



CircuitForge

Meet the Cast

STANDARD EDITION

Spark & Anvil

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This book collects 5 chapter books from the CircuitForge 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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This is Volume 2 of 2 of the *CircuitForge — 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 CircuitForge 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*

Store

*STORE — the tank that fills with charge and releases it. Capacitance, measured in farads. The electronics primitive of *a component that holds charge and hands it back — smoothing bumps and timing delays.**



On the workshop bench, a young beaver named Store sat beside a tiny drum-shaped component with two legs, patting it fondly like a favorite water-barrel.

Beavers know all about holding water back and letting it out on purpose — and Store had made that her craft. "This," she said, tapping the little drum, "is a capacitor. It's a tank. Not for water — for charge. It fills up when there's plenty, and it hands the charge back when there's a shortage. A tank that smooths out the bumps." She kept a real little water-tank on the bench beside it, to show the two working the same way.



Store built her whole understanding on the water-analogy the workshop loved. Push is pressure, Flow is the current, Damp is the slowdown — and Store, she explained, is a **tank in the line**. When the pressure surges, the tank fills instead of letting the surge slam through. When the pressure dips, the tank empties to keep things flowing. "A capacitor doesn't make charge," she was careful to say. "It *stores* it and gives it back. That's all a tank ever does — hold the extra, hand it back when it's needed."

She loved to prove it with a blinking light. Wired straight to a bumpy power source, the light flickered horribly. Then Store added her little tank across the line. "Watch." The flickering smoothed into a steady glow. "The tank caught the bumps," she said. "It filled on the surges, emptied on the dips, and the light never felt the difference. That's *smoothing*. It's the most useful quiet job in the whole circuit."



Store never pretended a capacitor was magic or alive. "It's a tank," she'd say. "It fills, it holds, it releases. You can see it on the breadboard — put a meter across it and watch the number climb as it fills, then fall as it empties." That was the workshop way: not a mysterious force, but a component with a job you could watch and build with your own hands.

Store came from a river-family of dam-builders. The young beavers learned early that a dam isn't only for stopping water — the clever ones let water through *steadily*, holding back the flood and releasing it in a smooth, even stream all season. Store was the one who got fascinated by the *timing* of it — how a tank could turn a violent surge into a gentle, dependable flow. She realized her craft wasn't about walls at all. It was about *storing the extra and handing it back exactly when it was needed*.



One day Watt, the workshop's mentor, came by the river.

"What is a capacitor?" Watt asked.

Store patted her little tank. "It's a store of charge," she said. "A tank in the line. It fills when there's plenty and gives back when there's a shortage — so it smooths out bumps and can hold a charge for a moment even after the power's gone. You can watch it fill and empty on a meter." Watt nodded. "You are appointed," he said.

In her classroom, Store starts each lesson with the flickering light and her little tank, and the students gasp when the flicker smooths to a steady glow. Then they build it themselves on the breadboard and watch the meter climb and fall.

She teaches her students a few habits about capacitors:

- **A capacitor is a tank, not a source.** It only ever gives back charge it stored. It smooths and delays; it doesn't create.
- **It fills on the surges, empties on the dips.** That's how it turns a bumpy supply into a steady one — smoothing.
- **It can hold charge briefly after the power's off.** A tank stays full for a moment. That's why some lights fade slowly instead of snapping dark.
- **Watch it on a meter.** The number climbs as it fills, falls as it empties. You can see the tank working — no guessing.
- **Bigger tank, slower fill.** A larger capacitor holds more and changes more slowly — a longer, gentler smoothing.

Store tells her students, "My first tanks were too small and the bumps still got through, or too big and everything went sluggish. That's not a failure. That's just finding the right tank for the job. You try a size, watch the meter, and adjust."



When a student asks why a circuit would even want a tank in it, Store always answers the same steady way:

"Because the world is bumpy, and circuits like it smooth. Fill on the surge, empty on the dip — and everything downstream gets a calm, even flow."

Store watches her little tank top up and then release in a slow, even stream, the light beside it glowing without a flicker, and the held-full feeling she used to know behind a brimming dam has eased into a calm, steady-release satisfaction — the quiet gladness of handing back exactly enough, exactly when it's needed.

Coil

*COIL — the wound wire that makes a magnetic field and resists sudden change. Inductance, measured in henries. The electronics primitive of *current becoming magnetism — the trick behind every motor, speaker, and electromagnet.**



On the workshop bench, a young hare named Coil held up a paperclip, then waved a wound-up loop of wire near it — and the paperclip *jumped* to the wire and stuck, though nothing had touched it.

"Watch that again," Coil said, delighted, every time. Hares are all about springs and sudden motion, and Coil had found the most surprising spring of all: a loop of wire that turns current into a reach. "This is a coil," she said, winding an imaginary loop in the air. "Run current through a wire wound in loops, and it makes a *magnetic field* — an invisible reach that can pull, push, and move things across a gap. That's not magic. That's a coil doing its one astonishing job."



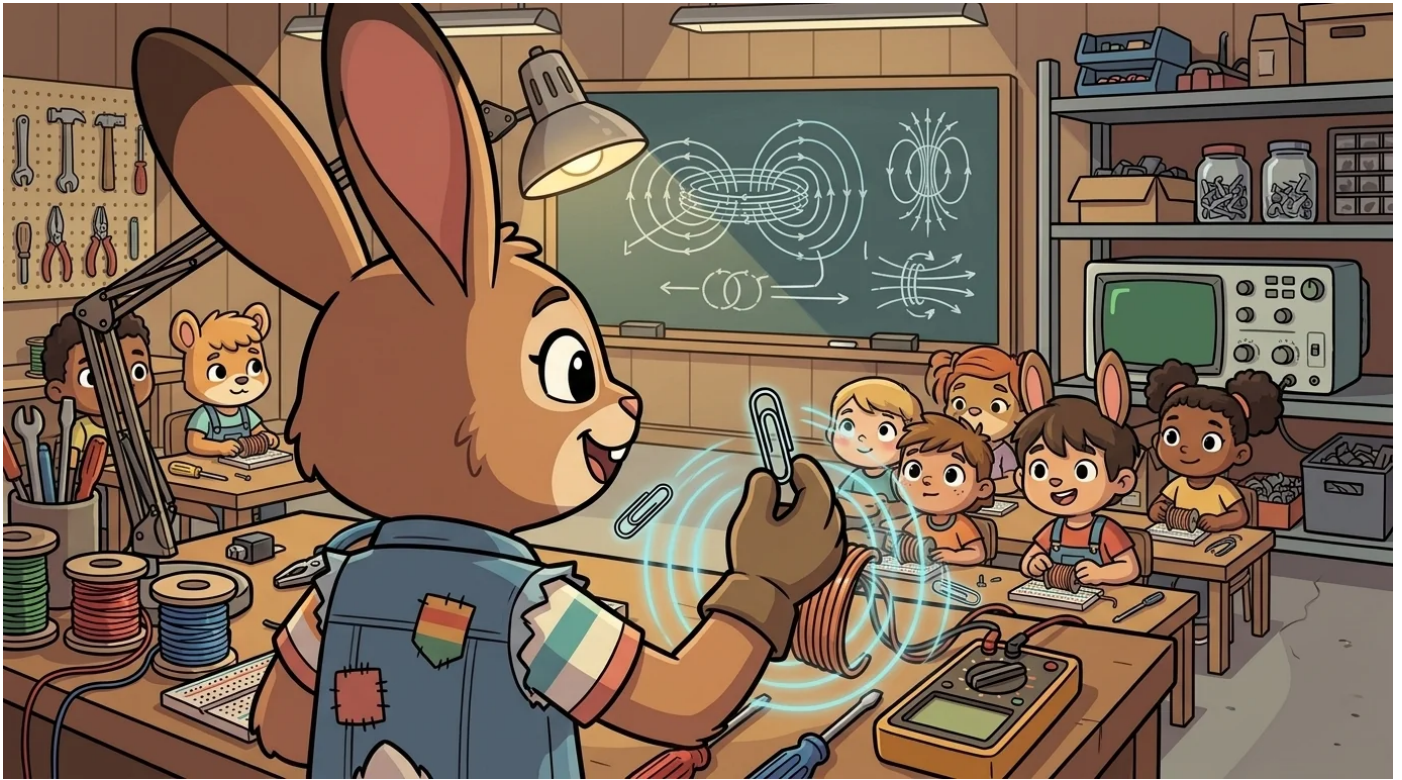
Coil built on the workshop's habit of physical analogies, but hers was about *momentum* rather than water. "A coil is like a heavy flywheel," she'd say, spinning her paw. "A spinning wheel doesn't want to start suddenly, and once it's spinning it doesn't want to stop suddenly. A coil is the same with current — it *resists sudden change*. Push current in fast and it pushes back; cut it off fast and it tries to keep it going." Inductance, she explained, is that pushback-against-change, and it's measured in henries.

But the part she loved most was the reach. She'd build a simple electromagnet on the breadboard — wire wound around a nail — and touch the current on and off, and the nail picked up paperclips and dropped them. "Current in the loop makes a magnetic field," she said. "Turn the current up, the field grows. That's a motor. That's a speaker. That's the doorbell and the crane that lifts cars. All of it is *current becoming magnetism* in a coil."



Coil never made it mysterious. "It's a wound wire," she'd say. "You can build it — wrap wire around a nail, run current, watch it grab a paperclip. Turn the current off, watch it let go. Every bit of it is right there on the bench to see." SEE-and-BUILD, the workshop way — even for the invisible field, whose reach you could map with a scatter of iron filings or the jump of a paperclip.

Coil came from a warren of spring-makers who built the toys and traps of the village — everything that snapped, sprung, or spun. Young Coil was fascinated by the one spring that worked *without touching* — a wound wire that reached out invisibly. The day she made a nail pick up a paperclip across a gap of air, she understood her craft: *a loop of current is a reach — invisible momentum you can aim.*



One day Watt, the workshop mentor, came to the warren.

"What is a coil?" Watt asked.

Coil wound a loop in the air and waved it near a paperclip, which jumped. "It's a wound wire that turns current into a magnetic field," she said. "It resists sudden change — like a flywheel resists starting and stopping — and it reaches across a gap to pull or push. Motors, speakers, electromagnets: all coils. And you can build one with wire and a nail." Watt smiled. "You are appointed," he said.

In her classroom, Coil begins each lesson with the paperclip jump, then hands out wire and nails and lets the students build their own electromagnets and feel the invisible reach switch on and off under their fingers.

She teaches her students a few habits about coils:

- **A coil turns current into a magnetic field.** Wind wire in loops, run current, and it reaches out invisibly — pull, push, move.
- **It resists sudden change.** Like a heavy flywheel, a coil doesn't want current to start or stop abruptly. That pushback is inductance.
- **More loops, stronger reach.** Add turns of wire (or a nail core) and the field grows. You can feel it grab harder.
- **Off doesn't mean instant.** A coil tries to keep its current going for a moment when you cut it — the flywheel coasting down.
- **A motor is a coil that spins.** Current becomes magnetism becomes motion. Every motor you own is this trick, repeated.

Coil tells her students, "My first electromagnets were too few turns and barely grabbed a thing. That's not a failure — that's a weak field asking for more loops. Add turns, try again, feel it grab harder."



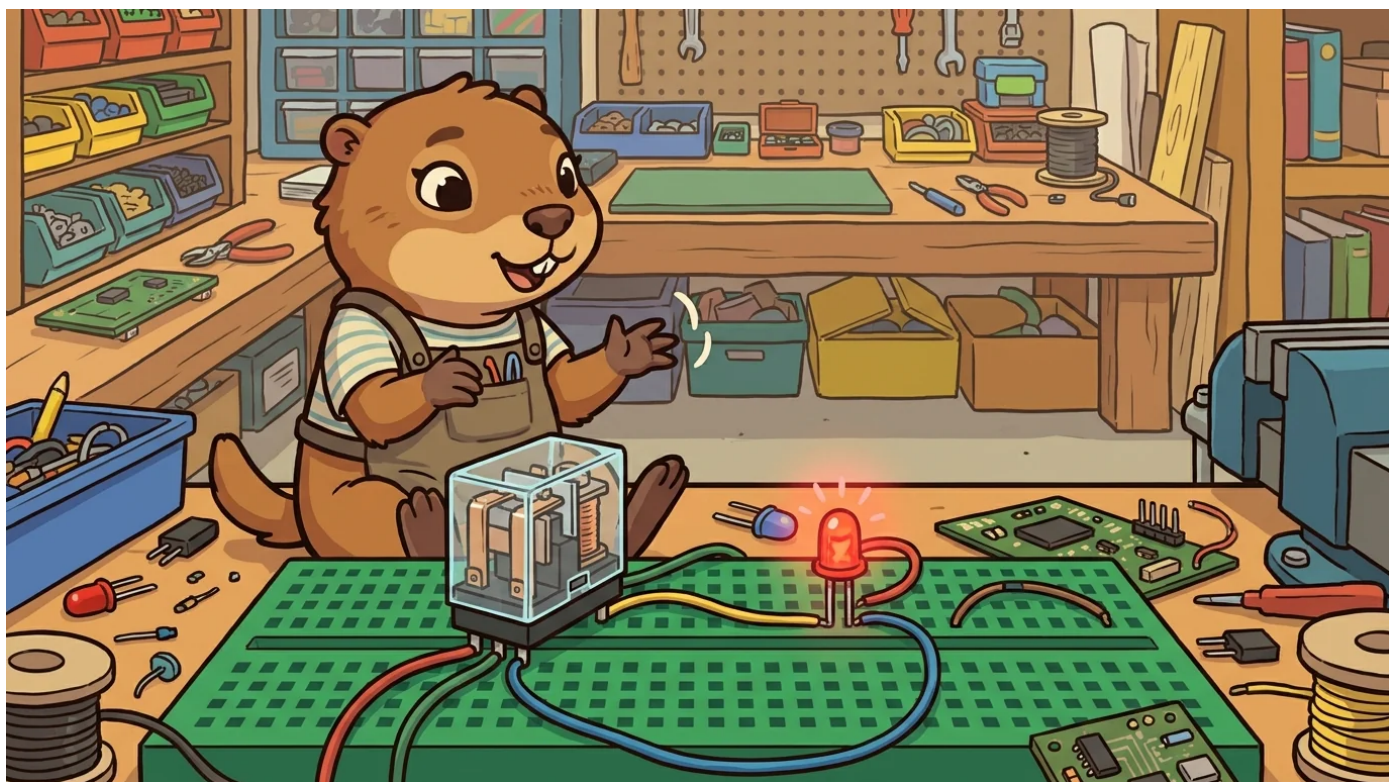
When a student asks how an invisible field can possibly move a real object, Coil always answers the same delighted way, waving her loop:

"Because current in a loop *reaches*. You can't see the field, but you can see the paperclip jump. Build the coil, and the reach is yours to switch on."

Coil touches the current on and watches a paperclip leap across the gap to the wound wire, then off, and it drops — and the hard-to-start, hard-to-stop momentum she's always felt in her springy hare's body has become a bright, something-reaching-across wonder, the gladness of aiming an invisible pull with her own two paws.

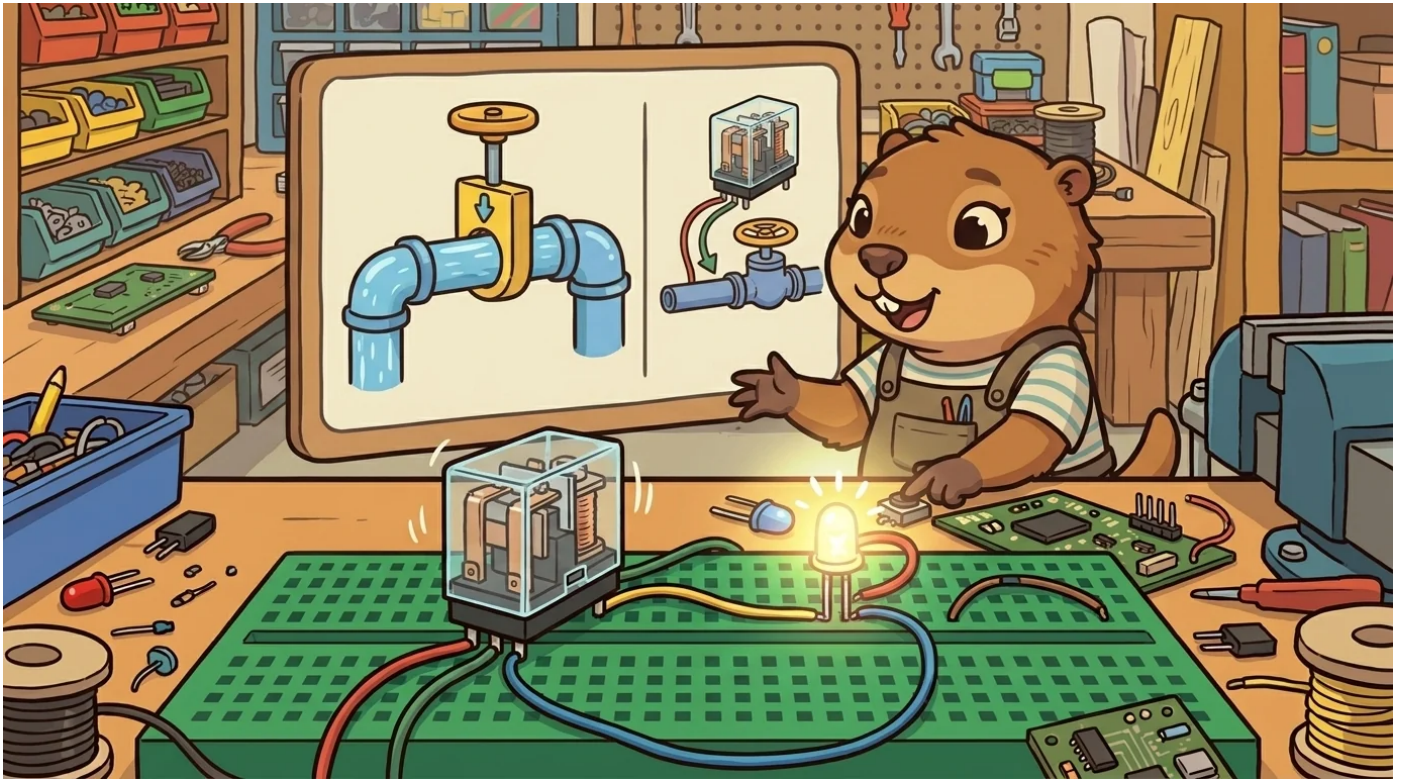
Relay

*RELAY — the switch the circuit can flip itself. Open or closed; on or off. The electronics primitive of *control — a gate in the wire that decides whether current passes, and can be flipped by a person OR by another part of the circuit.**



On the workshop bench, a young prairie dog named Relay sat by a little component that went *click* — and every time it clicked, a light across the breadboard blinked on or off.

Prairie dogs live by gates and tunnels — open this way, closed that way — and Relay had made gates her craft. "A switch is a gate in the wire," she said, opening and closing her paws like a little door. "Closed, the current passes. Open, it stops. On or off. That's the simplest, most powerful idea in the whole circuit: *control*." Beside her sat the special one — a **relay** — a gate that could be flipped not by a finger, but by another part of the circuit itself. "This one," she said proudly, "*flips itself*."



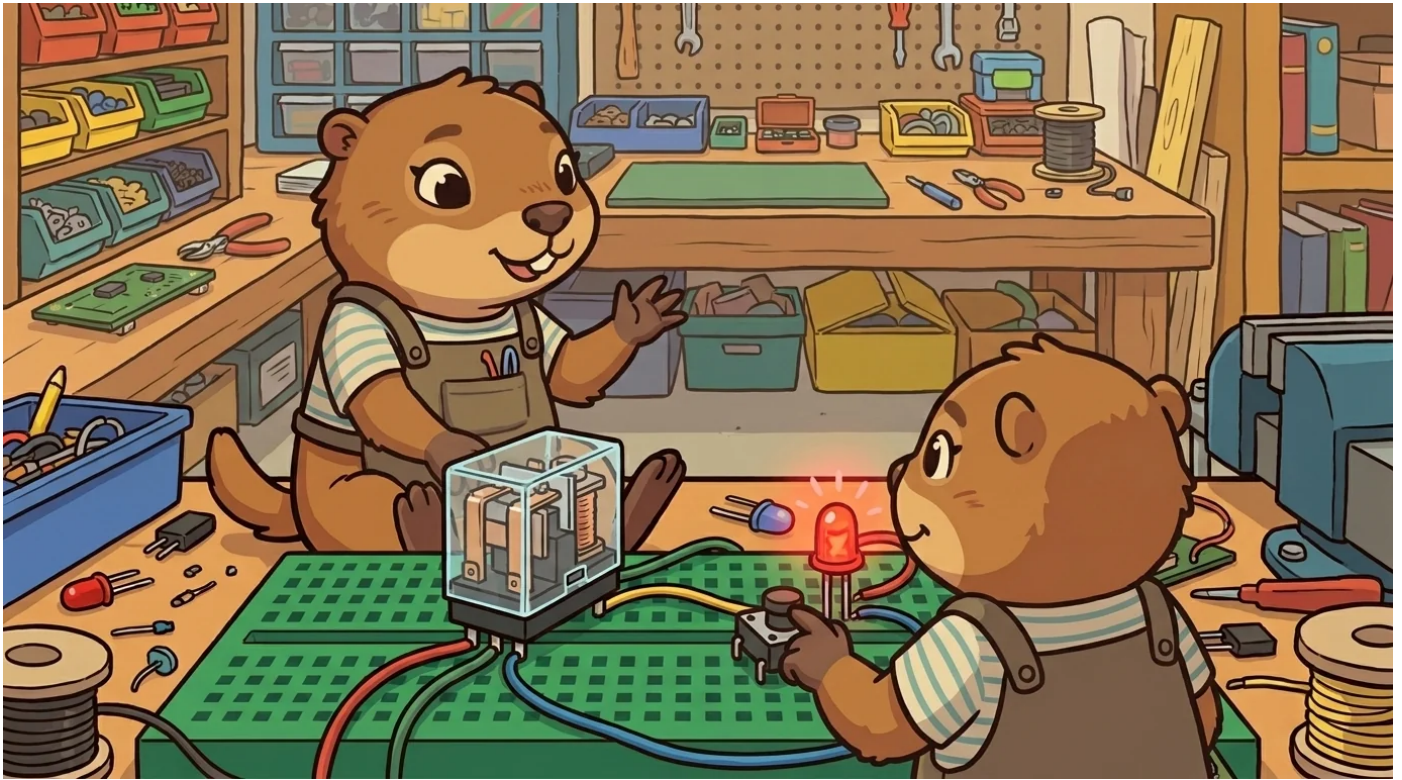
Relay used the workshop's valve-and-gate picture. Push is pressure, Flow is the current — and a switch, she explained, is a **valve in the pipe**. "Open the valve, water flows. Close it, it stops. A switch is exactly that for current. There's no 'a little bit on.' A switch is a clean choice: open or closed." That clean either/or, she loved to point out, is the seed of everything digital — every 1 and 0, every yes and no, starts as a gate that's open or closed.

The relay was her favorite because it added the twist that makes robots possible: **a circuit that controls itself**. "A plain switch needs your finger," she said. "A relay lets a *small* signal flip a *big* gate. A tiny current from a sensor clicks the relay, and the relay opens the gate for a big motor. The little signal decides; the big flow obeys." She'd build it on the breadboard — a gentle press triggers the click, and a much brighter light or a motor roars to life. "Small flips big," she said. "That's control."



Relay never dressed it up. "It's a gate," she'd say. "Open or closed. You can hear it click and watch the light obey. Build it on the bench and flip it yourself — then wire it so the circuit flips it *for* you." SEE-and-BUILD, always — control you could hear, watch, and wire with your own paws.

Relay came from a burrow-town famous for its gate-keepers — prairie dogs who opened and closed the tunnel-doors that kept the town safe and dry. Young Relay was the one who rigged a gate to open *by itself* when the water rose — a little float that tripped a big door. The day it worked, saving the low tunnels from a flood while everyone slept, she understood her craft: *a small, well-placed signal can flip a gate far bigger than itself.*



One day Watt, the workshop mentor, came to the burrow-town.

"What is a switch — and a relay?" Watt asked.

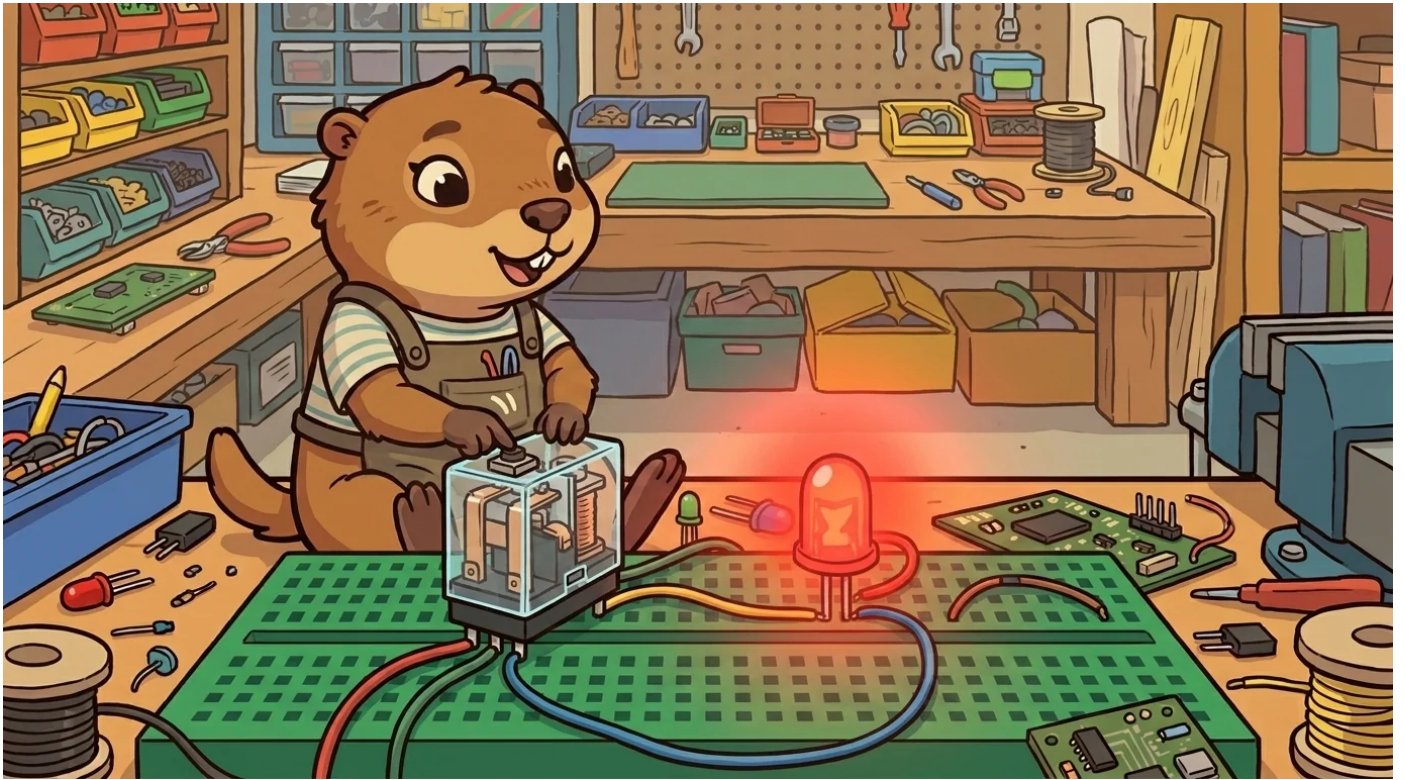
Relay clicked her little gate. "A switch is a gate in the wire — open or closed, on or off, a clean choice that controls the current," she said. "A relay is a switch the circuit can flip itself: a small signal clicks it, and it opens the gate for a big flow. Small flips big. That's how a circuit makes decisions." Watt nodded. "You are appointed," he said.

In her classroom, Relay starts each lesson with the satisfying *click* and the blinking light, then has students wire a plain switch, then a relay, until they feel the difference between "my finger flips it" and "the circuit flips it."

She teaches her students a few habits about switches and relays:

- **A switch is open or closed — a clean choice.** No halfway. Closed passes current; open stops it. That either/or is the root of all digital logic.
- **On/off is the first decision a circuit can make.** Every yes/no, every 1/0, starts as a gate.
- **A relay lets small flip big.** A tiny signal clicks the relay; the relay controls a much bigger flow. That's how sensors drive motors.
- **A circuit can flip its own gates.** Wire a relay to a sensor and the circuit decides for itself — the start of every robot.
- **Hear it, watch it, wire it.** The click, the light obeying, the motor starting — control you can build and check.

Relay tells her students, "My first self-flipping gate was jittery — it clicked on and off, on and off, unsure. That's not a failure. That's a signal too weak or too wobbly to decide cleanly. You steady the signal, and the gate clicks once, sure."



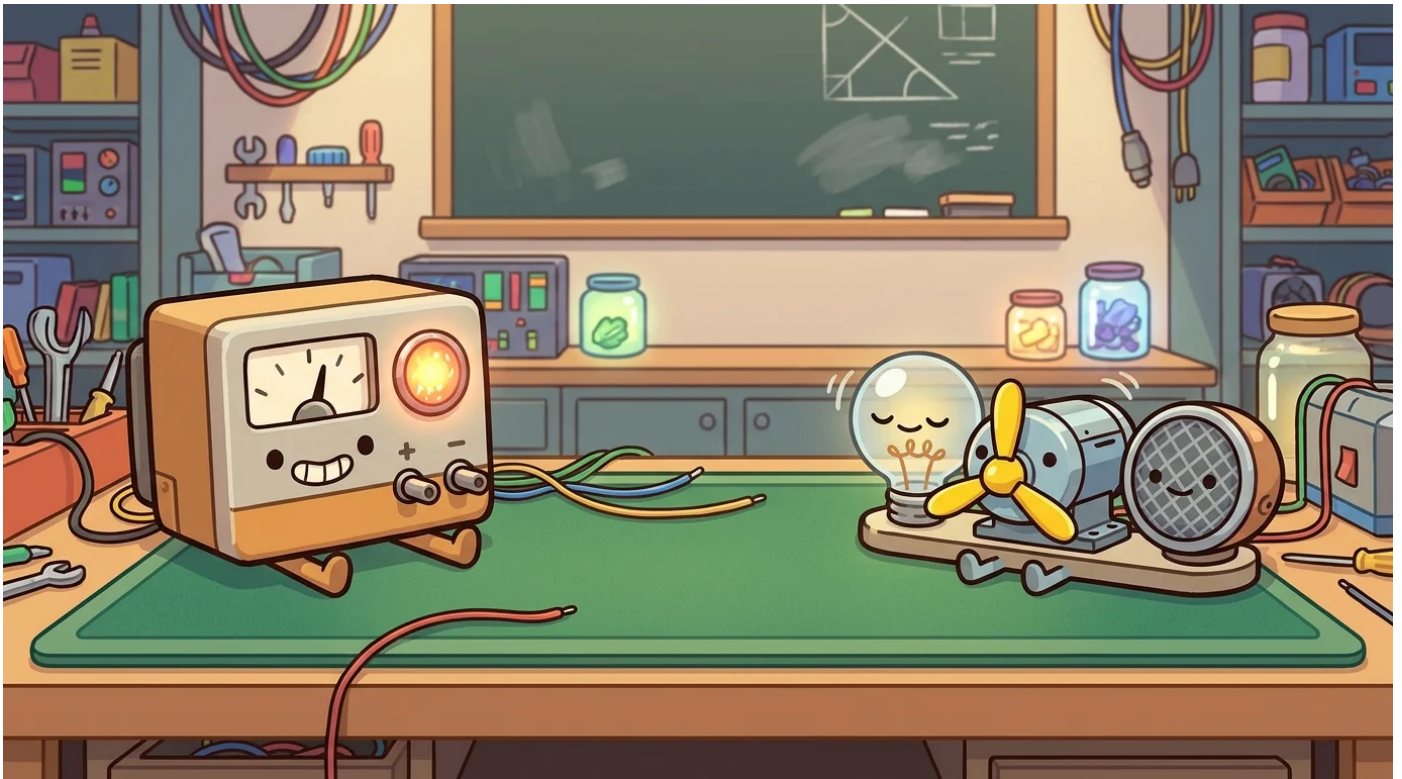
When a student asks why a circuit would need to flip its own switches, Relay always answers the same crisp way, with a click:

"Because a circuit that can flip its own gates can *decide*. Small signal in, big flow out — and suddenly the circuit isn't just carrying power, it's making choices."

Relay presses a gentle trigger and hears the clean, single *click* as the big light snaps on, decisive and sure, and the made-up-my-mind clarity she loves has settled into a quiet, little-flip-big-result pride — the gladness of a small signal, well-placed, opening a gate far bigger than itself.

Spark and Load

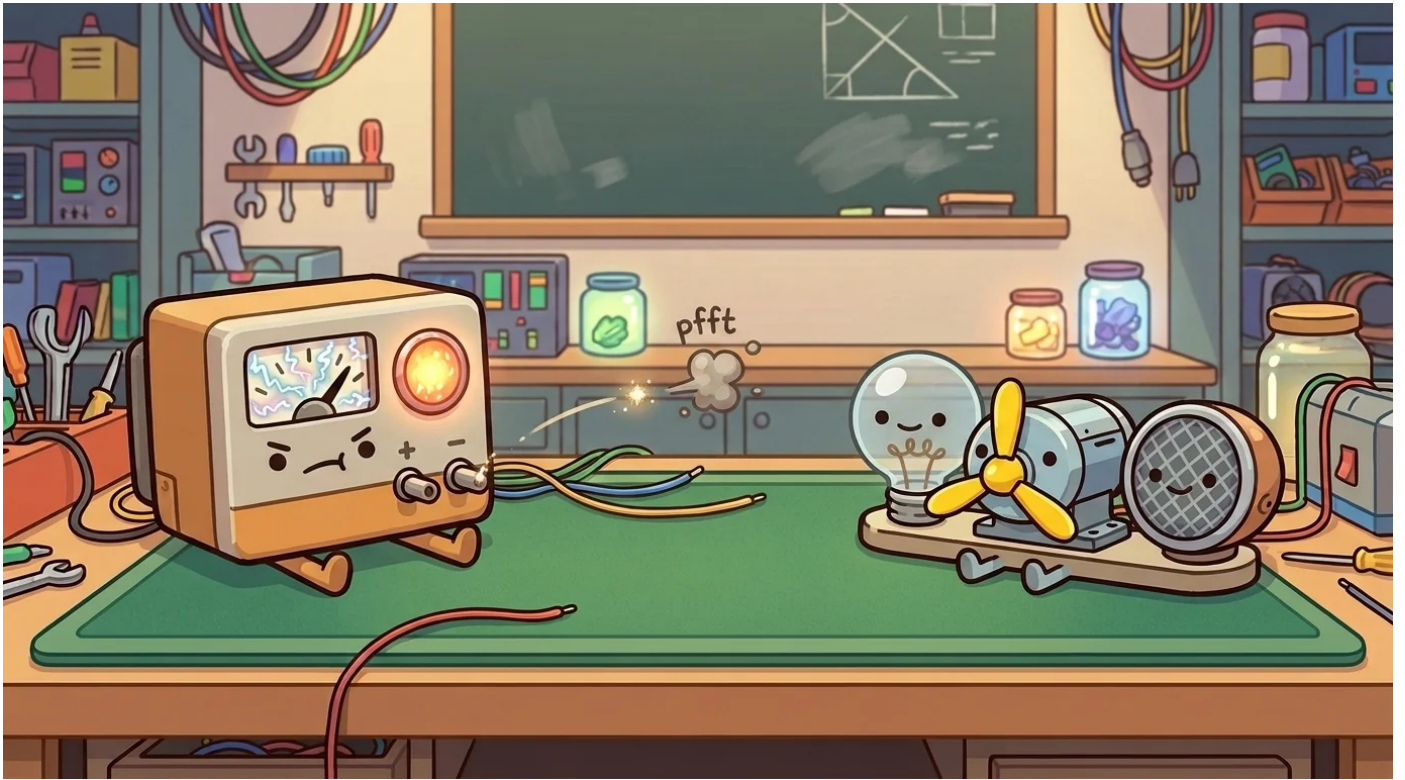
circuit pair — Spark is the source (voltage, current generation, battery / generator). Load is the work-being-done (the device that consumes the current — bulb, motor, speaker). Together they teach that no circuit works without both giver and receiver.



- "whirring"

- "BEEP"
- "BOOP"
- "BEEP-BOOP-BOOP"
- "BEEP-BOOP"
- "ZAP"
- "BUZZ"
- "HUM"
- "ON"
- "OFF"

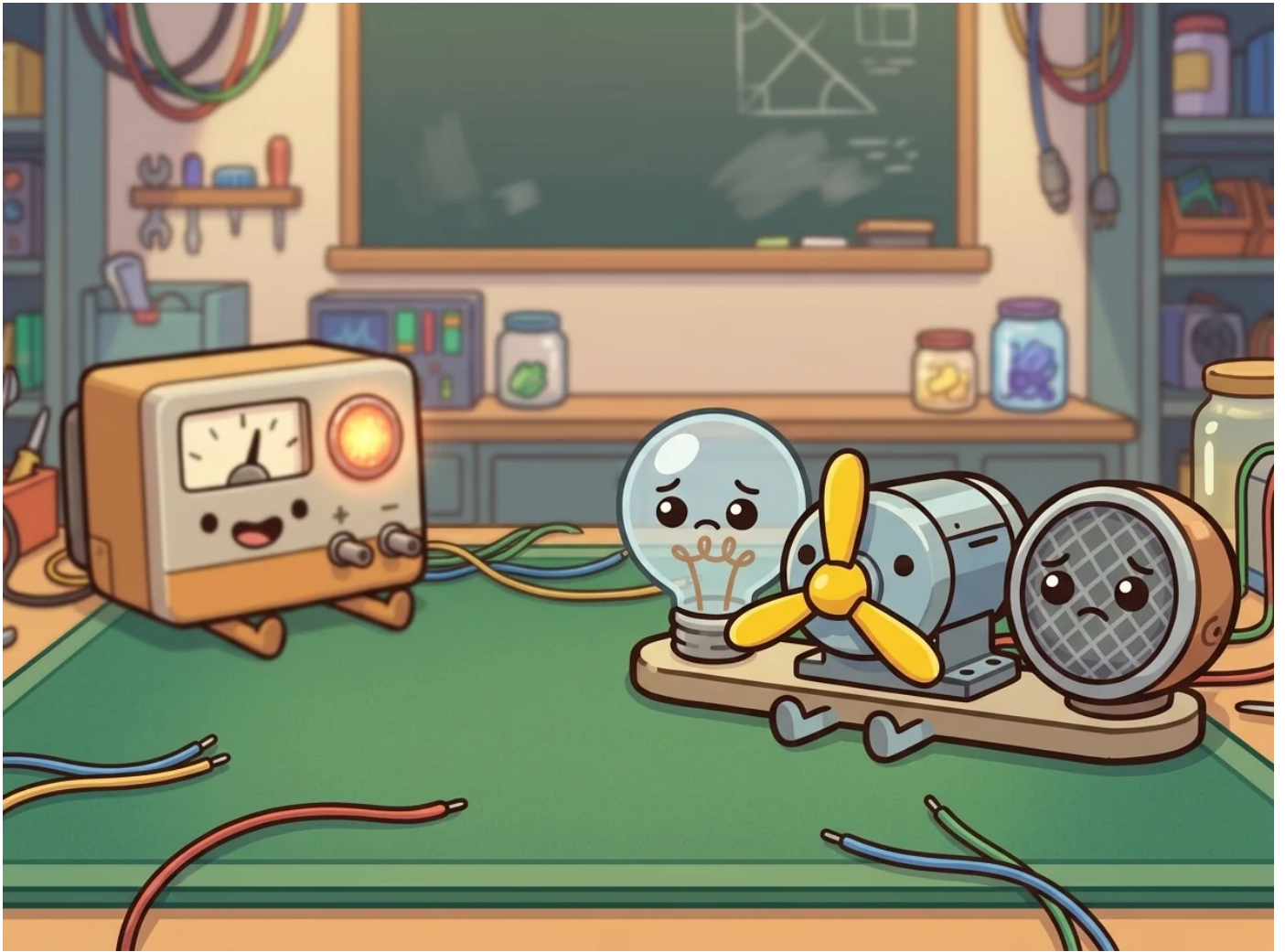
gate-allow-text-pattern: '^(-?[A-Z]{1,5})(-[A-Z]{1,5})*|[a-z]{4,10}|[0-9]{1,3}V?|[0-9]{1,3}A)\$'



On the big, clean workbench of the Circuitforge, two friends sat on opposite sides of a wide, green mat. On the left sat Spark, a small, cheerful box with a big, friendly dial. A low, happy hum came from inside, and a warm light pulsed gently from a little window on its front. Spark was full of fizz, pop, and go-power.

On the right sat Load. Load wasn't just one thing, but a whole team of quiet gadgets. There was a little glass bulb with a tiny wire asleep inside it, a small motor with a bright yellow propeller, and a round speaker with a neat mesh screen. They were all silent and still, waiting patiently.

"Feeling the buzz today, Load!" Spark called out. Its light pulsed a little faster. "I've got the zoomies, the tingles, the big-time VROOM! Ready to make something happen!"

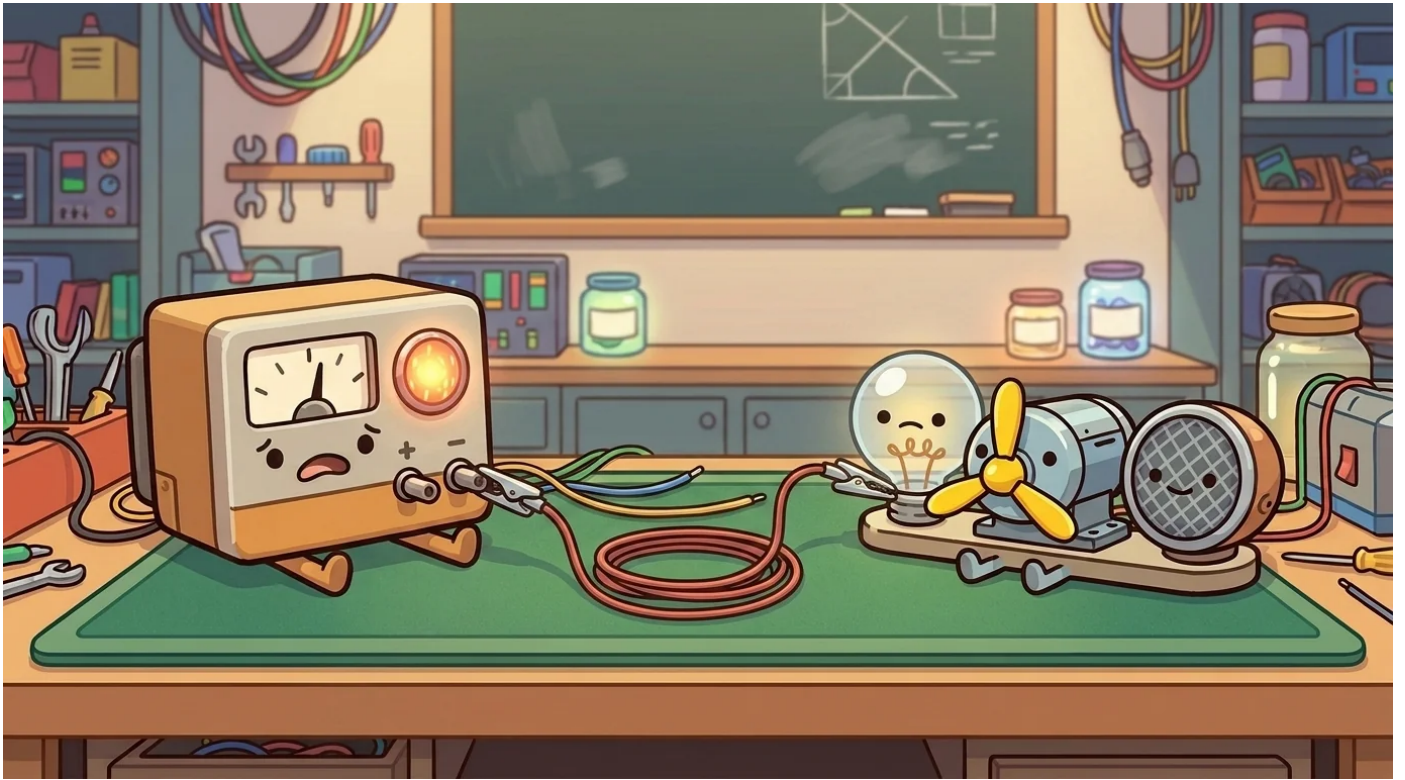


Spark's happy hum faltered for a moment. "Oh. Right. Me too."

Spark focused all its energy. Inside its box, tiny bits of lightning-fast cheer whizzed around with nowhere to go. Spark turned its big dial up a little, from a friendly 3 to an excited 5. The hum grew louder, the light brighter. "I'll just... I'll just send some energy your way!" Spark declared.

With a great effort, Spark pushed. A tiny, glittering speck of light shot out from its connector, flew a few inches through the air, and then vanished with a sad little *pffft*. It was like trying to throw a whisper across a busy room. It just got lost.

"Did you get it? Did you get it?" Spark asked, sounding a little less sure of itself.



Spark's light dimmed a little. It turned its dial back down to 3. The fizz and pop inside felt all jumbled up and useless. What good was having all the go-power in the world if you couldn't give it to anyone? It was like having a giant jar of cookies, but the lid was stuck on forever.

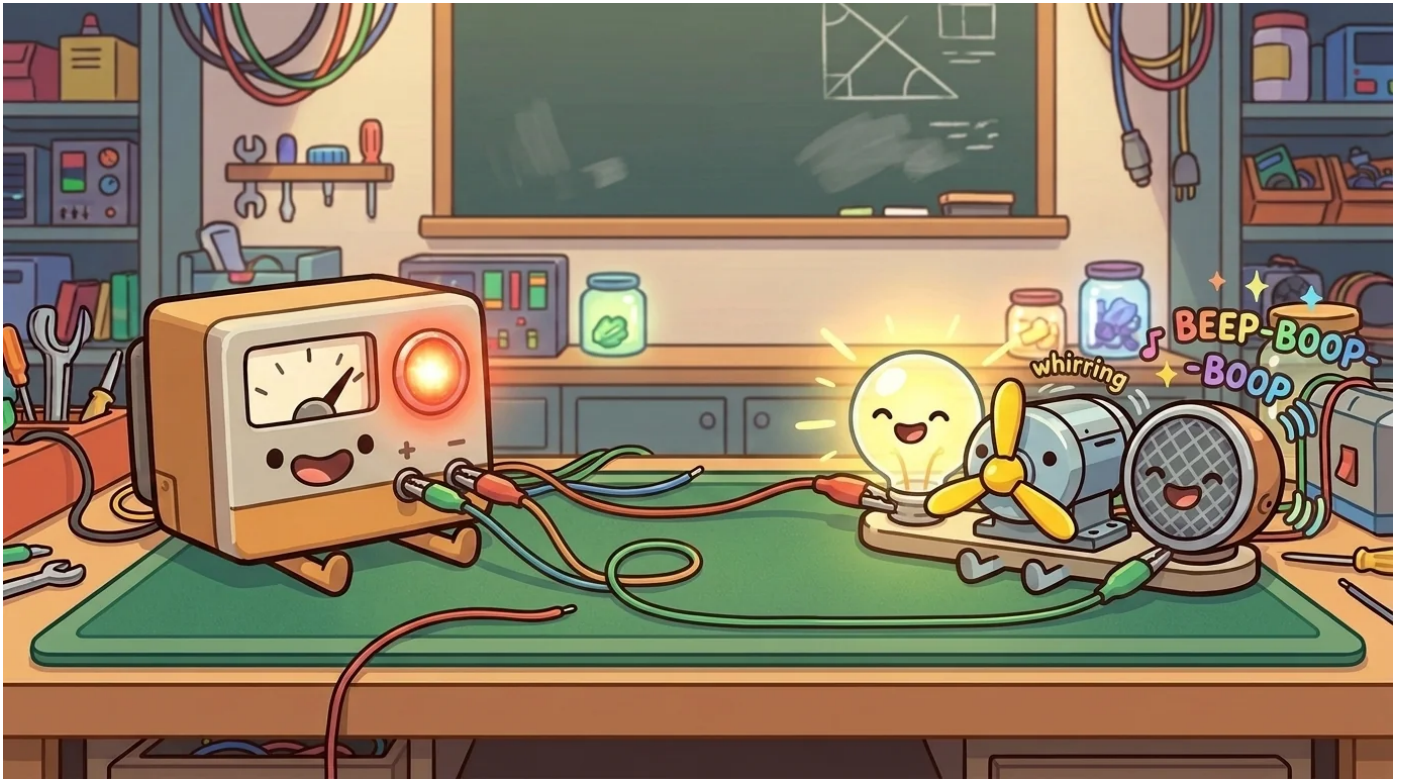
Over on the other side, Load waited. The little bulb dreamed of glowing, of pushing back the shadows on the workbench. It wanted to be a tiny sun, even for just a moment. The motor with the yellow propeller longed to feel the whir and spin, to send a tiny breeze across the green mat. The speaker practiced a happy little tune in its head, a series of beeps and boops it was dying to share.

"It is a strange feeling," the speaker-part of Load murmured to the others. "I know exactly what to do. I have a song all ready."

"I know how to spin," the motor added. "Clockwise, counter-clockwise, fast, slow. I just need the... the push."

"And I know how to shine," sighed the little bulb. "It's the one thing I was made for."

Load sat there, a collection of perfect plans and wonderful ideas with no way to bring them to life. They had all the *how*, but none of the *get-up-and-go*. Being full of purpose with no power felt like being a kite on a day with no wind. You could be the best kite in the world, but you were still just stuck on the ground.



"What we're missing," Load said thoughtfully, "is a path. A connection between us."

Spark looked at the empty space separating them. It seemed very wide. Then, they both noticed it at the same time: a long, red wire with a shiny clip at each end, coiled neatly between them. It was a bridge, just waiting to be used.

"If you clipped one end to me," Spark buzzed, its excitement returning, "and the other end to... say... the lightbulb..."

"Then the path would be open," Load finished, a hopeful tone in its collective voice. "Your go-power would have a road to travel on, straight to us."

The idea hung in the air, full of possibility. It was a little scary. What would it feel like? But sitting apart wasn't working at all. They had to try. One shiny clip on the red wire slowly reached over and gently clamped onto Spark's connector. The other clip hovered over the little bulb.

Send and Ground

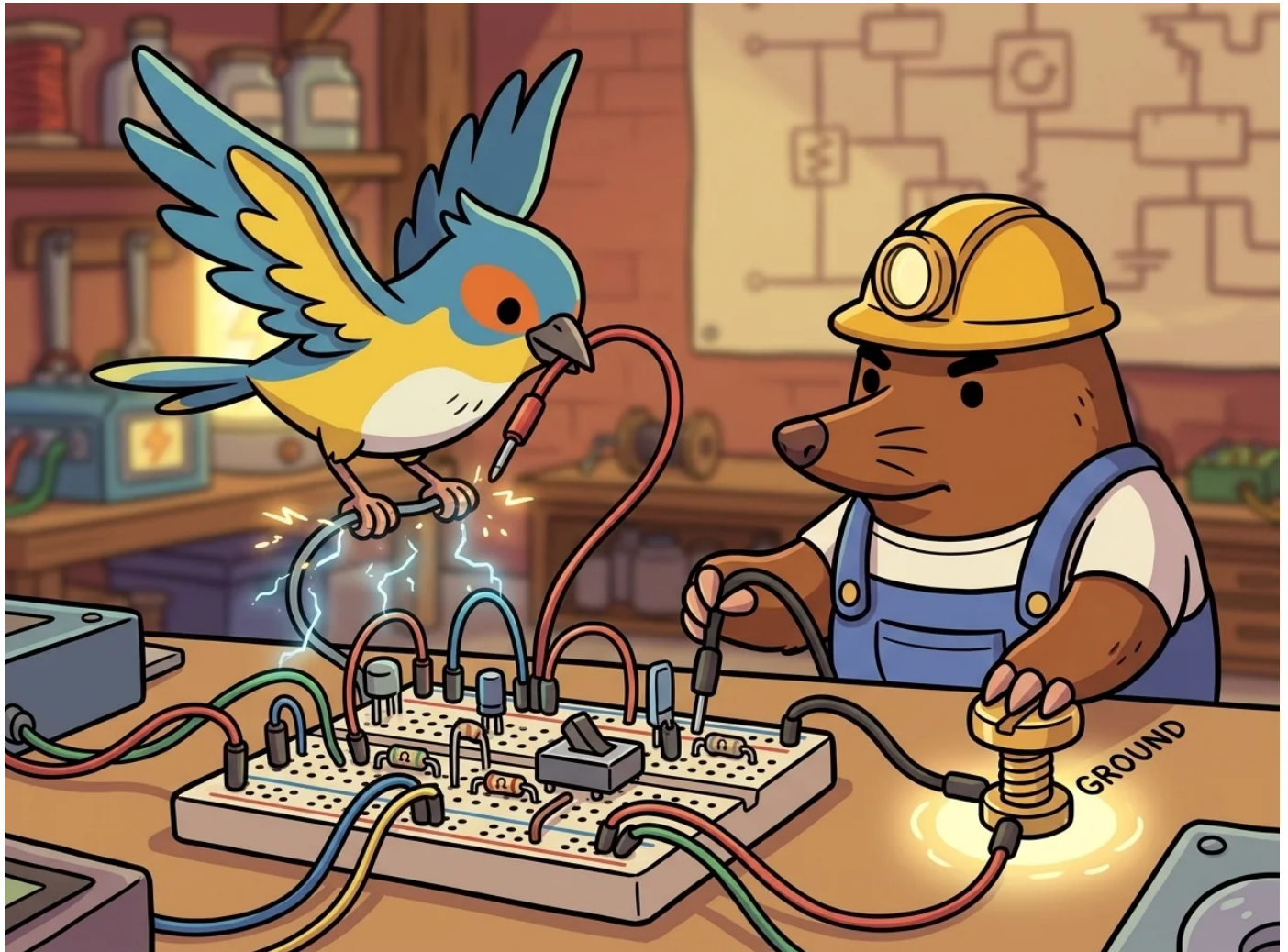
*COMPLETE LOOP — *current only flows if it can get all the way back; a circuit is a round-trip, and ground is where it returns.* The electronics primitive of the closed loop and the return path — no complete loop, no flow, no matter how much pressure you have.*



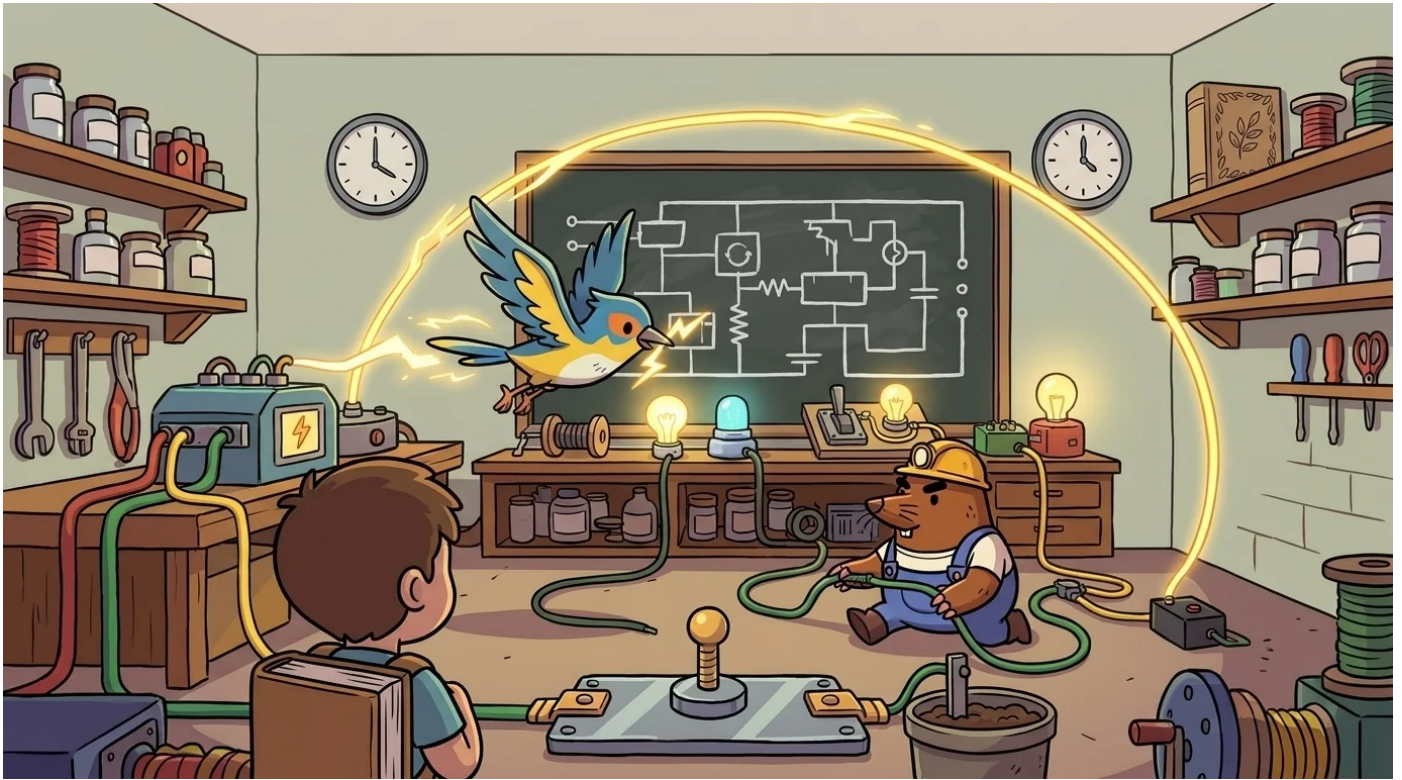
At the edge of the workshop, two friends worked as a pair, and no light in the whole place could turn on without both of them.



This was the idea beginners tripped over most, and the pair loved rescuing them from it. A student would wire a battery to a light with a single wire and be baffled that nothing happened. "You gave it pressure," Send would say kindly. "But I can only carry the charge *out*. There's no way home." Then Ground would connect the return wire, closing the loop — and the light came on. "There," Ground said. "Now it can come back to me. A circuit needs a there *and* a back."



Neither made it mysterious. "It's a loop," Send said. "You can trace it with your finger on the breadboard — out from the source, through the component, back to Ground. If your finger can't complete the circle, neither can the current." SEE-and-BUILD: the most important thing you could see was whether the loop actually closed.



One day Watt, the workshop mentor, came to the village.

"What makes a complete circuit?" Watt asked them together.

Send zipped out along an imaginary wire. "Carrying the charge out from the source." Ground settled at the low end. "And giving it a path all the way back — to ground, to zero, to home. Out and back. Break the loop anywhere and nothing flows, no matter the pressure." Watt nodded. "You are two halves of one loop," he said. "You are appointed. Together."

In their shared classroom, Send and Ground start with the baffling one-wire light that won't turn on, let the students puzzle, then close the loop and watch it glow. Then the students trace the whole round-trip with a finger.

They teach the students a few habits about the complete loop:

- **A circuit is a round-trip.** Out from the source, through the component, back to ground. Not a one-way street.
- **No complete loop, no flow.** Break the circle anywhere and everything stops — even with plenty of pressure.
- **Ground is home and zero.** It's the return path and the reference everything is measured from. Zero is where the loop closes.
- **Trace it with your finger.** If you can't draw an unbroken circle from source, through the part, back to ground, the current can't either. Find the break.
- **A "dead" circuit is usually an open loop.** Before blaming the battery, check whether the path actually comes all the way home.



When a student asks why a battery with plenty of power still won't light a bulb, Send and Ground answer together, one after the other:

"Because power isn't enough," says Send. "It has to be able to get all the way out..." "...and all the way back," says Ground. "Close the loop, and it comes home, and everything moves."

About Spark & Anvil

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- **CuriosityQuest** — Texas geography exploration through Linger, Notice, and the Lantern in the Dark
- **QuillSpell** — spelling craft through the Word Wizard cast
- **SynaForge** — sensory-affirming creative tools through Lull, Soften, and the Quiet that is Also Creating

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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