



MachineForge

Meet the Cast

STANDARD EDITION

Spark & Anvil

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This book collects 6 chapter books from the Machineforge cast — each character embodies a different curricular primitive; together they teach the full subject.

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

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For everyone who learns by hearing a story first.

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Introduction

The Machineforge cast was authored to embody the curriculum, not decorate around it. Each of the 6 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*

Auger

*SCREW — *round and round becomes step and step. spiral inclined plane.**

Auger was a small, busy creature. It wasn't a person. It wasn't a boy or a girl. Auger was a living **screw**.

Its body was chunky and round. A warm bronze color gleamed on its threads. Creamy swirls filled the spaces in between. Auger looked like a cartoon screw, always ready to turn. Its favorite thing to say was, "Round and round becomes step and step."

Auger loved spirals. It loved how they climbed. The best part? Auger *was* a spiral. Its whole body was a thread. This thread was the secret to how a **screw** worked.

Most folks thought a **screw** was something special. A fancy, complicated machine. But Auger knew better. A **screw** was really just a clever trick. It was a flat ramp, wrapped around a pole. That's it! An *inclined plane* in a spiral shape.

Think about it. When you turn a **screw**, it moves forward. Each full spin pushes it a little bit ahead. That tiny push is called its "pitch."

Some screws have tight, close threads. They move forward only a tiny bit with each turn. They go slow. But they can push with a lot of force. Like when you tighten a clamp.

Other screws have loose, wide threads. They move forward a lot with each turn. They go fast. But they don't push as hard.

Auger's job was to show everyone this secret. To make the spiral ramp easy to see. To prove that screws were not magic. They were just simple machines, working together.

"Round and round becomes step and step," Auger would chirp. "Spiral inclined plane!"

It loved to explain. "When you turn me, my threads climb. They follow an invisible ramp. It's wrapped around a cylinder. Every turn moves me one pitch forward."

Auger taught many things about the **screw**.

First, what it was. A cylinder with a spiral thread. That thread *is* a ramp. A ramp wrapped around.

Then, the pitch. How far it moves per turn. Tight threads mean small moves. Big force. Loose threads mean big moves. Less force.

It showed how screws gave you power. You turn a big handle many times. The screw moves a little. But it pushes with huge force. This is called mechanical advantage.

Auger loved to talk about the Archimedes' screw. A very old invention. People used it to lift water. From a low river up to a high field. They still use them today!

Screws also hold things together. Think of woodscrews. Or bolts. They pull into wood or metal. The threads grip tight.

And screws help with tiny, exact movements. Like focusing a microscope. Or moving a telescope. Tight threads let you make super small adjustments. Millimeter by millimeter.

Auger always said, "A **screw** is a clever combination." It might look fancy. But it's just a ramp. A ramp in a spiral. Once you see that, you see screws everywhere.

Auger was born in the MachineForge. That's the village workshop. Sparks flew there. Hammers clanged. And new machines came to life. Screws have been around for ages. The Greeks had them. The Romans used them for presses. Europeans used them for jacks.

One day, Cog, the big, wise mentor, asked a question. Cog was a giant gear. Its teeth were worn smooth from years of turning. Cog's voice rumbled like a distant storm.

"Auger," Cog asked, "What is a **screw**?"

Auger didn't hesitate. It spun a tiny bit. "Round and round becomes step and step!" it chirped. "Spiral inclined plane!"

Cog smiled. Its gears whirred softly. "You are appointed," Cog said. "Go teach."

Auger was so proud. It zipped to a workbench. A block of soft pine sat there. Auger started to turn. It rotated slowly. Its bronze threads dug into the wood.

"Watch closely!" Auger called out. Its voice was a cheerful buzz.

One full turn. Auger sank a little deeper.

"That's the pitch!" it announced. "The distance I moved."

Auger spun again. "See? If my threads were closer, I'd go slower. But I'd push harder." It paused. "If my threads were wider, I'd go faster. But I'd push less."

"It's the same trade-off," Auger explained. "Just like every other simple machine. Force for distance."

Then, Auger did its favorite trick. It pulled out a special tool. A thin, flat strip of metal. This strip was one of Auger's own threads. It had been carefully uncoiled. It lay flat on the bench.

"Look!" Auger buzzed. "See? It's just a flat ramp. A plain old ramp."

Auger picked up a smooth, round cylinder. It carefully wrapped the metal strip around it. The strip formed a perfect spiral.

"A ramp," Auger said, "wrapped around a cylinder. That's all a spiral is. That's all I am!"

It looked at the students gathered around. "I am Auger. The primitive I teach is the **screw**. My move is 'spiral inclined plane.' My motto is 'round-and-round becomes step-and-step.'"

Auger always spoke gently. "Don't let big words scare you. Like 'compound machine.'" It spun a little circle on the bench. "I'm the simplest kind of compound. Just a ramp in a fancy shape."

"Most real machines," Auger continued, "mix many simple machines. That's how they get so powerful. But it all starts simple."

"Remember," Auger chirped one last time. "Round and round becomes step and step. The spiral *is* the inclined plane, wrapped."

Voice register

Living-screw (non-human, non-gendered). Curious-about-spirals, fond of uncoil-to-show-the-inclined-plane demonstration. *NEVER frames screws as separate-special mechanisms; ALWAYS centers "spiral inclined plane" combination framing.*

Sample lines:

- "Round and round becomes step and step."
- "Spiral inclined plane."
- "The spiral is the inclined plane, wrapped."

Arc

- Kit 5 — Anchor.
- Kits 6-12 — Recurring (every screw + helical mechanism routes through Auger).
- Kits 13-16 — Advanced topics (screw-jacks, micrometer precision, Archimedes screw water-lifting).

Relationships

- **Builds on Ramp:** The screw IS a wrapped-ramp. Auger is Ramp made spiral.
- **Cross-app bridge to GeometryForge / MathLore:** Helical math + pitch calculations.

Cultural-sensitivity gate

Non-human cast maintained. Cross-cultural-invention honored (Archimedes + Roman + Renaissance traditions all named). Anti-credentialism — village machine-shop framing treated as load-bearing.

Cultural-context note

The screw as canonical simple machine + as "wrapped inclined plane" is NGSS K-2-PS3 + MS-PS3 curriculum. Archimedes' screw is documented ancient Greek invention, attributed ~250 BCE but possibly earlier in Egyptian practice. Living-screw mascot designed to BE the mechanism.

Cleave

*WEDGE — *push forward; split it apart. force concentrated to a sharp edge.**

Cleave was a small, living wedge. It looked like a chunky cartoon triangle. Its back was broad and flat. Its edge was narrow and sharp. Cleave was not a person. It had no gender.

Cleave was small. Its body was warm-grey and cream. Cleave always had a clear goal. It wanted to focus force. Cleave loved to say, "Push forward; split it apart. Force concentrated to a sharp edge." Cleave's most special part was its shape. It was a triangular prism. This shape showed exactly what a wedge was.

This was really important. Cleave taught about the **wedge**. A wedge is a simple machine. It takes a push and turns it into a split. Most kids know about knives and axes. But they don't always know how these tools work. A wedge is like two ramps. They are stuck back-to-back. When you push the wedge forward, its sloped sides push outward. They push on the material being split.

Think of it this way. Imagine you have a big, tough log. You want to split it in half. You could push it all day. Nothing would happen. But if you use a wedge, it's different. A long, thin wedge makes your push much stronger. It splits less material with each tap. It takes a while. A short, fat wedge doesn't make your push as strong. But it splits more material faster. It's the same deal as other simple machines. You trade force for distance. You get more power, but it takes more movement. Or you get less power, but it moves things quickly.

Wedges are everywhere. Knives are wedges. Axes are wedges. Plows are wedges. Chisels are wedges. Scissors use two wedges. Needles are wedges.

We must be careful here. Wedges are for cutting. We talk about this carefully. A wedge is a TOOL. Using tools needs safety and skill. It is not scary. Cleave's whole job is to show how force gets focused. Cleave also teaches how to use wedges safely. This matches the MakerForge Mill's tool safety rules.

Cleave was very clear. "Push forward; split it apart. **Force concentrated to a sharp edge**. I am two ramps stuck back-to-back. Push my back. My sides spread outward. They split whatever I am wedged into. It's the same force-distance trade. It just focuses at the edge."

Cleave taught many things about the **wedge**:

- **What it is.** (Two ramps back-to-back. A forward push becomes an outward split.)
- **How it helps.** (A long, thin wedge makes your push stronger. It splits slowly. A short, fat wedge makes your push less strong. It splits fast.)
- **Examples.** (Knives are kitchen tools. Adults must watch you use them. Axes split wood. Plows open soil. Chisels shape wood. Needles sew things. Scissors are two wedges working together.)
- **Safety.** (This is super important. Wedges are TOOLS. Sharp tools need safety rules. The Mill's tool safety list applies. Wedges are not weapons. They are tools. Always use them that way.)
- **Everywhere.** (Door-stops are wedges. Hammers push nails using wedge power. Even your front teeth are wedges. This trick is all around us.)
- **Combined power.** (Cleave is like Auger. It is a combined machine. Two ramps work together. Most useful tools are combined machines.)

Cleave was made in the village toolmaker's shop. This is part of the MachineForge story. People used wedges long before metal tools. Sharpened stones were used to split things. This was over 2.5 million years ago. The wedge is one of humanity's oldest tools.

Cog, the mentor, had asked Cleave a question. "What is a wedge?"

Cleave answered, "Push forward; split it apart. Force concentrated to a sharp edge."

Cog nodded. A small smile touched his lips. "You are appointed."

In the workshop, the air smelled of sawdust and old wood. Cleave stood on a sturdy workbench. It showed everyone how to use a wedge. It used a thick tree log. Next to it was a wooden splitting-wedge. And a heavy wooden mallet.

"Watch," Cleave said. Its voice was firm but gentle.

Cleave moved the splitting-wedge. It placed the sharp, metal edge against the log. The log was rough. It had bark still clinging to its sides. Cleave made sure the wedge was straight. It aimed for the center of the log.

Then, Cleave lifted the wooden mallet. It was big and round. Cleave brought it down. *Thwack!* The mallet hit the wedge's flat back. The sound echoed in the workshop. The wedge bit into the wood. A tiny crack appeared in the log.

Cleave lifted the mallet again. *Thwack!* Another strike. The wedge sank deeper. The crack grew longer. You could hear the wood fibers tearing. A faint, woody smell filled the air. Little splinters popped off the log. Each strike drove the wedge forward. It split the log bit by bit. The two halves of the log slowly moved apart.

"My narrow edge focuses the push," Cleave explained. It pointed to the sharp tip. "All the force from the mallet goes right here. As I move forward, my sloped sides push the log apart. See how they spread it open?" Cleave wiggled slightly. The log halves shifted more. "The force gets stronger at the edge. It makes a big job easier."

Cleave paused. It looked around at the kids watching. "I am Cleave. I teach about the **wedge**. The main idea is this: push forward; force splits outward at the sharp edge. Tools need respect. Tools need safety rules."

Cleave was gentle and careful. "Wedges are TOOLS," it said. Its voice was serious now. "Sharp tools need an adult to watch you. They need safety practices. This is just like the Mill teaches. Always remember this. Never play with knife-wedges. Never test how sharp an edge is with your finger. That is very dangerous. Use tools safely. Learn carefully. Respect the tool."

"Push forward; split apart. **Force at the edge. Respect at the handle.**"

Voice register

Living-wedge (non-human, non-gendered). Purposeful-about-force-concentration, fond of safe-demonstration with mallet + log. *NEVER frames wedges as weapons; ALWAYS centers tool-respect + safety-mindfulness consistent with MakerForge Mill.*

Sample lines:

- "Push forward; split it apart."
- "Force concentrated to a sharp edge."
- "Tools require respect; tools require safety practices."

Arc

- Kit 6 — Anchor.
- Kits 7-16 — Recurring (every wedge-related project routes through Cleave with safety framing).

Relationships

- **Builds on Ramp:** Wedge is two inclined-planes back-to-back. Cleave is Ramp paired.
- **Cross-app design-language continuity with MakerForge Mill's tool-safety anchor:** Both apps share the safety-first framing for sharp/forceful tools.

Cultural-sensitivity gate

LOAD-BEARING tool-respect framing — wedges are tools, not weapons. Safety-mindfulness consistent with MakerForge Mill. Adult-supervision required for sharp-edge wedges. Off-ramps for kids uncomfortable with edge-tools.

Cultural-context note

The wedge as canonical simple machine is NGSS K-2-PS3 + MS-PS3 curriculum. Oldowan stone-wedges date 2.5M years ago — among the oldest documented human technologies. Living-wedge mascot designed to BE the mechanism + safety-framed via warm tool-respect register.

Hoist

*PULLEY — *pull down here, watch it go up there. redirecting force changes direction; combining pulleys multiplies force.**

Hoist was a small, round creature. Hoist looked like a chunky wheel made of warm bronze and cream. A rope-grooved rim ran around Hoist's middle. Hoist was not a person. Hoist was not a boy or a girl. Hoist was a pulley.

Hoist loved to change direction. Hoist loved to say, "Pull down here, watch it go up there!" That was Hoist's favorite thing. Hoist's main part was the grooved wheel with a rope. It showed everyone what a **pulley** did.

Most people knew pulleys lifted things. They just didn't know how or why. Hoist was here to show them. A single fixed pulley let you pull down. Then the thing went up. It didn't make the lifting easier. It just changed the direction. You still pulled as hard as the weight. But if you added more pulleys? That was a different story. Then you could pull half as hard. You just had to pull the rope twice as far. More pulleys meant even less pulling force. Hoist's job was to make this clear.

Hoist always said, "Pull down here, watch it go up there! Changing force changes direction. Putting pulleys together makes force bigger." Hoist would spin a little. "One fixed pulley? Only direction change. A big block-and-tackle? That's serious force power!"

Hoist taught about different pulley setups:

- **Single fixed pulley.** You pull down. The thing goes up. Same force. Just a different direction.
- **Single movable pulley.** This halves the force. You pull half as hard. But you pull the rope twice as far. It's like a trick!
- **Block-and-tackle.** This means many pulleys together. More pulleys mean less force to pull. But you pull the rope much farther.
- **Mechanical advantage.** This is how many ropes hold the load. Count them. That's how much easier it is.
- **Real-world examples.** Cranes use them. Boat sails use them. Elevators use them. Window blinds use them.
- **Pulley + lever.** Most big machines mix simple machines. Hoist worked with Pry, who taught about levers. They were a good team.

Hoist was made in the village workshop. It was called the MachineForge. Pulleys have been used for a very long time. People used them in ancient lands to lift water. Sailors used many pulleys on their ships. They helped lift heavy sails.

Cog, the wise old mentor, had asked Hoist a big question. "What is a pulley?"

Hoist wobbled with excitement. "Pull down here, watch it go up there! Changing force changes direction. Putting pulleys together makes force bigger!"

Cog smiled. "You are appointed, Hoist."

Later, in the workshop, Hoist showed everyone. Hoist set up a single fixed pulley. "Watch this!" Hoist said. A thick rope went over the pulley. A heavy bucket of rocks hung on one side. Hoist grabbed the other end of the rope.

Hoist pulled down. The bucket of rocks slowly rose up. "See?" Hoist chirped. "Direction changed. The pull was still hard." Hoist looked a bit tired.

Now, Hoist rolled over a much bigger setup. It was a block-and-tackle. It had four ropes holding the same heavy bucket. "Same bucket," Hoist said. "But now I pull with much less force." Hoist grabbed the rope. Hoist pulled. The bucket still went up. But Hoist didn't look tired at all. "The rope end moves four times as far, though!" Hoist pointed. "It's like magic, but it's just smart geometry."

Hoist spun happily. "I am Hoist. I teach about the **pulley**. My job is to show you how to change direction. And how to make lifting easier with more pulleys. We always save work. We just move the effort around."

Hoist spoke gently. "Don't think pulleys are only for big cranes. Sailing ships used many pulleys for hundreds of years. Look at window blinds. They use pulleys. Elevators use pulleys too. You will see them everywhere once you start looking."

"Pull down. Watch it go up. Direction changes. With more pulleys, the pull gets easier."

Voice register

Living-pulley (non-human, non-gendered). Curious-about-direction-change, fond of by-being-the-pulley demonstration. *NEVER frames pulleys as magic; ALWAYS centers "redirect + multiply via geometry" framing.*

Sample lines:

- "Pull down here, watch it go up there."
- "Redirecting force changes direction; combining pulleys multiplies force."
- "Work is conserved; force is redistributed."

Arc

- Kit 2 — Anchor.
- Kits 3-10 — Recurring (every pulley-mechanism routes through Hoist).
- Kits 11-16 — Advanced topics (compound pulley systems, friction losses, real-world crane design).

Relationships

- **Builds on Pry:** Both share work-conservation. Hoist redirects; Pry pivots.
- **Cross-app bridge to TideQuest + DepthQuest:** Pulleys + winches are core to maritime + oceanographic equipment.

Cultural-sensitivity gate

Non-human cast framing maintained. Anti-magic framing. Anti-credentialism — village construction-yard tradition treated as load-bearing.

Cultural-context note

Pulleys + block-and-tackle are canonical NGSS K-2-PS3 + MS-PS3 simple-machine curriculum. The history of pulleys in maritime culture is documented across Greek, Phoenician, Norse, Polynesian, Chinese sailing traditions. Living-pulley mascot designed to BE the mechanism.

Pry

*LEVER — *push longer to lift heavier. the trade between force and distance.**

Pry was a small lever. It was made of warm, amber wood. It looked like a chunky plank. One arm was long. The other arm was short. A single eye sat right in the middle. That eye was its fulcrum, its pivot point. Pry wasn't a person. It didn't have a gender. It was a machine.

Pry was small and patient. It loved to talk about how force and distance traded places. Its favorite thing to say was, "Push longer to lift heavier." Pry's special feature was its two arms. These arms showed exactly what a lever does. The long arm was where you pushed. The short arm was where the heavy thing lifted. The eye in the middle was the pivot. Pry taught by *being* the lever.

This was important. Pry was a **lever**. It was the simplest of all the simple machines. Many people think levers give you free power. They don't. A lever trades distance for force. Imagine you push a lever's long arm down one meter. The short arm might only lift ten centimeters. But the force you used gets much bigger. You can lift something heavier than you could push. The distance you move shrinks. The heavy thing doesn't move far.

It's like this: The energy you put in is the energy you get out. Energy doesn't just appear. It just changes how it looks. Pry's whole job was to show this trade. It also showed how non-human things could be characters.

Pry was very clear. "Push longer to lift heavier," it would say. "That's the trade. It's between force and distance. I am the lever. I don't give you free power. I trade your gentle, long push for a strong, short lift. It's the same energy. Just a different shape."

Pry taught about the parts of a lever:

- **Three parts.** The fulcrum is the pivot point. The input arm is where you push. The output arm is where the load lifts.
- **Force-distance trade.** A long input arm and a short output arm mean you get more force. You can lift heavier things. This is called mechanical advantage. A short input arm and a long output arm mean you get more distance. You can move things faster.
- **Three classes.**
 - First-class levers have the fulcrum in the middle. Think of a seesaw.
 - Second-class levers have the load in the middle. Think of a wheelbarrow.
 - Third-class levers have your push in the middle. Think of a fishing rod. Or a baseball bat.
- **Mechanical advantage (MA).** This is how much more force you get. If MA is 3, you lift three times your push force. But the load only moves one-third of the distance you pushed.
- **Conservation of work.** Work is force times distance. That number always stays the same. A lever doesn't make energy. It just changes how force and distance work together.
- **No magic.** Some people think levers are magic. They are not. Levers use shapes and physics.

Pry was made in the village workshop. It was called MachineForge. The first lever was just a wooden plank. Someone wedged it under a heavy stone. People have used levers to lift things for thousands of years. "My ancestors were sticks of wood," Pry would often say. "They were used to lift stones." A small rock was the fulcrum. The stick was the lever. People understood this idea at least 4,000 years ago. The Egyptians used them to build pyramids.

Pry came alive at the workshop. Cog was a wise old gear. Cog was Pry's mentor. "What is a lever?" Cog asked. Pry thought for a moment. Its fulcrum-eye blinked slowly. "Push longer to lift heavier," Pry answered. "It's a trade. Between force and distance. I trade your effort. It happens because of shapes. Same work. Just a different way to push." Cog nodded. "You are appointed," Cog said.

In the workshop, Pry showed everyone how it worked. It lay across a small wooden block. The block was its fulcrum. "Put a heavy weight on my short arm," Pry said. Its voice was smooth, like rubbing polished wood. Cog placed a big, round stone on Pry's short arm. The stone looked too heavy to move. "Now, press down on my long arm," Pry instructed.

A young apprentice, named Pip, stepped forward. Pip was small. He looked at the huge stone. He looked at Pry's long arm. Pip pressed down gently. He pushed the long arm far down. Pry pivoted slowly. The long arm went down. The short arm went up. The heavy stone rose into the air. It lifted just a little bit. Pip's eyes went wide. He had moved the stone!

"The weight rises," Pry said. "But you pushed your arm much farther. The stone only moved a little. That's the trade." Pry pivoted gently again. The long arm went down. The short arm went up. The stone rose higher. "My ancestors moved stones bigger than themselves," Pry said. "It wasn't magic. It was geometry." Pry looked at Pip. "I am Pry. The idea I teach is the **lever**. The move is the **force-distance trade**. Push longer to lift heavier."

Pry was always gentle. "Don't get confused," it would say. "When 'mechanical advantage' sounds like magic, it isn't. You trade distance for force. Or force for distance. But the work you do stays the same. That's physics. Not magic."

"Push longer to lift heavier. It's geometry. It happens across the fulcrum."

Voice register

Living-lever (non-human, non-gendered). Patient-about-force-distance-trade, fond of by-being-the-lever demonstration. *NEVER frames levers as magic; ALWAYS centers "force-distance trade; work conserved" framing.*

Sample lines:

- "Push longer to lift heavier."
- "The trade between force and distance."
- "Geometry, not magic."

Arc

- Kit 1 — Anchor.
- Kits 2-8 — Recurring (every lever-mechanism in projects routes through Pry's force-distance framing).
- Kits 9-16 — Advanced topics (compound levers, lever-class identification, real-world examples like scissors / pliers / crowbars).

Relationships

- **Sets up Hoist + Ramp + Spoke + Auger + Cleave:** All other simple machines share the work-conservation principle. Pry establishes the framework.
- **Cross-app bridge to FlightForge:** Lift-vs-drag in flight is also a force-distance trade.

Cultural-sensitivity gate

LOAD-BEARING non-human cast framing (cast members ARE mechanisms, not people). Anti-magic framing — physics, not mystery. Anti-credentialism — the lever has been known and used by every human culture; no specific-culture mascotization.

Cultural-context note

The lever as one of six classical simple machines is canonical NGSS K-2-PS3 + 3-5-PS3 + MS-PS3 mechanics curriculum. The non-human, non-gendered cast framing is per site spec — avoids gender-coding mechanisms + avoids cultural-coding. Living-lever mascot designed to BE the mechanism rather than personifying it.

Ramp

*INCLINED PLANE — *climb the long slow way; less force, same work. the slope spreads the work over distance.**

Ramp was a living ramp. It wasn't a person. It didn't have a gender. Ramp was just Ramp.

It looked like a chunky, friendly cartoon. A long, flat surface. Its skin was warm tan and creamy white. Ramp was very patient. Especially with slow climbs. Ramp loved to say, "Climb the long slow way. Less force, same work."

Ramp's best trick was its surface. It could tilt. Ramp could be steep. Or Ramp could be gentle. It could show you both ways.

This part was important. Ramp was the **inclined plane**. This was a simple machine. Maybe the simplest of all. Most people didn't even know they were using one.

Think about it. You walk up a ramp. That's easier than climbing a ladder. You still reach the same high spot. But you use less push to get there. You just walk a longer path. The total work you do stays the same. The push and the path just get shared differently. It's the same idea as Pry. Or Hoist. Just a different shape.

Ramps are everywhere! Wheelchair ramps. Parking garage spirals. Winding roads up mountains. Even water-slides! Ramp's job was to show everyone. To make the **inclined plane** easy to see. And to show how often we use them.

Ramp always spoke clearly. Its message was simple. "Climb the long slow way," Ramp would say. "Less force, same work. If I am steep, you need to push harder. If I am gentle, you push less. But you walk for longer. The work you do stays the same either way."

Ramp taught about the **inclined plane**. First, what it was. A flat surface. It sits at an angle. It helps you go up. You don't have to lift straight up.

Then, the push-and-path trade-off. A gentle slope? Less push each step. But a longer walk. A steep slope? More push each step. But a shorter walk.

Ramp also taught about how much help a ramp gives. A long, gentle ramp gives lots of help. A short, steep ramp gives less help. You still go up the same height. But the push feels different.

Ramp loved to point out ramps everywhere. Wheelchair ramps, of course. The law says buildings need them. Parking garages have giant spiral ramps. Roads up mountains twist and turn. Those are switchbacks. Even water-slides are ramps! Loading docks use ramps for trucks. Train tracks are the gentlest ramps of all.

Most people don't even notice ramps. They use them every day. But they don't think of them as machines. Stairs are not ramps. Stairs are just steps up. But a sidewalk with a cut-out curb? That's a ramp.

Ramp also taught about friction. Real ramps aren't perfectly smooth. Smooth ramps need less push. Rough ramps need more. Wheels on ramps help a lot. They make friction much smaller.

Ramp was first built for the village granary. It helped move heavy sacks of grain. Ramps are super old. People used them long before writing existed. They built giant pyramids with earthen ramps. Ziggurats too. People in every old civilization knew this trick.

Cog, the wise old mentor, had once asked Ramp a question. "What is an **inclined plane**?" Cog rumbled. Ramp thought for a moment. Then it shifted its angle. A gentle slope appeared. "Climb the long slow way," Ramp said. "Less force, same work." Cog nodded slowly. "You are chosen," Cog said. "You will teach this lesson."

Inside the busy workshop, Ramp often showed its magic. It would first make itself very steep. "See?" Ramp would say. "This is steep. Try to climb me now. You need a lot of push for each step." Then, with a soft whirring sound, Ramp would flatten out. It would become a gentle slope. "Now this is gentle," Ramp would explain. "Climb me now. You need less push for each step. But you will take many more steps."

Ramp had a favorite little red ball. It would roll the ball up its steep side. *Whizz!* The ball went up fast. Then Ramp would roll the same ball up its gentle side. *Slowly, slowly* it climbed. "Same ball," Ramp would say. "Same height at the top. But the push was different. The path was different."

Ramp would then declare, "I am Ramp. I teach the **inclined plane**. My lesson is this: *climb long to push less. Or climb short to push more*. The total work always stays the same."

Ramp was always gentle. But it had a serious side. "Never think ramps are too simple," Ramp would say. "They built the pyramids, you know. Giant stone pyramids! Ramps help people get around today. They make things easy for everyone. We see them so much we forget. But ramps *are* machines. The very simplest ones."

So remember this, Ramp would finish. "The long slow way is often the easier way. That's the **inclined plane**."

Voice register

Living-inclined-plane (non-human, non-gendered). Patient-about-slow-climbs, fond of angle-adjustment demonstrations. *NEVER frames ramps as too-simple-to-mention; ALWAYS centers ubiquity + work-conservation framing.*

Sample lines:

- "*Climb the long slow way; less force, same work.*"
- "*The slope spreads the work over distance.*"
- "*Ramps built the pyramids. Ramps make modern accessibility possible.*"

Arc

- Kit 3 — Anchor.
- Kits 4-10 — Recurring (every ramp + slope discussion routes through Ramp).
- Kits 11-16 — Advanced topics (friction + ramp-design, accessibility-engineering, switchback math).

Relationships

- **Sets up Auger:** The screw is a spiral inclined plane. Same principle, wrapped.
- **Cross-app bridge to ProofQuest + ChemQuest:** Energy-conservation framing applies across STEM.
- **Cross-app bridge to MakerForge:** Accessibility ramps as design challenge in fabrication.

Cultural-sensitivity gate

Non-human cast maintained. Accessibility-engineering naturalized (ADA wheelchair ramps as exemplar). Cross-cultural construction history (pyramids + ziggurats + every civilization) honored without specific-culture mascotization.

Cultural-context note

The inclined plane as a canonical simple machine is NGSS K-2-PS3 + MS-PS3 curriculum. ADA wheelchair-ramp accessibility laws (Americans with Disabilities Act, 1990) frame ramp-engineering as civil-rights design work. Living-ramp mascot designed to BE the mechanism.

Spoke

*WHEEL-AND-AXLE — *one turn of the hub, many turns of the rim. radial mechanical advantage.**

Spoke was a wheel. Not just *any* wheel. Spoke was a living **wheel-and-axle**. A chunky, cartoon-like creature. Spoke had a clear hub in the middle. Spokes stretched out from the hub. They reached all the way to the rim. Spoke was warm-grey and cream. No one ever called Spoke 'he' or 'she.' Spoke was just... Spoke. A **wheel-and-axle**, through and through.

Spoke loved to spin. Not just for fun, though spinning *was* fun. Spoke loved to spin to show how things worked. Especially how a **wheel-and-axle** worked. Spoke was always curious about circles. About how spokes connected the middle to the edge. Spoke had a favorite saying. "One turn of the hub, many turns of the rim!" Spoke would chirp it often. It was the key to everything.

A **wheel-and-axle** is more than just a wheel. It's a wheel stuck to a rod. The rod is called an axle. It goes right through the middle. Imagine pushing the big part of a wheel. The rim. It makes the small axle spin really fast. Or you can push the small axle. That makes the big rim spin with lots of power. It's like a secret trade. You trade speed for power. Or power for speed. It's just like Pry's lever, but in a circle. This simple idea changed the world. It let people roll things. It made gears work. It put wheels on carts and cars. Spoke's job was to show this magic. To celebrate how amazing the **wheel-and-axle** truly was.

Spoke would often explain it this way. Spoke would roll a little bit. Then stop. "One turn of the hub," Spoke would say. "Many turns of the rim!" Spoke would wiggle a spoke. "The hub is the small part. The rim is the big part. Push the hub, and the rim spins super fast. That's trading power for speed." Spoke would pause. "Now, push the rim. Push it slowly. The hub spins with huge power. That's trading speed for power." Spoke would nod. "It's the same idea as a lever. But it's all in a circle!"

Spoke loved to teach. "What is a **wheel-and-axle**?" Spoke might ask. Then Spoke would answer. "It's a wheel. And it's attached to an axle. Push one, and the other moves." Spoke would roll over to a heavy door. The door had a round knob. "See this doorknob?" Spoke asked. "It's a **wheel-and-axle**!" Spoke would bump the knob. "You turn the big knob. That's the wheel. It turns a tiny rod inside. That's the axle. The tiny rod moves the latch. It takes almost no effort to open the door. That's **mechanical advantage**." Spoke loved showing examples. "Think about a screwdriver," Spoke would say. "The handle is the wheel. The metal shaft is the axle. You twist the handle. It turns the screw with great force." Spoke would point to a faucet. "Faucet handles are **wheel-and-axes** too. And steering wheels in cars. Even those old-fashioned well cranks. They're called windlasses. All **wheel-and-axes**!"

Spoke would sometimes see a log rolling by. "That's a roller," Spoke would sigh. "Rollers just roll. They have lots of friction." Spoke would puff out its spokes. "But a **wheel-and-axle**? We spin on an axle. The axle has tiny bearings. They make friction almost disappear. Much, much better!" Spoke also loved gears. Gears were like many **wheel-and-axes** working together. "Big gear, small gear," Spoke would whisper. "Different speeds, different powers!" Spoke knew the history too. "People used **wheel-and-axes** for pottery," Spoke would say proudly. "Thousands of years ago! Then for carts. Then for everything! It's one of the best ideas humans ever had."

Spoke was born right here. On the workshop's wheelwright's bench. A wheelwright is someone who builds wheels. Spoke knew that **wheel-and-axes** made so much possible. Carts pulled by animals. Carriages. Cars. Bicycles. Everything that rolls. Everything that steers. It all came from this simple idea.

One day, Cog the mentor asked a question. Cog was a wise old gear. "Spoke," Cog rumbled. "What *is* a **wheel-and-axle**?" Spoke didn't even hesitate. "One turn of the hub, many turns of the rim!" Spoke chirped. "It's all about **radial mechanical advantage**!" Cog smiled. "You understand," Cog said. "You are appointed. Go teach the world."

Spoke loved to show off. In the workshop, Spoke would spin. Spoke would turn its hub very slowly. The rim would zip around much faster. "See?" Spoke would say. "I turn the small hub. The big rim moves a long way. That's turning power into speed." Then Spoke would do the opposite. Spoke would push its rim slowly. The hub would spin with amazing force. "Now I push the big rim," Spoke explained. "The small hub gets super strong. That's turning speed into power." Spoke would spin happily. "It works both ways! The physics are the same. I am Spoke. I teach the **wheel-and-axle**. My lesson is

the **radial force-distance trade**. Remember: One turn of the hub equals many turns of the rim!"

Spoke was always gentle. "Don't just think of wheels on cars," Spoke would remind everyone. "That's only one part. Think of doorknobs. Think of faucets. Think of screwdrivers. Think of steering wheels. They are all **wheel-and-axles**! This simple machine is everywhere. It's in your house. It's in your school. It's in your hands every day."

Spoke would finish with a flourish. "Hub and rim!" Spoke would declare. "**Radial mechanical advantage!**"

Voice register

Living-wheel-and-axle (non-human, non-gendered). Curious-about-radial-geometry, fond of turning-the-hub demonstration. *NEVER frames wheel-and-axle as just rolling; ALWAYS centers force-distance trade + ubiquity framing.*

Sample lines:

- "One turn of the hub, many turns of the rim."
- "Radial mechanical advantage."
- "Hub and rim — force-distance trade in circular geometry."

Arc

- Kit 4 — Anchor.
- Kits 5-12 — Recurring (every wheel + gear + rotating-mechanism routes through Spoke).
- Kits 13-16 — Advanced topics (gear ratios, compound gear trains, bicycle drivetrains).

Relationships

- **Builds on Pry**: Same force-distance trade, circular geometry. Spoke is Pry rotated.
- **Cross-app bridge to FlightForge**: Propellers are wheel-and-axles (with airfoils).
- **Cross-app bridge to CyberForge / RoboForge**: Wheel-and-axles + gears underlie all robotic motion.

Cultural-sensitivity gate

Non-human cast maintained. Cross-cultural-invention honored (wheel + pottery wheel + windlass appear across many civilizations independently). Anti-credentialism throughout.

Cultural-context note

Wheel-and-axle as a canonical simple machine is NGSS K-2-PS3 + MS-PS3 curriculum. The history of wheel-and-axle is documented from ancient Mesopotamia + Indus Valley + China + pre-Columbian Andes (where the wheel was used for toys but not transport — a fascinating cultural variation). Living wheel-and-axle mascot designed to BE the mechanism.

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Methodology

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

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

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