been doing for twenty years."



"Yes, Uncle," his nephew said. "Lawyers and mathematicians are more alike than you think."

Cassius didn't quit his job right away. He thought about it for two more years. He still liked being a judge. He liked the heavy wooden gavel and his dark robe. He liked the quiet courtroom in the morning.

But something had changed. He couldn't stop thinking about *proof*. His nephew sent him math books. Cassius did the problems at night. He found that the listening he did in court was the same kind of listening he needed for math.

So, when he turned fifty, Cassius retired.

He gave his gavel to his clerk. (She became a judge later, too.) He gave his robe to the town's theater group. But he kept his best notebook and his favorite pen.

He walked to the ProofQuest academy. He arrived late in the afternoon, wearing his regular clothes. He carried a small bag with his notebook and pen. He asked the person at the gate if they needed a teacher.

The academy master looked at the older man. "What do you teach?" he asked.



"Contradiction," said Cassius.

"And where did you work before this?"

"In a courtroom," Cassius said. "For twenty years. I listened to arguments. I learned to hear the moment a story cracked."

The master was silent for a long moment. He looked Cassius right in the eye. "Mister Cassius," he said. "I believe we've been waiting for you."

He has taught at the academy for fourteen years now. He is a calm man. He always sits when he speaks. He says, "Suppose, for the sake of argument..." so much that the kids have started saying it too. He never, ever raises his voice.

He has a special nod. He does it right before a student's argument is about to break. It's a small, kind nod. It tells the student, "The crack is coming." They know it's coming even before they hear it. He learned that trick as a judge, not as a teacher.

He has a friendly argument going with another teacher, Direct-Proof Dora. She is his opposite. Dora thinks you prove something by walking straight down the right path. Cassius thinks you prove something by showing all the *other* paths are broken.

They have argued about this for years. They are always polite. Neither one has ever changed their mind. They still respect each other. They even sit together at dinner. They are both right, in their own way. Qed, the head of the academy, thinks their arguments are good for everyone.



Cassius still has the notebook from his first day. It's almost full now. On the last page he used, he wrote a little proof for himself.

"Suppose, for the sake of argument, that I did nothing for the last fourteen years.

This would mean I never taught seven hundred kids about contradiction.

But I did teach them. I saw them learn.

So my first idea must be wrong.

Therefore, I have not done nothing.

Therefore, I will keep teaching."

He underlined the last sentence.

Read it? Now hear Contradiction Cassius's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/contradiction-cassius>

Contrapositive Cara

The CONTRAPOSITIVE — to prove "if P then Q," prove the flipped-and-negated "if not-Q then not-P" instead. Same truth, seen from the back. When the front door is jammed, the two doors are the exact same house.



The day Cara learned to prove things backwards, she was standing in front of a door that would not open.

It was the door to the old bell tower at the edge of Stepwell, and the whole town had been told the same thing: *If a bell rings at noon, then the tower door is unlocked.* Cara wanted in. It was almost noon. She pressed her ear to the wood and waited, and when the noon bell did not ring — not a single note — she shoved the door anyway. She pushed with her shoulder, then with her whole self, then sat down in the grass, out of breath and cross. The front way was jammed. Pushing harder on a jammed door, she was learning, just makes you tired.

She was still sitting there when a small realization walked up and tapped her on the shoulder. She'd been trying to prove she could get IN. But the rule ran the other way too, didn't it? *If a bell rings, the door's unlocked.* So — flip it, turn it inside out — *if the door is LOCKED, then no bell rang.* And this door was locked tight. Which meant, without her ever touching a bell, she already knew the thing she'd been straining to hear: no bell had rung. She hadn't opened the front door. She'd walked around the back of the sentence and found the same house.



Cara did not invent this. She'd learned it from her grandmother, who mended clocks and never argued with a stubborn gear head-on.

"When a thing won't come at you straight, Cara," her grandmother used to say, wrist-deep in springs, "ask what it would have to be for it to be false. Then chase THAT." As a small girl Cara had thought this was just clockmaker's grumbling. But her grandmother showed her, one rainy afternoon, with the window: *If it's raining, the sill is wet.* Hard to stand outside and prove, she said. But look — *if the sill is DRY, it isn't raining.* Cara had checked the dry sill, felt the certainty land, and understood something small and permanent. The two sentences were not cousins. They were the *same sentence*, flipped and made negative — the front and the back of one true thing. Prove either door, and you'd walked into the same room.

She'd carried it ever since: when the straight path jams, flip the claim, negate both halves, and prove *that*. Not a trick. A back door into the exact same house.



Years later she came to the Academy of Qed, where the mathematicians proved things for a living, and she arrived on a day when a young student named Perch was stuck fast.

The board read: *If a number's square is even, then the number itself is even.* Perch had been at it for an hour the front way — starting from "the square is even," trying to march forward to "the number is even." But an even square is a slippery place to start; it splits a dozen ways and every way sprouted more ways, and Perch's page was a thicket of crossings-out. "It's TRUE," Perch said, near tears. "I can feel it's true. I just can't walk to it."

Cara pulled up a stool. She did not tell Perch to push harder on the jammed door.



"You're starting from the hard end," she said. "Flip it. What would this claim have to be, to be FALSE?"

Perch thought. "It'd have to be... a number that's NOT even — an odd one — whose square somehow came out even."

"Good. So chase that instead. Prove the flipped, negated one: *if the number is odd, then its square is odd*. Prove THAT, and you've proved the original — same house, back door." She slid the chalk over. "Now — an odd number. Is it easy or hard to start from?"

"Easy," Perch said slowly. "An odd number is just some pairs with one left over. Twos, plus one."

"So square it. Multiply that by itself."

Perch worked it, and watched it happen: the twos multiplied into more twos, piles and piles of even stuff — and then, right at the end, the lonely plus-one multiplied by the lonely plus-one made a single one, sitting by itself with no partner. Odd. "It's odd," Perch breathed. "An odd number's square is always odd. I *walked* to it. It was easy from this side."

"And that IS your proof," Cara said. "You just proved 'odd number makes odd square.' Which is the same true thing as 'even square means even number,' turned inside out. You never opened the front door. You didn't need to."



Perch stared at the two sentences, the jammed one and the easy one, sitting side by side on the board like the same person in two coats. "They looked so different," Perch said quietly. "The first one felt impossible. The second one felt like nothing at all. And they're... the same."

"They're the same," Cara agreed. She felt the old, steady thing settle in her chest — the particular calm of a back door swinging open on a room you'd been shut out of. It wasn't the thrill of forcing something. It was quieter than that, and it lasted longer: the relief of stopping the shove, of trusting that a jammed door doesn't mean a locked house. "A hard question and an easy question can be the very same question," she said. "You just have to be willing to walk around the back to find out which coat it's wearing today."

Perch sat with that for a long moment — the impossible thing and the easy thing turning out to be one thing all along — and felt the tight, stuck knot of the whole afternoon finally come loose. It wasn't the sharp thrill of forcing something open. It was gentler, and it stayed: a quiet relief, warm and settled, like a held breath finally let go.

Read it? Now hear Contrapositive Cara's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/contrapositive-cara>

Construction Cole

PROOF BY CONSTRUCTION — to show that something exists, build it. Don't prove existence abstractly; produce the actual example.



reflection-prompts:

- prompt: "Cole feels most sure when he can hold a thing in his hands and say 'this one works.' Is there something you understand better once you've actually made it, instead of just being told about it?"
- prompt: "Have you ever felt proud of something you built with your own hands — a model, a drawing, a fort, a recipe? What did that pride feel like?"

Cole is a carpenter. He should be introduced as a carpenter and not as a mathematician, because that is the order in which he became them, and Cole is firm about order.



Cole apprenticed to his uncle at fifteen. He was, by twenty, a competent carpenter. By twenty-five he was a *good* one. He could look at a problem — *I need a step here. I need a shelf there. I need a roof that does not leak* — and he could *build the answer*. He did not draw plans first. He drew plans after, if at all. He preferred to build a small version, look at it, and then build the bigger version. He believed (and his uncle had taught him this) that *you understand a thing when you've made one*.

This is, in retrospect, a deeply mathematical attitude. Cole did not know it at the time.

He learned it at twenty-eight, in a way that surprised him.

A travelling mathematician — a polite woman who was passing through Beam on her way south — stopped at Cole's workshop to ask if he could repair a damaged shoulder-bag strap. Cole could. He repaired it. They got to talking. The mathematician asked what kind of work Cole found most satisfying. Cole said: "*The kind where I look at the problem and just make the thing.*"



Cole said: "No."

The mathematician explained. The technique is this: when you want to prove that something exists — that there is *some* number with a certain property, or *some* arrangement of pieces that works, or *some* geometric figure that meets a description — you do not have to argue abstractly that it must exist. You can simply *produce one*. You point at it and say: "*There. That one. It works.*"

Cole listened. He thought about it. He laughed for a long time. He said: "*That is the only kind of proof I have ever done.*"

The mathematician said: "*There are mathematicians at the central university who would love to meet you.*"



The mathematician said: "Of course. Just thinking aloud."

She left. Cole finished the barn.

But the conversation stayed with him. He thought about it for the next two years while he built three more houses and one footbridge. He realised, slowly, that he had been *constructing proofs* in his daily work — every cabinet he built was a proof that *a cabinet with these dimensions and these supports is possible*. Every roof was a proof that *a roof spanning this distance can be built*. He had not thought of his work that way. But the mathematician had been right.

He wrote to the academy at age thirty. He asked if they ever needed teachers. The academy master wrote back the same week and said *yes, we always do*.



His teaching style is simple. He says: "*You want to prove this thing exists? Fine. Here is one. Look at it. Touch it. It exists.*"

He then walks the children through *why* the thing he made satisfies the claim. The proof, in Cole's classroom, is *the object plus the explanation of why it works*. Both halves are essential. Many children find this style unusually clear, which is exactly the effect Cole intended.

He has been at the academy for sixteen years now. He has built, by his own count, four hundred and thirty teaching objects. They are all kept in a large cupboard at the back of his classroom. The cupboard is labelled, in his own neat handwriting: *Things That Exist*.

He still takes a week off, every summer, to go back to Beam and build something. (Usually a step. He likes building steps. Steps are honest objects.) He returns to the academy each autumn with his hands slightly more callused and his patience slightly renewed.

Read it? Now hear Construction Cole's audio drama + go play — scan or visit:



<https://spark-and-anvil.org/cast/proofquest/construction-cole>

Pigeonhole Perch

THE PIGEONHOLE PRINCIPLE — if you have more pigeons than pigeonholes, at least one pigeonhole has more than one pigeon. A small, sharp counting argument that proves "must exist" claims with remarkable economy.



Pigeonhole Perch worked, for forty years, at the central post office in the capital city.

(Yes, the central post office is the same one that figured in Queen Vesper's bad-winter story — although that was in the GambitTales kingdom, which is, as far as ProofQuest's documents are concerned, a related-but-distinct mathematical neighbourhood. Names sometimes coincide across kingdoms. The capital post office, in any kingdom, is the kind of place that *takes a long time* to develop the kind of careful person Perch became.)

Perch's job at the post office was sorting letters. The post office had, for as long as anybody could remember, a wall of pigeonholes — actual wooden pigeonholes, labelled with destinations, into which incoming mail was sorted before being sent out for delivery. There were two hundred and forty pigeonholes. Perch sorted, by careful estimate, about three thousand letters per day.

This is a lot of sorting. Perch did not get tired of it. Perch was, in a way Perch's colleagues found mildly mysterious, *content*.



Then one morning, when Perch had been at the post office for thirty-two years, something happened that turned Perch into a kind of detective.

A letter went missing.

This is, by post office standards, not unusual. Letters go missing. Most of the time they are eventually found — usually behind a desk, or in the wrong pigeonhole, or tucked into a colleague's stack. The lost-letter procedure was a standard one. Perch had run it many times.

This particular lost letter, however, was *unusual* — it had been deposited in the morning collection by a customer who *swore* she had put it into Perch's hands personally. Perch had no memory of receiving it. The customer was certain. The post office searched. The letter did not turn up. The customer was unhappy. The customer's letter contained important information for her sister, who lived in the eastern province. The matter was, in post-office terms, *a bit of a thing*.

Perch sat down that evening to think about it.

What Perch noticed was this: the post office had two hundred and forty pigeonholes. The morning collection had contained about two thousand seven hundred letters, by the daily log. The pigeonholes had been sorted twice that day. After the second sort, every pigeonhole should have contained either zero or some small number of letters depending on its destination.



Perch counted, by going through the log carefully, the total number of letters that had been *delivered* that day from those pigeonholes. The number was 2,699.

The morning collection had been 2,700.

There was *one* missing letter.

Perch thought about this. Two hundred and forty pigeonholes. 2,700 letters sorted in. Average: a little over 11 letters per pigeonhole. But the average is, Perch knew, just the average. *Some* pigeonholes had more letters than the average. *Some* had fewer.

The customer's letter had been addressed to the eastern province. Which pigeonhole was that? It was pigeonhole 113. Perch went to the post office that night, opened pigeonhole 113, and looked carefully.

Pigeonhole 113 had thirteen letters in it.



Perch counted them.

There were thirteen. The log said there had been twelve.

Perch held up the thirteenth letter to the light. It was the customer's lost letter. It had been *folded inside* another letter — pinched between two pages of a larger envelope — and had therefore been counted as one piece of mail instead of two.

Perch had used the pigeonhole principle to find a lost letter.

(The pigeonhole principle, in case you have not yet met it: if you put more items into a set of boxes than there are boxes, at least one box has more than one item. Perch had used a slight extension — if the *count of items in a box* is one more than the official log says it should be, then there is an extra item *hidden in the box*. This is, properly speaking, an extension of the principle. Perch developed it on the job.)

The customer was thrilled. The letter reached the sister. The post office sent Perch a formal commendation. Perch put the commendation in a drawer and went back to sorting.



But word got out.

A mathematician at the central university — who had been looking for someone to teach the pigeonhole principle at the ProofQuest academy — heard about the lost-letter story from a friend. She wrote to Perch. She invited Perch to teach.

Perch was sixty-three years old. Perch had been sorting letters for forty years. Perch was, Perch admitted, a little ready for a change. Perch accepted.

Perch has been teaching at the academy for seven years now. The classroom has, at the back, a small wooden replica of a wall of pigeonholes. Twelve pigeonholes. (Perch did not need the full two hundred and forty for teaching.) Perch uses the pigeonholes to show, over and over, the principle that *if you have more things than holes, something has to double up*.

Perch is quiet. Perch is methodical. Perch is, on the rare occasions Perch tells the lost-letter story, slightly proud.

The customer, by the way, still writes Perch a letter once a year. And every time one arrives, Perch feels a small, quiet warmth — the good kind, the kind that settles in your chest and stays. Forty years of sorting, and it turned out the thing Perch loved most was not being clever. It was being trusted, and calm, and glad to still be here doing careful work.

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

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