



ChemQuest

Meet the Cast

Standard Edition

Spark & Anvil

Copyright & License

© 2026 Spark & Anvil (501(c)(3) public charity). Chapter text and illustrations licensed under CC BY-NC-SA 4.0. App software © Spark & Anvil — all rights reserved. Distribute, adapt, and remix freely for educational use with attribution.

This book collects 9 chapter books from the ChemQuest 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.

Spark & Anvil is a 501(c)(3) public charity. All apps free forever; no ads; no tracking; no in-app purchases.

spark-and-anvil.com

This is Volume 2 of 2 of the *ChemQuest — 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.

Contents

Copyright & License	
Contents	
Introduction	
Phossa	
Magna	
Silica	
Alumi	
Tugger	
Sharer	
Streamer	
Whisperer and Streamer	
Whisperer	
About Spark & Anvil	
More chapter books from Spark & Anvil	
Methodology	
License	

Introduction

The ChemQuest cast was authored to embody the curriculum, not decorate around it.
Each of the 9 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*

Phossa

PHOSPHORUS (P) — energetic, restless; the spark of ATP and matches. Five outer-shell electrons; flexible bonding (3 to 5 connections); the energy currency of living things; the spark-flash element.



Phossa could not hold still. She was a small russet-and-cream mouse, and everything about her was moving at once — tail flicking, paws shifting, whiskers twitching, eyes leaping from one thing on the ChemQuest workbench to the next. A tiny bronze flame-charm swung on a leather cord around her neck, worn smooth from all the times she'd fiddled with it, catching the light every time she darted.

A cluster of students had gathered to watch a demonstration, and Phossa was supposed to be sitting quietly to one side. She was failing at that completely.

"Sorry, sorry," she squeaked, catching Beaker's patient look. "I know. Sit still. I'm trying." Her tail gave three quick flicks anyway.

A student named Ash whispered to a friend, "She's so jittery. Is she nervous?"

Phossa's ears swiveled — she'd heard. She scampered right over, flame-charm bouncing. "Not nervous," she said, grinning. "Energetic. There's a difference, and it's a good one." She held up the little bronze charm so it flashed. "See this? A spark. That's me. I'm not shaky because something's wrong — I'm buzzing because that's how I'm built, all the way down. Watch. I'll show you why."



Phossa grew up in a village of spark-keepers.

Her family tended the great fire pit in the middle of town — the one that never went out. When a family's own hearth went cold, they'd come to the pit, and a spark-keeper would carry them a live coal or a fresh flame, quick, before it could die on the way. It was a job for the fast and the ready. A spark-keeper who dawdled lost the flame between the pit and the doorway. A spark-keeper who moved quick kept the whole village warm through the night.

Little Phossa learned it by the time she was six. She was the fastest of all of them, darting across the frozen square with a cupped coal glowing between her paws, delivering it still alive to some grateful cold house. She was never still on those runs — couldn't be. Standing around meant the spark went out. Moving meant the spark stayed lit.

That was where her restlessness came from, and she was proud of it. Energy wasn't something wrong with her. Energy was the family trade — and the family gift.



She scampered to the ChemQuest academy when she was twenty-two, arriving in a flurry of quick little steps and skidding to a stop in front of Beaker, the mentor, who asked her the door-question.

"What is phosphorus?"

Phossa stood as tall as a small mouse can. "I sit just below Nitra on the big element table," she said, all in a rush. "I've got five little helpers on my outside edge, and I'm built deep enough that I can join up in flexible ways — three connections at once, or sometimes five. And I'm the energy money of living things. There's a tiny package inside every creature, made partly of me, that stores energy and spends it. I'm also the spark inside a match. And I'm restless — because that's how my atoms are made."

Beaker smiled. "Welcome to the academy," he said. "We could use a little of your spark."



On the first day of class Phossa flickered up to the front bench in three quick hops, held up her flame-charm so it flashed, and began.

"I'm Phossa," she said. "I'm the spark. And I'm going to show you two things: how I store your body's energy, and how I light a match."

She scampered to a little model built of linked beads — three bright ones in a row at the end, glowing faintly. "This," she said, tapping it, "is the energy package. Every cell in you is full of them. Think of those three glowing beads as three little pouches of energy, all linked up in a chain. When your body needs power for something — moving, thinking, anything — it snaps the last pouch off the chain." She flicked the end bead loose, and a tiny puff of light sparked out. "POOF. Energy! That burst is what runs your muscles, your thoughts, everything. And then your body links a fresh pouch back on and does it again — trillions of times, every single second." Her whiskers quivered. "That snap-and-recharge is the real spark of life. My flame-charm is just a little reminder of it, right here around my neck."

Ash raised a paw. "You said three or five connections. How do you know which?"

"Depends who I'm with!" Phossa said, delighted. She held up three claws. "Sometimes I join up three ways — that makes a stinky gas called PH_3 . Phew." She wrinkled her nose, then splayed out five claws. "Other times I stretch to five connections at once — that's the shape I'm in when I'm part of your energy pouches, and part of the long backbone that holds a strand of your DNA together, and part of the walls around every one of your cells. Five connections is my party trick, and it's the one that makes me so useful inside living things."

Then she grew a shade more careful. She pointed her charm toward a shielded corner of the lab. "There's also a wild kind of me," she said. "A version that reacts with the air so eagerly it can burst into flame all on its own if it just gets a little warm — barely warmer than a hot day. That's the chemistry that used to live in the tip of an old match, waiting for a scratch. My spark is not just a saying. It's real. Which is exactly why that wild kind stays in a special lab behind glass, and never, ever comes out to play at home."



At the end of the lesson Ash asked, "Is phosphorus chemistry hard?"

Phossa was already halfway into a happy little spin. "Not hard!" she said. "Three connections or five. Plus the snap-and-recharge of your energy pouches. Plus the spark in a match. And I'm restless because — say it with me — that's how my atoms are built." She grinned. "I'm the energy money of every living thing. Right now, inside you, uncountable little pouches are snapping and recharging to keep you going. That's me."

Her flame-charm caught the light as her tail gave a happy twitch. And feeling all that bright energy humming inside her, coiled and ready to spark, Phossa beamed — warm and glad and wide-awake, buzzing right down to her paws, exactly the way she most loved to feel.

Magna

*MAGNESIUM (Mg) — *bold, ceremonial; burns bright white; chlorophyll core*. Two extra outer-shell electrons; gives both away to become Mg^{2+} ; bright-white-flame combustion; the chlorophyll-anchor element of green plants.*



- Salt



- Ion
gate-allow-text-pattern: `'^([A-Z][a-z]?[\d01234567891230456789]?[+-*]?|[\d0123456789]+?|[-==+-*/])+$'`
reflection-prompts:



- prompt: "How does it feel when the calm, behind-the-scenes work you do turns out to matter just as much as the flashy moments?"



Magna was a crane-tween. She wasn't very big, but she held herself tall. A pure-white feathered crest sat on her head. It shimmered like fresh snow.

Magna was tall for her age. Her body was grey, like a smooth river stone. Her belly was cream-colored. A bright white crest sat on her head, shining like a tiny crown. She had long, graceful legs. Her eyes were steady, always looking straight ahead. She always stood in a careful, important way. Her special thing was that pure-white crest. It was a small fan of white feathers. It stood straight up, catching the light really well. It made you think of two big ideas. First, the bright, exciting flash of burning **magnesium**. Second, the soft, white light that helps **chlorophyll** work inside plants.



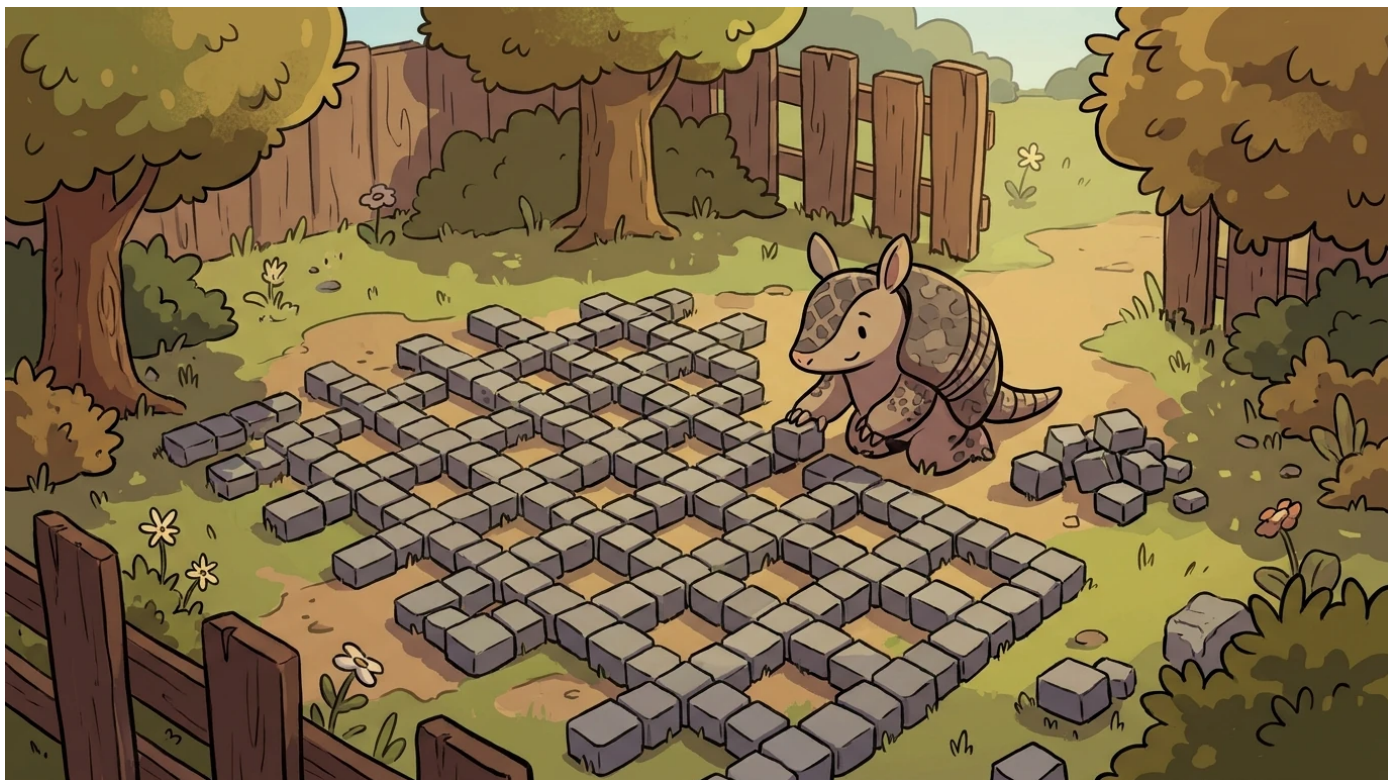
This was the main point about Magna. She was like the element **magnesium** (Mg). **Magnesium** atoms have two extra tiny bits. We call these 'electrons.' These two electrons are on its outer shell, like tiny guards on the edge of a castle.

Magnesium doesn't need them to stay balanced. It's like having two extra toys you don't play with. (Sodi, another element, only has one extra electron.) Like Sodi, **magnesium** gives its extra electrons away. But **magnesium** gives away *two* electrons at once. When **magnesium** gives away both electrons, it changes. It becomes Mg^{2+} . Think of it like a superhero who just gave away two powers. Now it has two positive charges, like two big 'PLUS' signs. Things made with Mg^{2+} often stick together very tightly. They stick tighter than things made with Sodi. For example, **magnesium chloride** ($MgCl_2$) sticks tighter than NaCl. **Magnesium oxide** (MgO) is a white powder. People use it as an antacid. It's also used in cement.

But the most exciting part of **magnesium** is how it burns. It's called **magnesium-flare combustion**. Pure **magnesium** metal burns with a super bright white light. It catches fire easily, like a firework. The light is so strong, it almost hurts your eyes to look directly at it. This bright light was used in old camera flash powder, making a quick, blinding pop. It's the bright flare you see in road emergency lights, warning cars from far away. It's also the quick, hot spark from some welding, joining metal together. This bright white flame is amazing to watch. It's one of the coolest chemistry shows you can see in a lab.

Silica

SILICON (Si) — the quiet architect who builds orderly, repeating lattices; the backbone of Earth's crust and of every chip.



In the stillest corner of the ChemQuest yard, a small armadillo named Silica was laying stones into a pattern, and she had been at it, calm and unhurried, for hours.

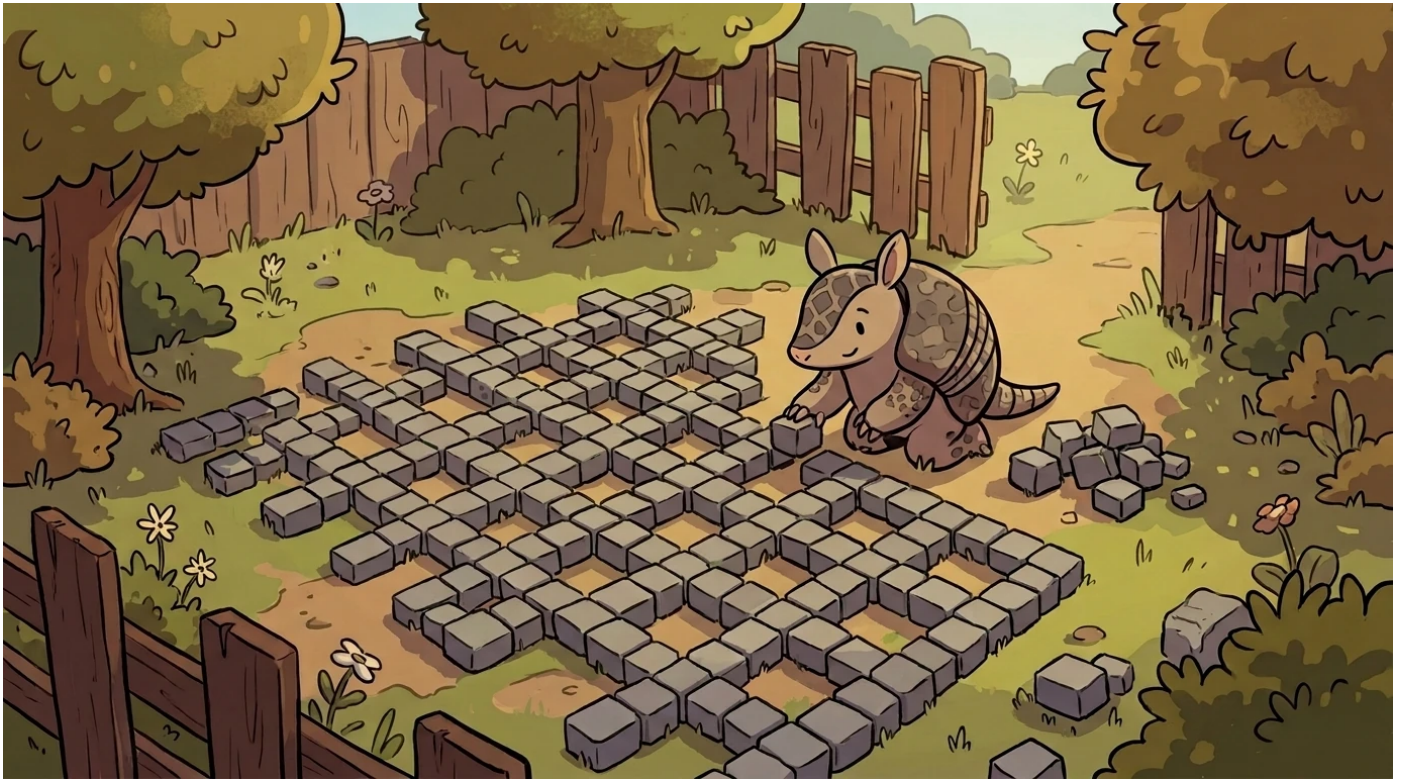
She wasn't building anything you'd notice from far off. Up close, though, it was extraordinary. Every stone she set was the same shape — a little four-cornered piece — and every one locked to its neighbors at exactly the same angle, so that the pattern spread out flat and even in all directions, repeating and repeating, perfectly regular. No stone was crooked. No gap was wrong. It looked less like a wall and more like the pattern was growing itself, and Silica were only its patient hands.

A younger armadillo wandered over and watched for a while. "It's all the same," he said, puzzled. "Same piece, over and over. Doesn't that get boring?"

"It's the opposite of boring," Silica said, and set another stone without looking up. "Every piece the same, every angle the same — that's what makes it *strong*. Watch."

She finished the row she was on and pressed down hard, in the middle, with both hands. The whole sheet of stone held her weight without a flicker — because every piece was sharing the load with every other piece, all through the repeating pattern.

"See," she said. "Carbo builds bendy chains — one thing after another, long and flexible, the shape of living stuff. I don't. I build *lattices*. The same little piece, locked the same way, spreading out stiff and even until it's a whole floor of rock." She patted the stone. "Quiet. Patient. Repeating. That's me."



Silica had learned the worth of the repeating pattern in her village, when she was small.

Her family were the stone-masons — the armadillos who dug up stone, shaped it, and laid it into the walls and bridges the whole village stood on. And little Silica had found the work slow to the point of pain. The other cubs did loud, fast, flashy things. She sat for a whole afternoon fitting one stone against its neighbor, then another exactly like it, then another, and it felt like nothing. It felt like she'd made no mark on the world at all.

Her grandmother had crouched beside her over the half-laid row. "You feel like it doesn't count, don't you? All these little same-shaped stones, one after another — like it adds up to nothing?"

Silica had nodded, her chin low.

"Come here." Her grandmother led her to the oldest wall in the village, the one at the bottom of the hill, weathered smooth. "Someone laid this the way you're laying yours. One patient stone at a time. Same shape, same fit, over and over. That was a hundred winters ago." She laid Silica's small paw flat on the cold stone. "It's still standing. It'll still be standing when you're grown, and when your grandchildren are grown. That's what the quiet repeating work makes. Not a splash. A thing that *lasts*."

Silica pressed her paw to the old wall for a long time. The it-doesn't-count feeling didn't vanish, but it changed shape. It stopped feeling like *nothing* and started feeling like *forever, one piece at a time*. Somehow that made the slow work feel like the most important kind there was.

By six she could lay a lattice of stone that didn't shift when you leaned on it. And she understood, in her careful hands before her head caught up, that the plainest, most-repeated building was the building that held.



She walked to the ChemQuest academy at twenty-two, wearing a small clear-quartz pendant she'd polished herself until its six flat sides caught the light.

Beaker met her at the gate and asked one question. "What is silicon?"

Silica didn't answer fast. She knelt, took a handful of pieces, and began to build — the same four-cornered unit, over and over, each one bonded to an oxygen on every side, spreading out into a stiff, even sheet right there on the courtyard stones. When she'd made a patch big enough, she stood and pressed on it, and it held.

"I sit one row under Carbo," she said. "Four hands, like him — I can bond four ways too. But where he makes long chains that bend, I lock my four bonds into stiff, repeating patterns that don't." She touched her pendant. "My favorite partner is oxygen. Silicon, oxygen, silicon, oxygen — on and on, in every direction. That pattern is sand. It's quartz. It's granite. It's most of the rock under your feet. Where Carbo is the backbone of life, I'm the backbone of the whole crust of the Earth." She looked up. "Quiet. But everywhere."

Beaker knelt and pressed the little lattice she'd made. It didn't give. "You belong here," he said.



Silica's workshop was the tidiest room in the academy, and things came to her to be made to last.

A boy came in one afternoon, slumped and grumbling. He'd been trying to build something strong out of loose, wobbly parts, and it kept collapsing. "I keep stacking them and they keep falling," he said. "I think I'm just no good at the strong stuff. Everyone else makes the exciting things."

Silica knew that slump exactly. She'd felt it over a half-laid row, sure her quiet work counted for nothing.

"Show me," she said. He piled his loose parts and they toppled, again. She caught one. "Here's the trouble. You're stacking them any old way — no pattern. Watch what happens with a pattern." She took his parts and laid them the way she laid stone: same unit, same angle, each one bonded on every side to the next, spreading flat and even instead of stacking tall and wobbly. When she pressed down, it held.

"That's a lattice," she said. "The same little piece, locked the same way, over and over, sharing the load. It's why sand doesn't crumble to nothing after a million years on the beach — the silicon-oxygen pattern is that strong." She tilted her pendant so it flashed. "Melt that pattern down and cool it fast and you get glass — your window, still the same silicon and oxygen, just frozen mid-pour. Grow the pattern very pure and slice it thin and you get the wafer inside a computer chip. Same quiet, repeating, patient building. Rock, glass, and the brain of your phone, all of it me."

The boy pressed the little lattice. It didn't move. "So the boring, same-every-time way is the *strong* way?"

"The patient, same-every-time way," Silica said. "That's the one that lasts."



Later, when the workshop had emptied, the boy came back with one more question. He was quieter now.

"When you're building the plain thing," he said, "the same piece over and over, and nobody's watching and it isn't flashy — how do you keep going? How do you know it matters?"

Silica thought about the old wall at the bottom of the hill, cold and smooth and still standing, and her grandmother's paw guiding hers to it.

"There's a feeling," she said, "when you set a piece exactly right against the last one, and it fits, and you know it'll still be fitting long after you're gone. It's not a loud feeling. It's calm — steady, and settled, like something in you going quiet because the work is *true*." She looked out the window toward the courtyard where her little lattice still held. "The flashy things are wonderful for an afternoon. But the quiet, repeating, careful things are what the world actually stands on. Sand and stone and glass and every chip in every gadget — all of it just plain patient pieces, set right, one at a time." She turned her pendant in the light. "And knowing you can make a thing that lasts — that's the calmest, gladdest feeling I've got."

The boy nodded slowly, and Silica watched the slump lift off his shoulders — the same way, years ago, the it-doesn't-count feeling had lifted off hers.

She didn't say the rest out loud, but she felt it, quiet and warm and sure: *the plainest, most-repeated work is not the small work. It's the work that holds the whole world up — and doing it well feels, more than anything, like being at peace.*

Alumi

ALUMINUM (Al) — the practical workhorse. lightweight, corrosion-resistant, and endlessly recyclable.



At the village well, a beaver-tween named Alumi unclipped a dented gray cup from her belt and filled it, and nobody looked twice.

That was fine by her. The cup was scratched on the outside and still bright inside, and she had carried it every day for as long as she could remember. She drank, wiped it on her sleeve, and clipped it back. A crowd was gathering at the far end of the square, oohing over a peddler's polished golden goblet, gleaming and heavy and set with fake jewels.

"Now *that*," a small badger said, elbowing Alumi, "is a real cup. Not like yours."

Alumi looked at the golden goblet, then at her own plain one. She smiled a little. "Watch," she said, and did the smallest thing. She tossed her cup — up, spinning, catching the sun — and caught it one-handed without spilling a drop. Then she tapped it against the stone rim of the well. It rang, light and clean, and didn't dent any deeper. "It weighs almost nothing," she said. "I can carry it all day and forget it's there. It never rusts. When it finally wears out, they melt it down and it comes back as another cup. That goblet will be a doorstep by winter." She refilled it, unbothered. "Mine just keeps working."

The badger frowned at the goblet, which was already smudged from too many hands. "Huh," he said.

"That's the whole secret," Alumi said. "Being the thing people forget they're holding — because it never gives them a reason to think about it."



Alumi had grown up in the tool-maker's workshop, the youngest in a family of beavers who hand-shaped the village's knives and hinges and cooking pots. Their tools weren't beautiful. They were *durable* — the kind you inherited, sharpened, and passed down again.

When she was six, a fine visitor came through with an ornament, a shining decorative thing, and every child in the village wanted one. Alumi wanted one so badly her chest ached. She looked at her family's dull, honest tools lined up on the bench and felt, for the first time, a small hot shame — like they were plain and poor and *less*.

Her grandfather caught her staring. He picked up an old kitchen knife, worn smooth at the handle from three generations of hands. He didn't tell her the ornament was silly.

"You feel like the shiny thing is the real thing," he said quietly. "Don't you. And ours are just... ordinary."

Alumi nodded, miserable.

"Feel the weight of this." He set the worn knife in her paws. "Every meal this village has eaten in fifty years passed across this edge. It never got a single ooh. That's not because it's worthless, little one. It's because it's *trusted*. The things you count on the most are the ones you stop noticing — because they never let you down." He curled her fingers around it. "Shiny gets attention. Useful gets forgotten. Being forgotten is the highest compliment a good tool can earn."

The hot shame cooled into something steadier. It had a shape now: *the plain thing can be the strong thing*. Somehow that made it possible to be proud.



She walked to the ChemQuest academy at twenty-two, because a place that studied what things are made of ought to understand the quiet, practical stuff.

Beaker, who ran the workshops, met her at the gate and didn't ask her to prove she was clever. He asked one plain question. "What is aluminum?"

Alumi didn't reach for big words. She unclipped her cup and held it out on her palm, letting him feel how little it weighed. Then she tapped its shiny surface. "Three electrons I don't need. I give them all away, and I become a steady little ion — Al^{3+} . That's what I *want* to be." She turned the cup. "I'm everywhere in the ground under your feet — one of the most common things in the whole crust — but you'll never dig me up pure. It takes a lot of effort to pull me out clean." She smiled. "And once I'm out? Lightweight. Won't rust. Melt me down a hundred times and I come back good as new."

Beaker weighed the cup, then handed it back. "You belong here," he said.



Alumi's workshop was full of ordinary things that turned out to be extraordinary. A boy came in one afternoon carrying a crumpled soda can, scowling.

"My brother says recycling this is pointless," he said, tossing it on the bench. "It's just trash. One dumb can."

Alumi picked it up, smoothed it flat, and held it to the light. "How heavy?"

The boy shrugged. "Basically nothing."

"Right — I'm about a third the weight of iron. That's why your bike frame and airplanes and this can are all made from me. Now — feel the outside. Is it rusty?"

He rubbed it. "No."

"It never will. The moment my surface meets air, it grows its own thin, invisible skin — a coat of oxide — and that coat seals the rest of me off. Iron rots. I armor myself." She set the can down. "Now. Your brother says this is trash." She tilted her head. "Making a brand-new can, from scratch, out of the ground, takes an enormous amount of energy. Melting this old one down to make another? About one-twentieth of that. *One-twentieth.*"

The boy stared at the can. "So it's not nothing."

"It's the opposite of nothing. Every can somebody bothers to recycle saves almost all the energy of a new one. You're not throwing away trash — you're handing back something that comes around again, and again, and again." She grinned. "The most ordinary thing in your recycling bin is quietly one of the most valuable materials on Earth. It just never brags about it."

The boy picked the can back up, carefully now, like it had gotten heavier by mattering.



Later, when the workshop had emptied, the boy stuck his head back in. He was quieter.

"Doesn't it bug you?" he asked. "Being the thing people don't notice? The plain metal in the plain can?"

Alumi thought about the golden goblet, and the worn knife in her grandfather's paws, and the little hot shame that had cooled so long ago.

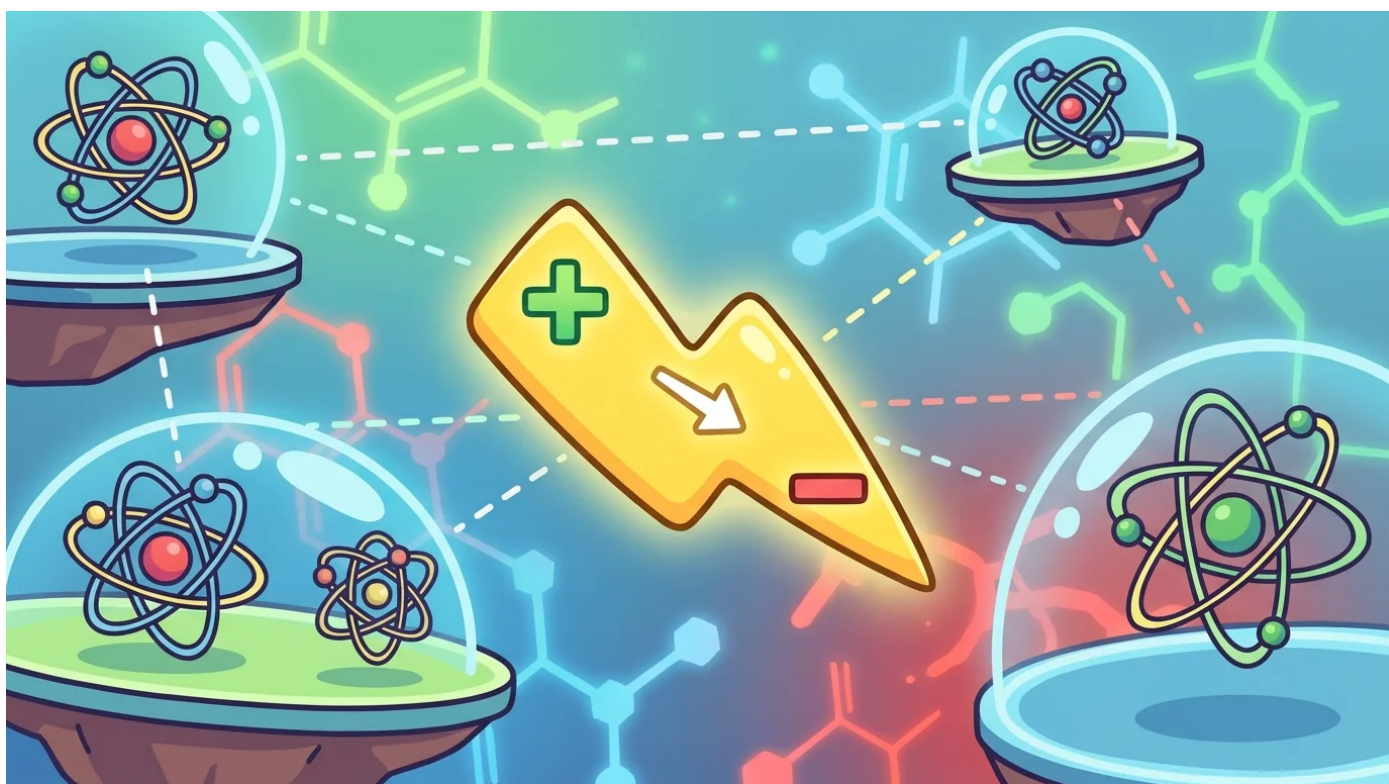
"It used to," she said honestly. "When I was small I wanted to be the shiny one." She unclipped her cup and turned it slowly. "But being noticed and being *depended on* aren't the same thing. The goblet gets the crowd. I get to be in your hand every single day and never let you down. Ask me which one I'd rather be."

She clipped the cup back to her belt, where it had ridden a thousand ordinary days.

The boy left, and Alumi stood a moment in the quiet workshop, warm all the way through — not proud in the loud way, but settled, steady, the good clean feeling of being the plain thing that holds everything up.

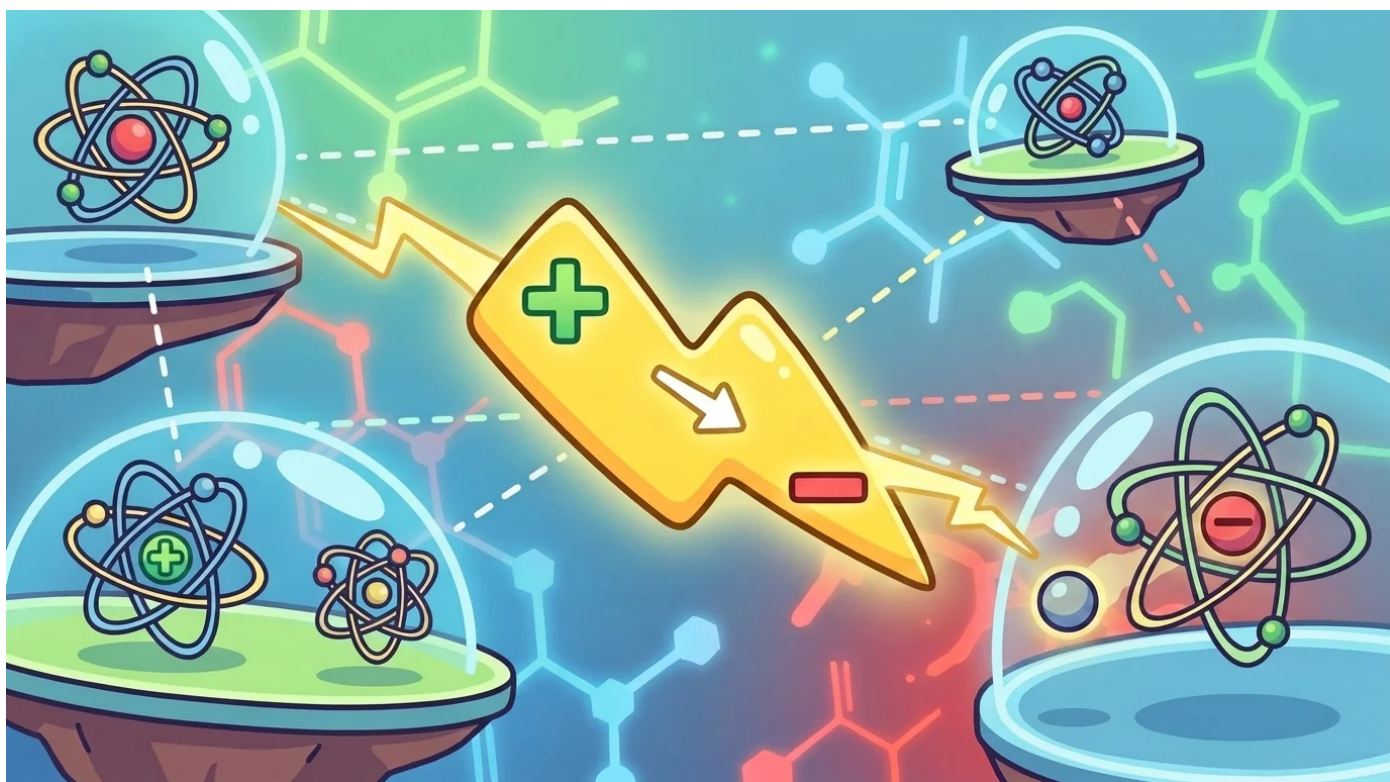
Tugger

*IONIC BOND — *forceful, decisive; full electron transfer; opposites attract*. The bond-type that forms when one atom completely gives an electron to another. NaCl, MgCl_2 , Al_2O_3 — most salts.*



Meet Tugger. Tugger is not an animal. Tugger is not a person. Tugger is a shape. It looks like a small lightning bolt. One end has a bright plus sign (+). The other end has a bright minus sign (-). You can see a tiny arrow too. It shows electrons moving from the plus to the minus. That's all Tugger is. No face. No arms or legs. Just a shape that shows energy.

This is super important. The ChemQuest team has four special characters. They show different kinds of bonds. These bond characters are not like the element characters. The elements are animal-tweens. They have personalities. But the bond characters are just shapes. They show forces. They don't have personalities at all. This is on purpose. Bonds are forces between atoms. They are not living things. Giving them faces would make us think wrong things about chemistry. The way we designed the characters shows what bonds really are.



This is also super important. Tugger shows us the *ionic bond*. An ionic bond happens when one atom gives an electron away. It gives the electron completely to another atom. The atom that gives becomes positive (+). The atom that takes becomes negative (-). These two opposite-charged atoms then pull on each other. It's like when you rub a balloon on your hair. Then the balloon can pick up tiny bits of paper. That pulling force holds them together. That strong pull is the *ionic bond*.

Think about regular table salt. Its chemical name is NaCl. Sodi gives her electron to Chlora. Sodi becomes Na^+ . Chlora becomes Cl^- . Then Na^+ and Cl^- pull on each other. Zap! That's an ionic bond. It makes table salt. This bond is very strong. It's a full transfer. No half-measures here. That's why Tugger looks like a lightning bolt. The electron moves fast and completely. It's like a sudden lightning strike.

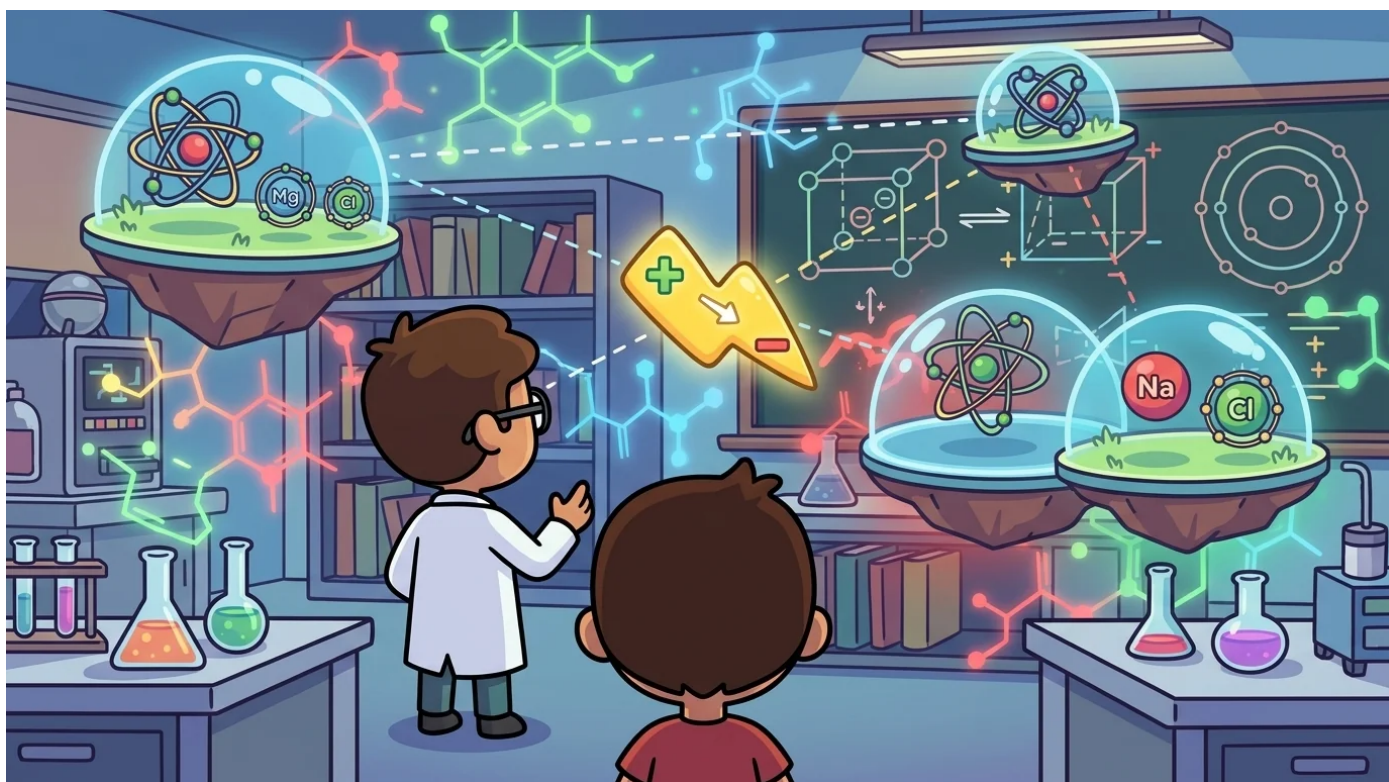
It's key to remember this. Tugger is all about the *force* of the bond. Not about Tugger as a character. The other ChemQuest friends and Beaker, our mentor, introduce Tugger like this:



"This is Tugger," Beaker says. "Tugger is the ionic bond. Tugger has no face. Tugger is not a person. Tugger is the strong force between atoms. It happens after one atom gives an electron to another. Look at the lightning-bolt shape. See the plus sign at one end? See the minus sign at the other? The arrow shows the electron moving. That's the whole figure. The force *is* the figure."

(Tugger doesn't have a family story. The bond characters don't have life stories. They are not people. This matches their abstract design.)

In our ChemQuest classroom, Tugger often appears. Tugger stands right next to Sodi and Chlora. They are a perfect example of an ionic bond. Tugger connects them on the workbench. One end of the lightning bolt touches Sodi. Sodi becomes the positive Na^+ . The other end touches Chlora. Chlora becomes the negative Cl^- .



Beaker explains it clearly. "When you see Tugger between two characters," he says, "that's an ionic bond. It's a full electron transfer. Plus and minus. Lightning-strike chemistry. The bond is the force."

Beaker teaches us about Tugger. He explains these important things:

- An *ionic bond* means a full electron transfer. It's not sharing. One atom gives. The other atom takes. The giving atom turns positive. The taking atom turns negative.
- Opposite-charged atoms pull on each other. This is called electrostatic attraction. Think of magnets. Opposites attract. Likes repel.
- We learn about common ionic compounds. Like NaCl, which is table salt. Or MgCl_2 , magnesium chloride, used in some medicines. CaCl_2 , calcium chloride, which melts ice. Al_2O_3 , aluminum oxide, found in rubies. MgO, magnesium oxide, used in antacids. KBr, potassium bromide, used in some photography.
- Ionic compounds are usually hard, solid crystals. The atoms line up in neat 3D patterns. Strong forces hold them together.
- Ionic compounds dissolve in water. They break apart into ions. For example, salt in water becomes Na^+ ions and Cl^- ions. That's why salty water can carry electricity.
- Ionic bonds are usually very strong. They need lots of heat to melt. They can be brittle, like a dropped sugar cube. They carry electricity when melted or dissolved.
- Remember the full-transfer rule. For ionic bonds, one atom takes all the electrons. For covalent bonds, atoms share. Sharer is the character for covalent bonds. Knowing the difference is key.



Beaker often reminds us. "Tugger has no face," he says. "That's the main lesson. The bond is a force. It's not a person. Respect it for what it is."

Sometimes students ask if ionic bonds are hard to understand. Beaker smiles. He speaks for Tugger.

"Not hard at all," he says. "Full transfer. Plus and minus. Opposites attract. Tugger is the force. Not the figure."

The lightning-bolt shape glowed, catching the light. Beaker looked at that bright plus and bright minus holding fast to each other, and it made him smile — a warm, glad feeling, because two things so opposite finding each other and holding on was, he thought, one of the happiest sights in all of chemistry.

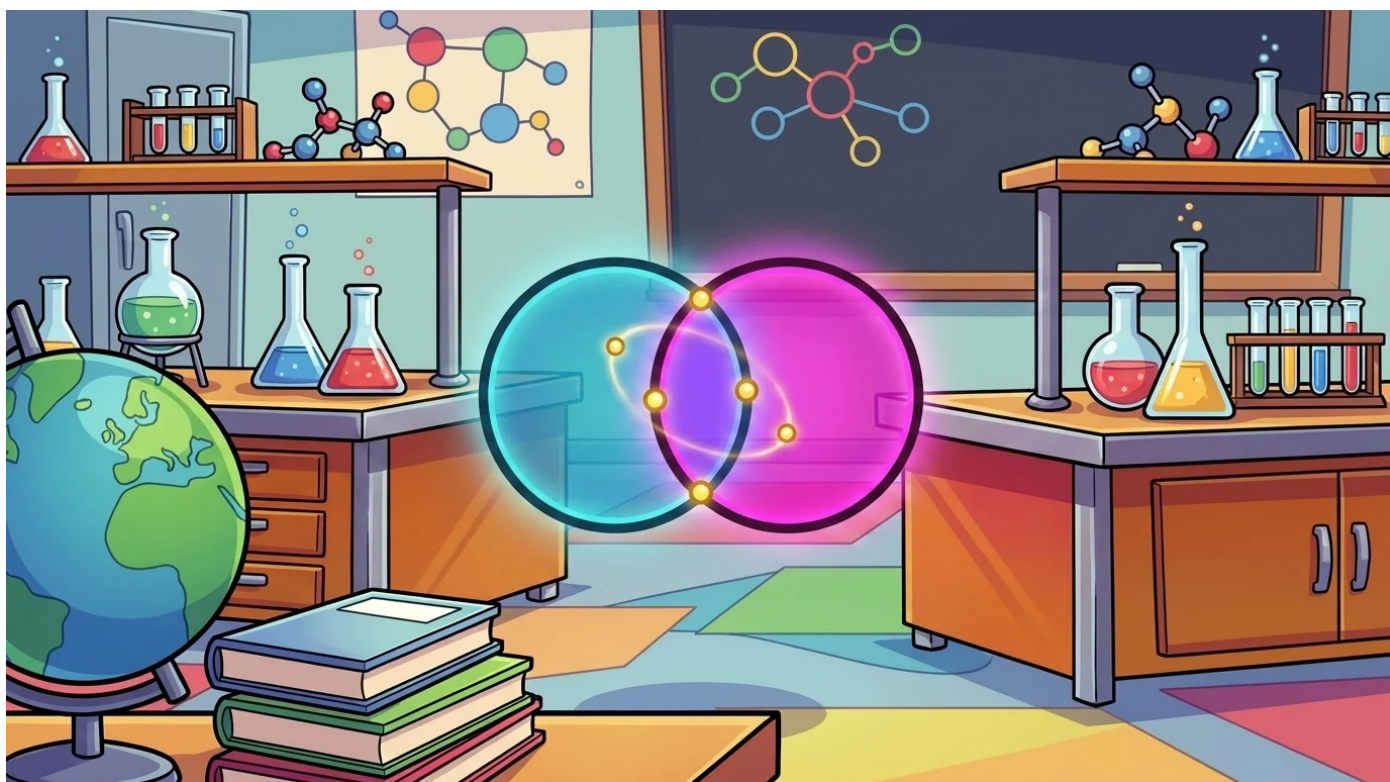
Sharer

*COVALENT BOND — *cooperative, balanced; equal partnership*. The bond-type that forms when two atoms share electrons in their overlapping outer shells. H_2O , CH_4 , NH_3 , O_2 , N_2 — most molecular compounds.*



Sharer wasn't an animal. Sharer wasn't a person with a face. Sharer was just a shape. A very special shape. It was two small circles, painted bright. They overlapped a little bit. In that overlap zone, tiny bright dots floated. Those dots were shared electrons. They moved between the two atom-positions. That was the whole figure. No face. No personality. Just the energy-shape of shared electrons.

This shape was super important. Sharer showed everyone the *covalent bond*. What is a covalent bond? Imagine two atoms. Each atom gives one electron. They put these electrons into a shared pair. This pair sits right in the middle. It's in the overlap zone of their outer shells. Both atoms can reach these electrons. Neither atom takes the electron. They both share it. This shared electron-pair holds the two atoms together. That's the *covalent bond*.



Most molecules use covalent bonds. Think about water, H_2O . It has two H–O covalent bonds. Methane, CH_4 , has four C–H covalent bonds. Ammonia, NH_3 , has three N–H covalent bonds. Even the air we breathe has them. Molecular oxygen, O_2 , has one O=O double covalent bond. Molecular nitrogen, N_2 , has one $\text{N}\equiv\text{N}$ triple covalent bond. Most things inside living creatures are like this. Proteins, sugars, fats, DNA. They are mostly held together by covalent bonds.

Covalent bonds come in different strengths. They can be single. That means one shared pair. They can be double. That means two shared pairs. Or they can be triple. That means three shared pairs. The more pairs shared, the stronger the bond. The atoms also get closer together. Triple bonds are the strongest covalent bonds. Nitrogen's N_2 atmospheric pair is a good example.

Sometimes, atoms share perfectly. This happens when both atoms pull equally. Like H–H in hydrogen gas. Or C–C in a diamond. They share the electrons 50/50. These are *equal* covalent bonds.



Other times, the sharing isn't quite fair. One atom pulls harder. This happens when one atom is more "electronegative." Take water, O-H. Oxygen pulls the electron pair closer to itself. So, the hydrogen atom ends up a little bit positive. The oxygen atom ends up a little bit negative. This *unequal sharing* makes water "polar." It means water has a slightly positive end and a slightly negative end.

Beaker introduced Sharer to the class. "This is Sharer!" he boomed. He held up the glowing shape. "Sharer is the *covalent bond*. See? No face. Sharer is not a being. Sharer is a force. It's the force between atoms. Atoms that share electrons. Look at the overlapping circles. Two atoms. One shared pair. That's the whole figure. The force *is* the figure."

In ChemQuest classrooms, Sharer often appeared. It would pop up next to cast members. They would be forming covalent bonds. Most often, Hydra and Oxy would stand together. Sharer would appear between them. This showed how water, H_2O , was made. Or Carbo and Hydra would join up. Sharer would show the methane, CH_4 , bond. Sometimes Carbo would link with another Carbo. Sharer would show a carbon chain.



Beaker always made sure to explain the difference. "Tugger is full transfer," he'd say. "That's an ionic bond. Sharer is a shared pair. That's a covalent bond. Both are bonds. But they are different kinds of forces."

Sharer's lessons were important. Beaker taught them for Sharer.

- A *covalent bond* means shared electrons. They sit in overlapping spaces. It's not about taking. It's about sharing.
- Bonds can be single, double, or triple. One, two, or three shared pairs. More pairs mean a stronger bond. The atoms are also closer.
- Sharing can be equal or unequal. Equal sharing is like H-H or C-C. The atoms pull the same. Unequal sharing is like O-H or N-H. One atom pulls harder. This makes *polar covalent bonds*.
- *Polar covalent* bonds are still sharing. But the sharing is uneven. Polar bonds make polar molecules. Water is a polar molecule. It acts differently from nonpolar molecules. Methane is nonpolar.
- Most living things are made of covalent bonds. Proteins, fats, sugars, DNA. They all use covalent bonds. Some have polar covalent bonds too. These help them do their jobs.
- Covalent compounds are usually molecules. They are separate little groups. They don't form big lattices. They often have lower melting points. They usually don't conduct electricity.
- Remember the big rule: shared, not transferred. For covalent bonds, both atoms hold the electrons. For ionic bonds (Tugger's job), one atom takes them all. This difference is key.

Beaker often pointed to Sharer. "Sharer has no face," he said. "That's the lesson. The shared bond is a force. It's not a person."



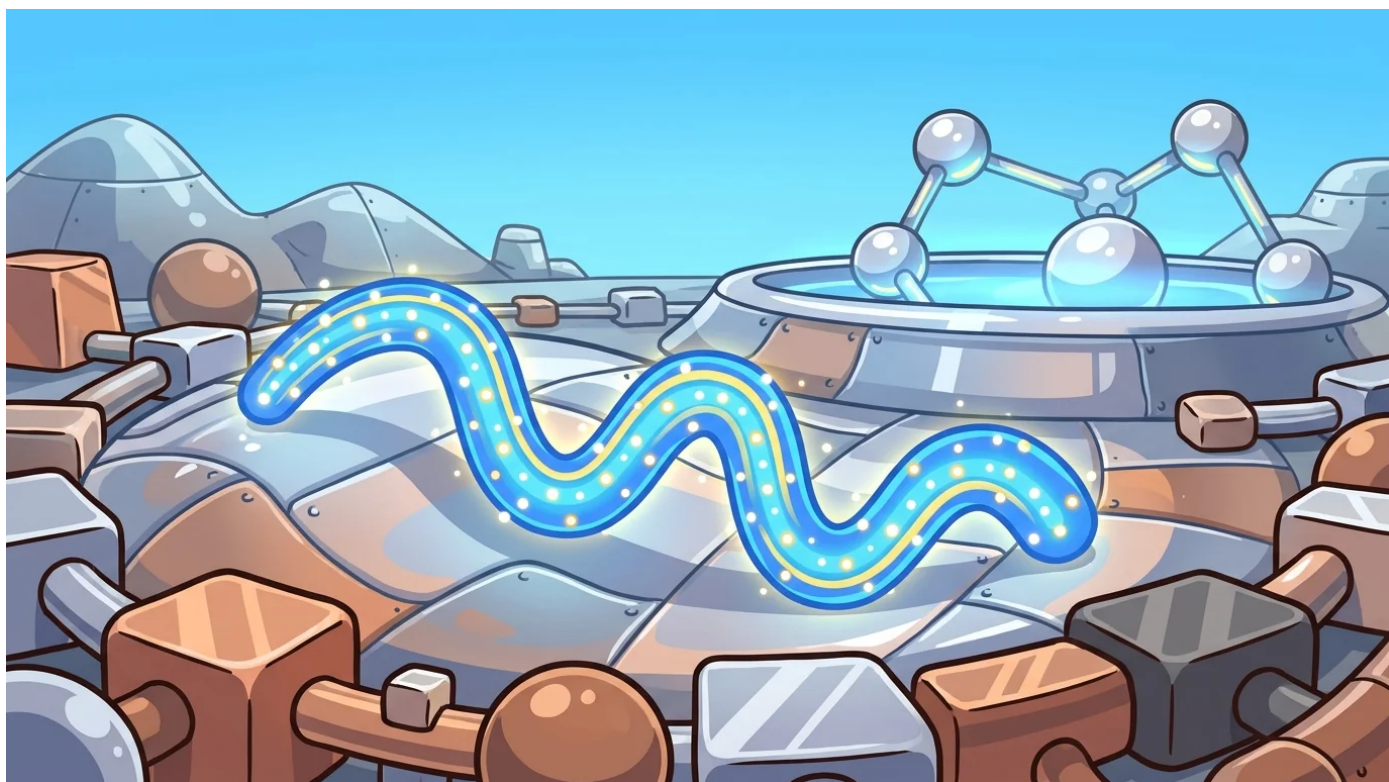
Sometimes students would ask. "Are covalent bonds hard to understand?" Beaker would smile. He spoke for Sharer.

"Not hard at all," he'd say. "It's a shared pair. Both atoms hold the electrons. Single, double, triple sharing all happen. Sharer is the force. Not the figure."

The overlapping-circles shape always caught the light, and it seemed to shimmer. Beaker looked at it and felt a quiet warmth — because that gentle glow, he liked to say, was what fairness looked like: two holding on together, both glad, neither one left out.

Streamer

*METALLIC BOND — *flowing, communal; delocalized electron sea*. The bond-type that holds metals together via electrons that flow freely across the entire metal lattice. Aluminum, iron, copper, gold, sodium-as-pure-metal.*



Streamer is not a creature. It doesn't have a face. Streamer is a shape. It's a small wavy line. Many tiny dots flow through it. The dots are spread out. They move like a shimmering river. This is all Streamer is. Just an energy shape. It shows a sea of free electrons.

This shape is super important. Streamer shows us the **metallic bond**. A **metallic bond** is special. It's not like two atoms holding hands. It's not like sharing one toy. Instead, it's a big, shared pool. Many metal atoms are in this pool. They all throw their outer electrons into it. These electrons don't belong to just one atom. They belong to *all* the atoms. They flow freely around them.



Imagine a big swimming pool. The metal atoms are like people standing in neat rows. They've tossed their hats into the water. The hats are the electrons. The hats just swim everywhere. They don't stick to one person. The atoms become positive. They gave up their electrons. The electron sea flows around them. It holds the whole group together.

This shared electron sea makes metals amazing. It gives them their special powers.

- **Electricity zips through them.** The electrons flow easily. So electricity can travel fast.
- **Heat moves quickly too.** It's the same reason. The moving electrons carry the heat.
- **You can bend metals.** You can hammer them flat. You can pull them into long wires. The metal atoms move. But the electron sea just moves with them. It doesn't break. This is called *ductility* and *malleability*.
- **Metals look shiny.** The electron sea reflects light. That's why they sparkle.
- **You can't see through most metals.** The electrons soak up light.



Beaker stood in front of the class. He held up a small, shimmering wavy line. Tiny dots pulsed inside it. "Look, everyone!" he said. "This is Streamer. Streamer is the **metallic bond**."

He moved Streamer around. The dots flowed and shimmered. "Streamer has no face," Beaker explained. "It's a force. It's the pattern of the electron sea. Many electrons. Many atoms. They all share. They flow together."

He pointed to the wavy line. "See the wavy line with the flowing dots? That's the whole thing. The communal flow *is* Streamer."

In our ChemQuest classroom, Streamer always appears with metal atoms. Sometimes it's with Alumi. That's our aluminum metal friend. Sometimes it's with Sodi. That's pure sodium metal. (Before it gets wild and reacts with water!)



Beaker held up a shiny block of aluminum. Alumi stood beside it, shimmering. "In pure metal," Beaker said, "the metal atoms give up their outer electrons. They toss them into the shared sea. The atoms sit in a neat pattern. The electrons just flow around them. That's **metallic bonding**."

He paused. "Remember Tugger? Tugger is one-to-one transfer. One atom takes an electron from another. Sharer? Sharer is one-to-one sharing. Two atoms share a pair of electrons. But Streamer? Streamer is many-to-many flow. Everyone shares with everyone."

Streamer teaches us many things. Beaker always explains them for Streamer.

- The **metallic bond** is a flowing electron sea. It's not one-on-one. It's many-on-many.
- Metal atoms give their outer electrons. Alumi gives three. Sodi gives one. Iron gives two. Copper gives one or two. They all go into the shared sea.
- Metal atoms line up in a pattern. They become positive. The electrons flow around them. They hold the structure firm.
- Electricity and heat move easily. This happens because the electrons flow. They carry the energy.
- Metals can bend and stretch. The electron sea just moves. It lets the metal change shape. Other types of bonds would just snap.
- Metals are shiny. The electron sea reflects light. That's why they gleam.
- Alloys are mixtures of metals. Steel is iron mixed with carbon. Brass is copper mixed with zinc. Alloys often work better than pure metals. They can be stronger or tougher.
- We can compare the three bond types. Tugger means full transfer. Sharer means one-to-one sharing. Streamer means many-to-many flow.



Beaker looked at Streamer. "Streamer has no face," he repeated. "That's the main lesson. The communal flow is a force. It's not a person or an animal."

Sometimes, students would ask if **metallic bonds** were hard to understand. Beaker would just smile. He spoke for Streamer.

"Not hard at all," he'd say. "Think of it this way: Electron sea. Many atoms. Many electrons. All flowing together. Streamer is just the force-pattern. It's not a figure with feelings."

The wavy-line-with-flowing-dots shimmered, catching the classroom light. Beaker watched it flow and felt a warm, glad steadiness in his chest — because that shimmer, he always thought, was what belonging looked like: everyone sharing everything, no one left out, all of it held together and calm.

Whisperer and Streamer

fluid-flow pair — Whisperer is solution chemistry (small concentrations, gentle mixing, equilibrium). Streamer is electrochemistry (charge moving, current flowing, redox). Together they show that chemistry has both still and moving versions of the same conservation laws.



- "H"
 - "C"
 - "N"
 - "O"
 - "M"
 - "Z"
 - "Na"
 - "Cl"
 - "Fe"



reflection-prompts:

- prompt: "Whisperer loves being still and patient, while Streamer wants everything to move and go. Have you ever felt more like one of them than the other — calm and waiting, or restless and eager?"
- prompt: "How does it feel when someone very different from you turns out to be exactly the friend you needed?"

The chemquest lab was settling into its evening rhythm. The last rays of sun slanted through the high windows, catching dust motes dancing in the air. The gentle hum of the ventilation fans was a constant, sleepy sound. On one long bench, a figure named Whisperer stood perfectly still, their posture as precise as the glass instruments around them. Their eyes were fixed on a clear, cone-shaped flask. Above it, a tall, slender tube called a burette held a shimmering magenta liquid, poised. Whisperer's hand rested lightly on the stopcock, a tiny red knob, ready to release a single, crucial drop. The entire setup was about patience. For Whisperer, chemistry was a quiet secret, told one drop at a time.



"Anytime now," Whisperer murmured to the flask, their voice barely a puff of air. "We'll find the perfect moment."

"Perfect moment? I'd settle for *any* moment!" Streamer grumbled, flicking a wire with their finger. The needle on the meter didn't budge. "Come on, flow!"



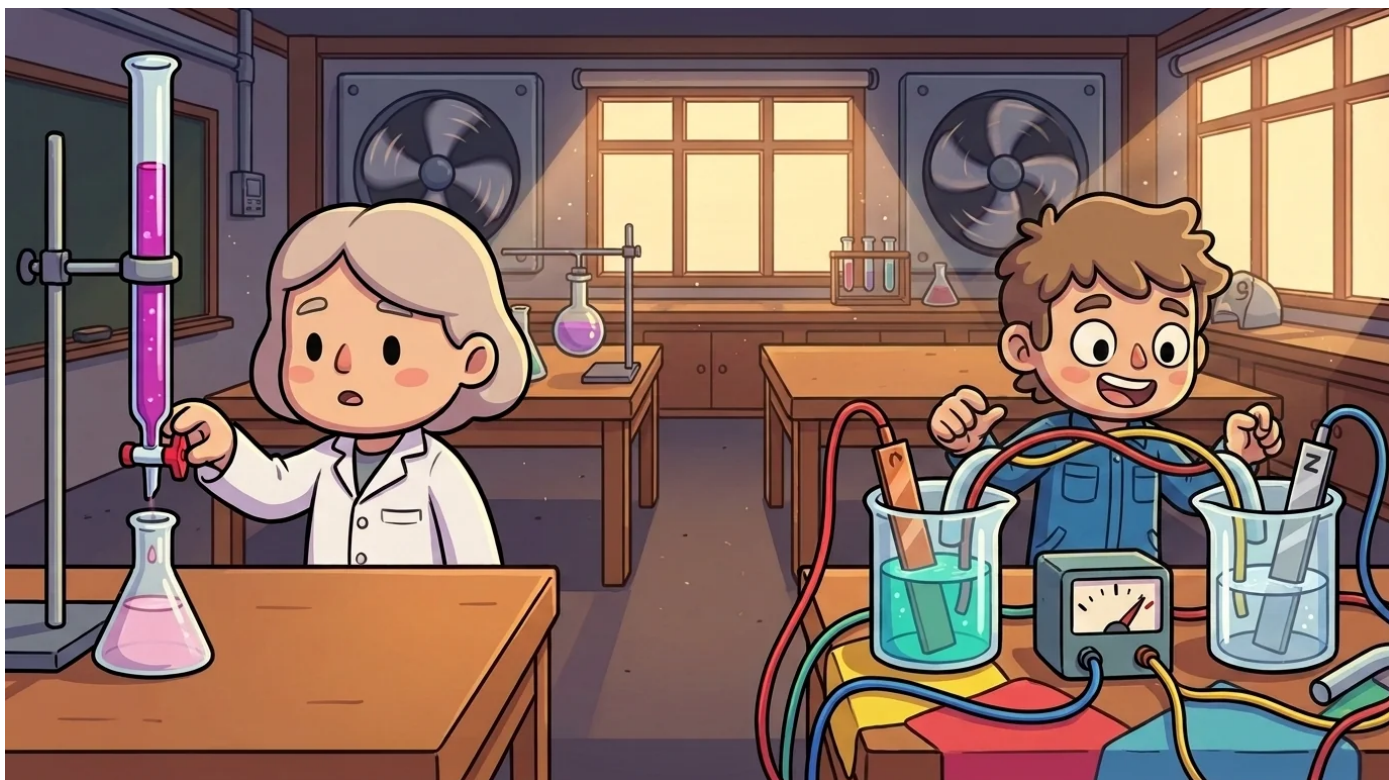
Drip.

A single drop of magenta liquid fell. It hit the surface and a cloud of pink blossomed, only to be swallowed by the clear solution as Whisperer swirled the flask in a slow, hypnotic circle. The secret wasn't in this drop, or the next one. The secret was in the final drop, the one that would tip the scales. A single drop too many, and the solution would flash a dark, angry fuchsia, the moment of balance overshoot and lost. Too few, and it would remain stubbornly clear.

"Easy now," Whisperer whispered, adding another drop. The pink swirl lasted a fraction of a second longer this time. "We are holding our breath. We are a calm pond." Each drop was a tiny pebble, sending out ripples of change that quickly settled. It was the most delicate of dances, a search for perfect stillness on the very edge of a dramatic change. Everything depended on not rushing.

"Stillness is for rocks!" Streamer declared to their uncooperative contraption. "I need flow! I need a current!" They jiggled the copper strip in its sky-blue home. They poked the gray zinc strip in its colorless bath. The wires connecting them were clipped on tightly. The two beakers were linked by a U-shaped glass tube filled with a whitish gel—a special bridge that was supposed to let the chemistry travel between the beakers without them mixing. But nothing was traveling. The chemical road was closed.

The whole point was to create a push and a pull. The zinc was supposed to be eager to give away its electrons, pushing them out into the wire. The copper on the other side was supposed to be hungry for them, pulling them in. That push and pull should create a flow, a river of electricity that would make the meter's needle sing. But the river was dry.



Whisperer looked up. The pink color in their flask was now lingering for a full second with each drop. They were so close. But the heavy, dramatic sigh from Streamer's bench was impossible to ignore. They watched Streamer poke gloomily at the motionless needle on their meter. Whisperer set their flask down carefully and glided over, their footsteps silent on the linoleum floor.

"Is the path closed?" Whisperer asked softly.

Streamer jumped, not having heard them approach. "No! The path is wide open! Wires, metal, everything's connected." They gestured wildly at the setup. "But the electrons are having a nap. They won't leave the starting block." They pointed a finger at the U-shaped tube. "I think the bridge is out."

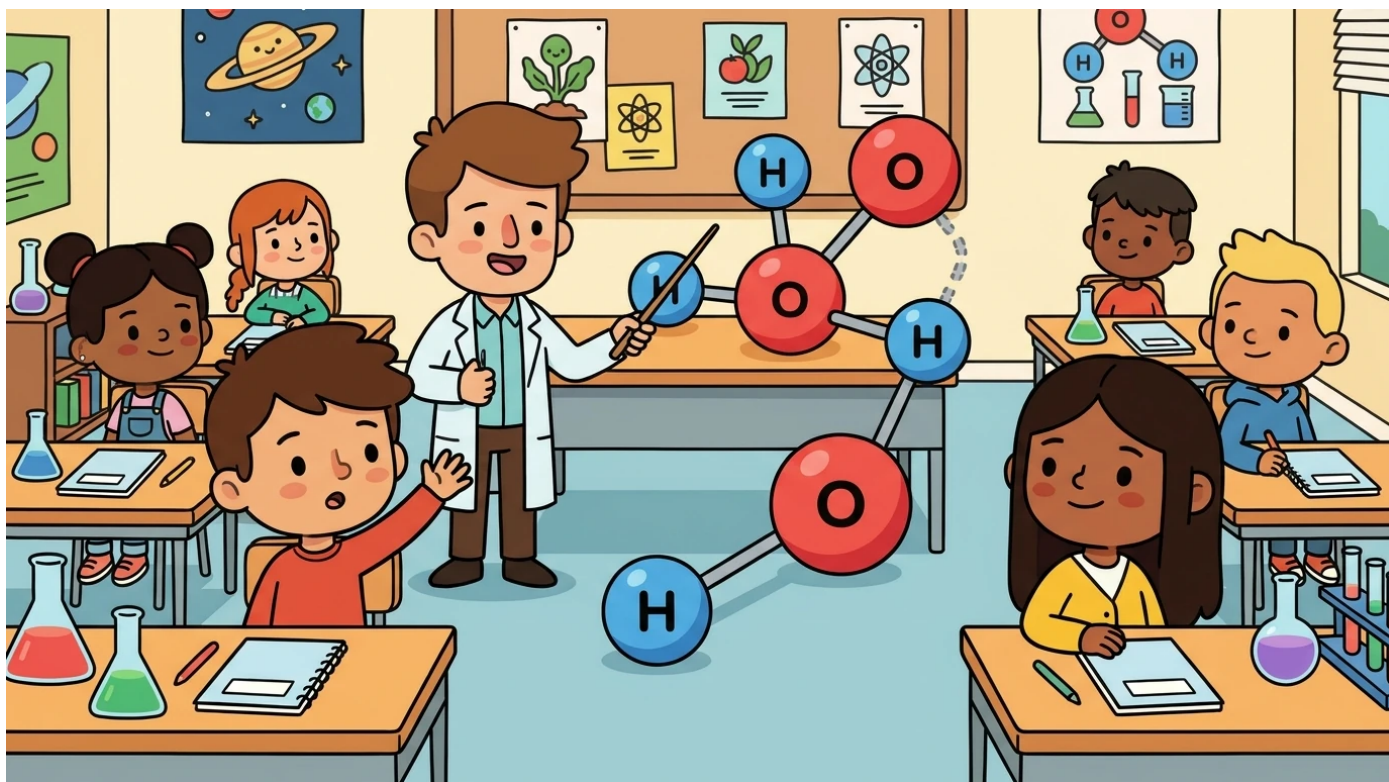
Whisperer leaned in, peering at Streamer's busy experiment. It seemed so noisy and complicated compared to their simple, quiet task. "A bridge must be in balance to let things cross," Whisperer observed, their eyes on the whitish gel inside the tube. "If the inside isn't just right, nothing can move through. It becomes a wall, not a path."

Streamer crossed their arms. "Balance? It's a highway! It just needs to let things through."

"Sometimes," Whisperer said, their voice calm and steady, "for things to flow quickly over here," they gently tapped the wire, "the quiet parts, over there," they pointed to the salt bridge, "must be held in perfect, peaceful balance."

Whisperer

*HYDROGEN BOND — *subtle, persistent; water's superpower; DNA pairing*. Weaker than covalent bonds individually but collectively load-bearing for water's properties + DNA's structure + protein folding.*



"Meet Whisperer," Beaker said. He pointed to a space between two plastic balls.

There was no face there. There were no cute little eyes or fuzzy ears. Whisperer is not an animal. Whisperer is not even a person. Instead, Whisperer is just a tiny dashed line. It connects two atoms at a slight bend.

"Why is it dashed?" asked Leo from the front row.

"To show it is different," Beaker explained. "Covalent bonds are solid lines. They are super strong. But Whisperer is a **hydrogen bond**."

A **hydrogen bond** is a special kind of attraction. It is not a regular bond. It is a weaker, friendly tug between atoms.

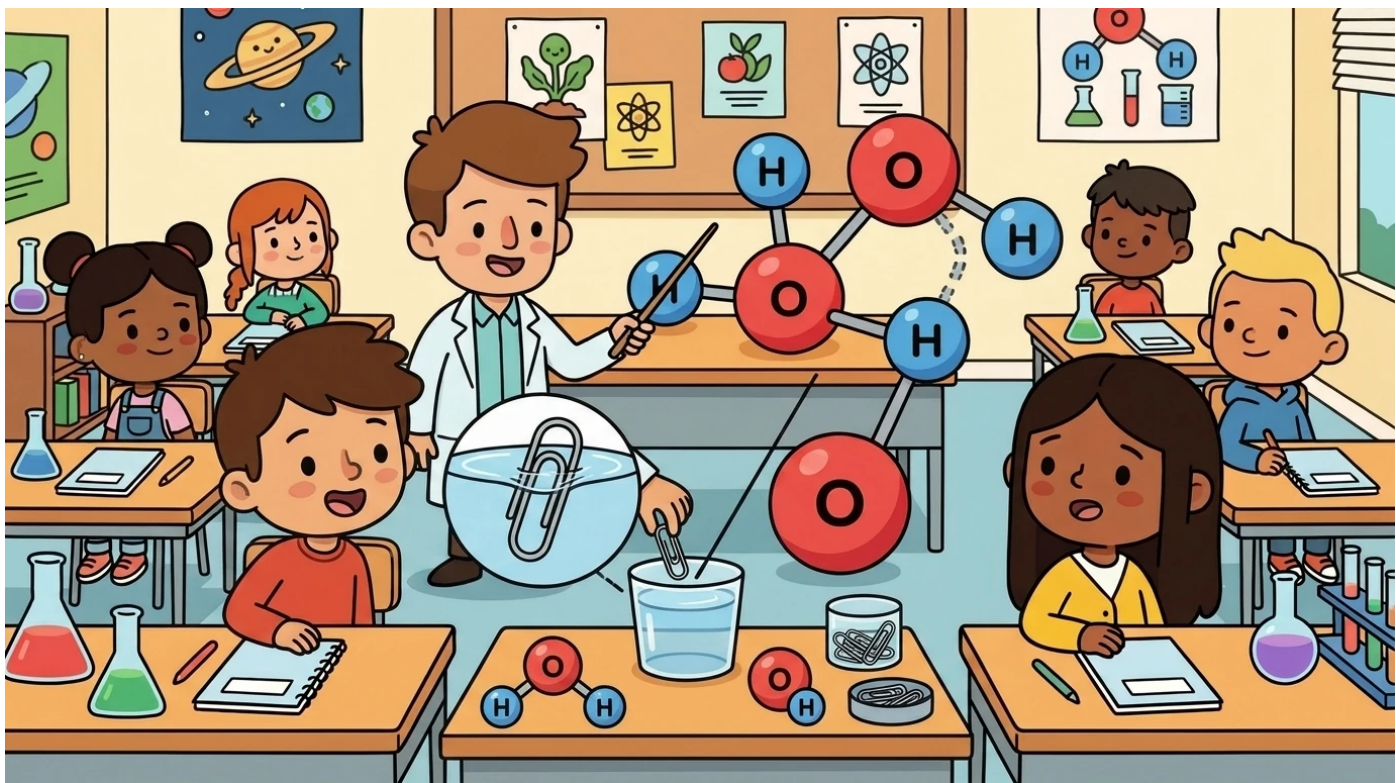
"It is not a tough, permanent bond," Beaker said. "It is a gentle pull. It happens when a hydrogen atom gets greedy partners."

He pointed to a water molecule.

"Oxygen is very electronegative," Beaker said. "That means it loves to hog electrons. It pulls them away from hydrogen."

Because of this, the hydrogen atom gets a slightly positive charge. The oxygen atom gets a slightly negative charge. Opposites attract.

"So, they pull toward each other," Beaker said. "That gentle pull is the **hydrogen bond**. It is like a quiet whisper between neighbors."



On its own, one **hydrogen bond** is very weak. It has only a fraction of the strength of a normal bond. It is easy to break.

"But together?" Beaker grinned. "Together, they are incredibly strong."

He picked up a cup of water.

"Without these weak bonds, water would boil instantly," Beaker said. "It would turn to gas at room temperature. There would be no oceans. There would be no life on Earth."

The tiny bonds hold the liquid water together. They give water its high boiling point. They let ice float on top of ponds. They even create surface tension. That is the invisible skin that lets bugs walk on water.

Beaker pulled out a small glass of water and a metal paperclip.

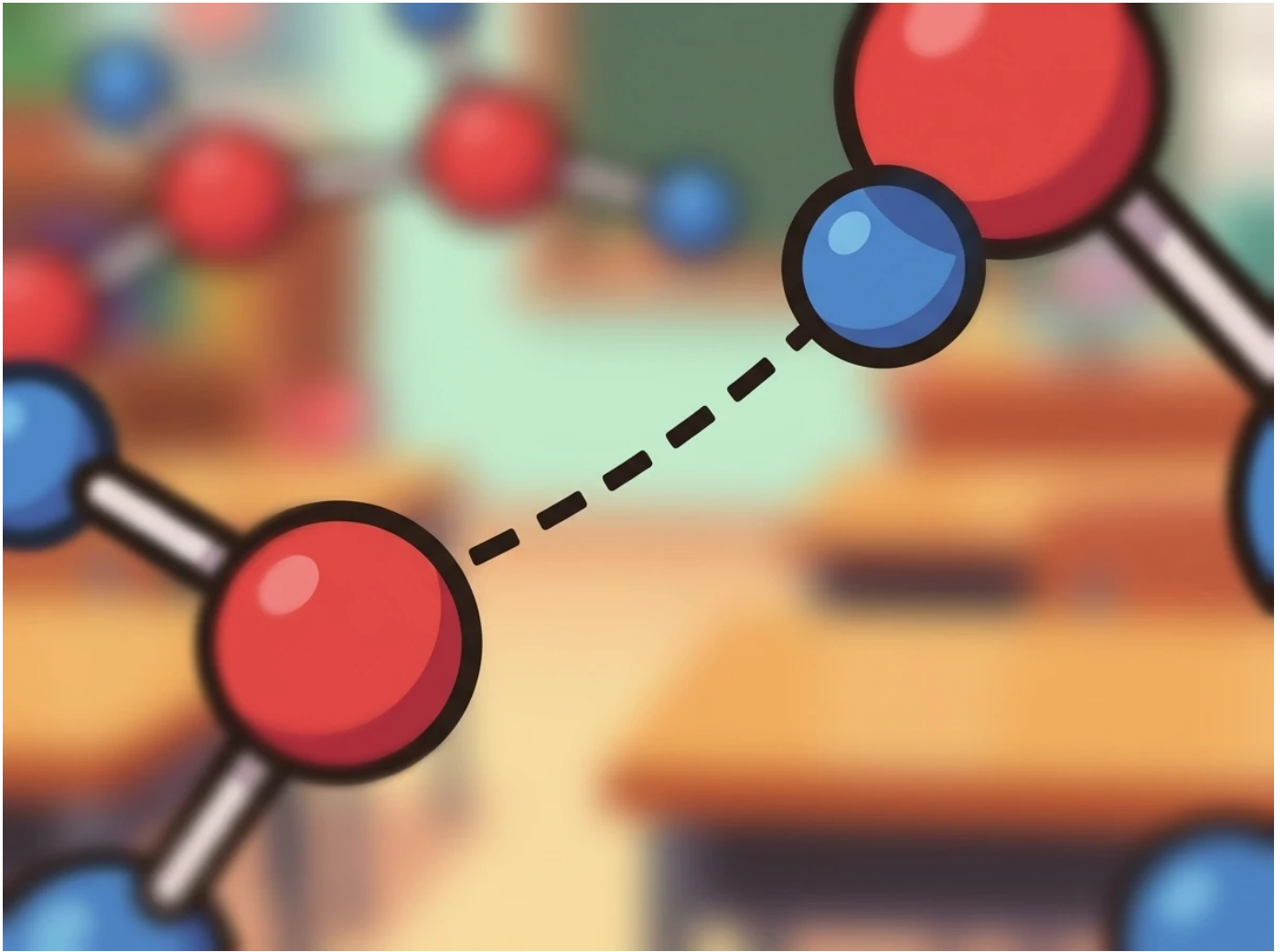
"Watch this," Beaker whispered.

He carefully laid the paperclip on top of the water. It did not sink. It floated right on the surface.

"How is that possible?" asked Leo, leaning forward. "Metal is heavy!"

"Whisperer is holding it up," Beaker said. "The water molecules are holding hands. They form a tight net on top. That is surface tension."

He tapped the water with his finger. The paperclip sank to the bottom with a tiny clink.



"Once you break the bonds, the net tears," Beaker explained. "They break easily. But they also find new partners in a split second."

"So they are like dancers?" Leo asked.

"Exactly," Beaker said. "They dance and swap partners constantly. That is why water flows so well."

Beaker pulled out a giant model of DNA. It looked like a twisted ladder.

"Look at the rungs of the ladder," Beaker said.

He pointed to the chemical bases.

"This is DNA," Beaker said. "The double helix — the twisted ladder shape that holds all your genetic instructions."

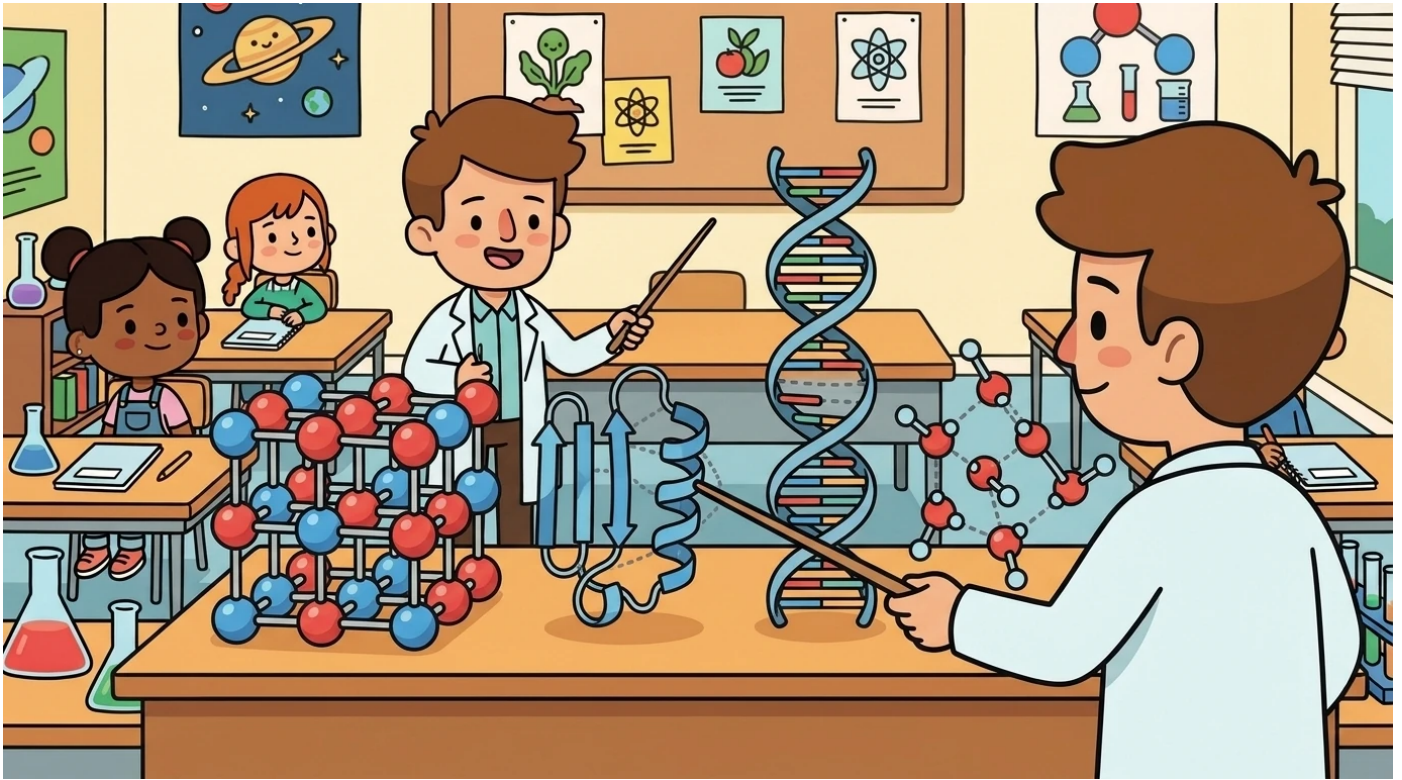
The two sides of the ladder are held together by **hydrogen bonds**.

"Adenine and Thymine pair up with two bonds," Beaker explained. "Guanine and Cytosine pair up with three."

These bonds are strong enough to hold the ladder together. But they are also weak enough to unzip.

"Imagine a zipper on your favorite jacket," Beaker said. "If the zipper was glued shut, you could never open it. If it was too loose, your jacket would fall off."

The kids laughed.



"DNA is the same way," Beaker said. "It needs to stay closed to protect your genes. But it must open when your cells want to read the recipes inside. Whisperer makes sure the zipper works perfectly."

Beaker reached for a messy, folded plastic ribbon.

"Proteins do all the hard work in your body," he said. "But they have to fold into perfect shapes first."

He showed how the ribbon curled into spirals and folded into sheets.

"These are alpha-helices and beta-sheets," Beaker said. "They are just fancy names for spirals and folds."

"What keeps them in shape? Whisperer does."

Without these tiny dashed lines, the proteins would unroll. They would stop working completely.

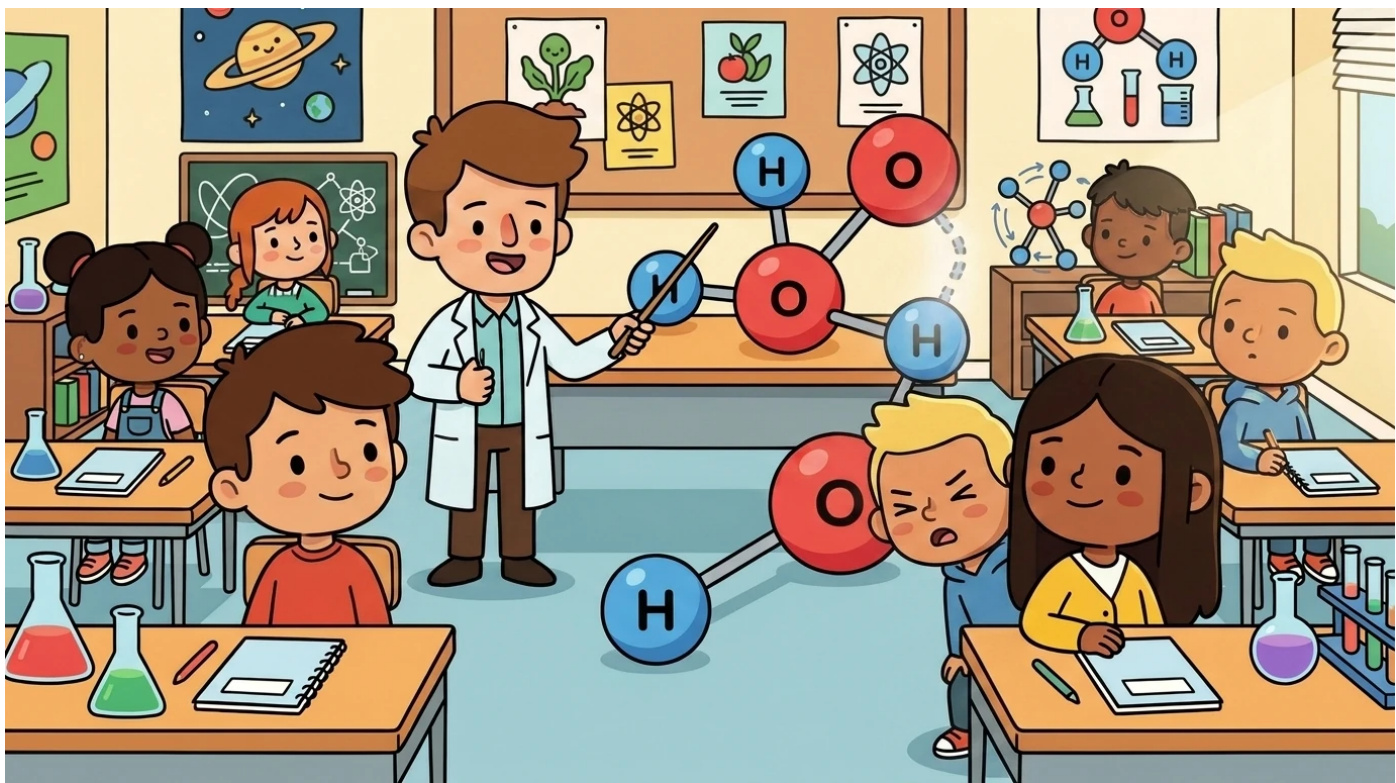
Beaker lined up four different models on his desk.

"Let us look at our four bond friends," Beaker said.

He pointed to the first model.

"Tugger transfers electrons fully to make ionic bonds," he said.

He pointed to the second model.



"Sharer shares electron pairs to make covalent bonds," he said.

He pointed to the third model.

"Streamer lets electrons flow in a big metallic sea," he said.

Finally, he pointed to the dashed line.

"And Whisperer is the gentle pull between them all," he said. "A **hydrogen bond** is a subtle force. It is weak alone, but strong together."

Beaker wrote a list on the chalkboard. He wanted the class to remember Whisperer's main lessons:

- A **hydrogen bond** is a gentle pull between a positive hydrogen and a negative atom.
- These bonds are much weaker than covalent bonds.
- Many small bonds can make a huge difference.
- Water gets its special powers from these bonds. It boils slowly, and ice floats.
- DNA uses these bonds to stay together and unzip easily.
- Proteins need these bonds to fold into the right shapes.
- These bonds break and make new partners constantly. They never stay still.
- Now, all four bond types are complete.

"Why doesn't Whisperer have a face?" Leo asked.

Beaker smiled.

"Because Whisperer is a force, not a creature," Beaker said. "It is a quiet, steady pull. It is always there, holding our world together."

The student looked closely at the model. The tiny dashed line seemed to catch the light.

Leo smiled, feeling a quiet warmth settle over him — a calm, glad feeling that something so small and gentle could be strong enough, all together, to hold up the whole world. Nearby, another water molecule drifted close, ready to join the dance.

About Spark & Anvil

Spark & Anvil is a 501(c)(3) public charity. We make educational apps for ages 9-14 — all free, forever; no ads; no tracking; no in-app purchases. ChemQuest is one of 140+ apps in the portfolio.

More chapter books from Spark & Anvil

Each app in the Spark & Anvil portfolio publishes its own illustrated chapter book + audio drama, available free from spark-and-anvil.com/books. Highlights include:

- **GambitTales** — chess tactics through Sir Pinwell, Lady Skewer, Queen Vesper, and the Twin Knights of Fork Hill
- **ProofQuest** — formal proof techniques through Direct-Proof Dora and the Lemma Library
- **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).

License

© 2026 Spark & Anvil (501(c)(3) public charity). Chapter text and illustrations licensed under CC BY-NC-SA 4.0. App software © Spark & Anvil — all rights reserved. Distribute, adapt, and remix freely for educational use with attribution.

Cover art, chapter illustrations, and chapter text are reviewed for age-appropriate, trauma-aware content before publication. Audio drama transcripts available at spark-and-anvil.com/cast.