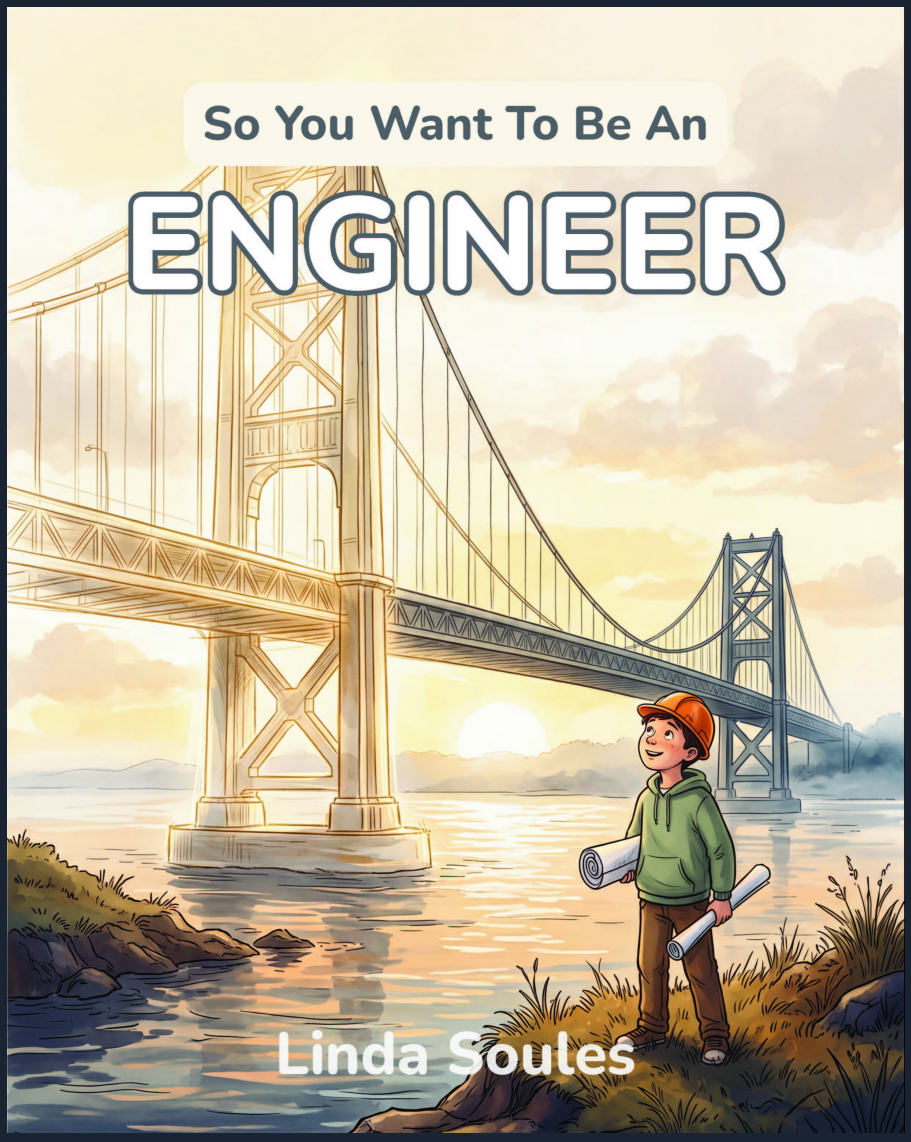
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So You Want To Be An Engineer

Linda Soules

BookGist Summary

So You Want To Be An Engineer

by Linda Soules

Genre: Children's Nonfiction

Key Takeaways

• Engineers turn scientific knowledge into practical solutions, from bridges and power grids to prosthetic hands, software, and clean-water systems.

• Engineering follows an iterative process: define a real problem, brainstorm, build a prototype, test it, learn from failure, and improve the design.

• A successful design must balance competing constraints such as safety, cost, strength, weight, time, and ease of use.

• Thinking about how things could fail is a central form of care: engineers test designs before problems can harm people in the real world.

• Engineering is collaborative work. Engineers rely on technicians, machinists, scientists, construction crews, project managers, and the people who will use their designs.

• Curiosity, persistence, precision, systems thinking, and responsibility for public safety matter as much as technical knowledge.

• Writing, presenting ideas, listening to users, and understanding human needs are essential engineering skills—not optional extras.

• Engineering careers are varied, and the field offers many ways to improve lives, from medical devices and safer transportation to energy, communications, and disaster protection.

• Young readers can begin exploring engineering now by taking apart broken objects with permission, building and testing simple designs, keeping a notebook, learning to code, and noticing everyday problems.

Who Should Read This Book

This book is ideal for curious readers, especially children and young teens who like taking things apart, building projects, solving puzzles, or wondering how everyday objects work. It is also useful for parents, teachers, librarians, and mentors looking for an inviting way to discuss engineering careers and connect classroom ideas to real life. Its accessible explanations, playful examples, hands-on challenges, and profiles of engineers from varied backgrounds make it suitable for shared reading as well as independent exploration. Readers will gain a practical picture of what engineers actually do: not just inventing, but collaborating, writing, testing, revising, weighing constraints, and taking responsibility for safety. Compared with books that focus mainly on famous inventions or technical explanations, this one emphasizes the whole experience of the work—including routine tasks, setbacks, user feedback, career preparation, and the human value of thoughtful design. It is especially encouraging for readers who may not yet see themselves represented in traditional images of engineers, or who assume they must be math geniuses before they can begin.

Chapter Summaries

What If You Were an Engineer? What an Engineer Actually Does

The book opens by showing that engineering is woven into ordinary life: chairs, lights, pipes, toilets, bridges, and countless other things exist because someone worked out how they should function, how strong they must be, and what they can cost. Engineers apply science and mathematics to real-world problems. Unlike scientists, who often investigate why nature works as it does, engineers focus on how that knowledge can be used to make something useful. Engineering typically proceeds through a cycle: define the problem and its users, generate ideas, select a promising approach, build a prototype, test it, and revise it. Each round is an iteration. The book emphasizes that failure during testing is valuable information: a crack or crash can reveal a weakness while the design is still inexpensive and safe to change. Engineers also work within constraints and trade-offs. A lighter car may use less fuel but offer less crash protection, for example, so designers must balance requirements rather than maximize just one feature.

Where Engineers Work and the Tools of the Trade

Engineers work in offices, laboratories, factories, hospitals, power plants, construction sites, and remote locations. Civil engineers may visit building sites; biomedical engineers may work with medical-device teams; software engineers can work almost anywhere with a computer. The book introduces fields including civil, mechanical, electrical, chemical, biomedical, aerospace, environmental, and software engineering, while showing that many projects need several specialties. A hospital, for instance, needs engineers to plan its structure, ventilation, electrical systems, and medical equipment. The tools range from a simple pencil and notebook to advanced simulation software and test equipment. Engineers use notebooks to record sketches, measurements, and results; CAD software to create detailed models; simulations to predict how designs respond to wind, heat, or weight; and 3D printers and machine shops to produce prototypes. Test labs deliberately push objects to their limits: they shake structures, stretch metal until it snaps, crash cars with dummies, and even fire dead chickens at airplane windshields. Such tests help engineers discover problems before the public encounters them.

Weird Tests, Best Parts, Hardest Parts, and Engineering Mishaps

The book makes engineering vivid through unusual tests: fake poop made from soybean paste is used to evaluate toilets, machines repeatedly drop heavy bottoms onto chair seats, and software developers sometimes explain their code to a rubber duck to help locate mistakes. These odd-sounding practices have practical purposes: they imitate real use, expose weaknesses, or help people think clearly. The same willingness to test and revise lies behind the job’s rewards. Engineers may see a bridge they designed carrying traffic, solve a problem after many failed attempts, move between industries, or work with a team that turns shared ideas into a useful product. The work also carries pressure. Engineers are responsible for designs that affect public safety, projects can be canceled or delayed, deadlines may mean long hours, and design reviews can involve pointed criticism. Historical failures show why caution matters: the Tacoma Narrows Bridge collapsed after twisting in the wind, prompting engineers to study wind effects and test later bridge designs. Mishaps can also lead to unexpected inventions or important corrections. Percy Spencer’s melted candy bar helped inspire the microwave oven, Bubble Wrap began as unsuccessful wallpaper, and London’s Millennium Bridge had to be modified after crowds made it sway. The lesson is to treat failures as evidence, own mistakes, and improve the design.

Surprises, Myths, and a Day in the Life

Engineering stories often reveal that asking the right question—and admitting a problem—can matter as much as having the right answer. A student’s question about diagonal winds helped prompt a closer look at New York’s Citicorp Center, while the building’s engineer independently discovered that wind forces and bolted joints created a serious risk. He alerted the owners, and crews reinforced the building before a storm could threaten it. The James Webb Space Telescope provides another example of rigorous preparation: engineers

identified hundreds of single-point failures and tested critical systems before its complex mirror unfolded in space. The ancient Pantheon illustrates a different kind of ingenuity, using lighter materials near the top of its concrete dome. The book challenges familiar stereotypes: engineers are not solitary geniuses, they do not need to be effortless math prodigies, and their work does not end when construction is complete. A day in the life of a biomedical engineer designing a prosthetic hand demonstrates the reality. The engineer revises a thumb joint in CAD, prints it, and drop-tests the prototype; a child user then reveals that the hand is too heavy and cannot manage shoelaces. That feedback changes the next round of work. The example shows that engineering combines technical testing with close attention to people's experiences.

The People You Work With, Records, Rituals, and a Challenge

Engineering is a team activity involving people with different kinds of expertise. Technicians and technologists build and test prototypes; machinists and welders turn drawings into physical parts; scientists explain material behavior; architects shape buildings; and project managers, inspectors, construction crews, electricians, and plumbers help bring projects to life. The people who use a design are equally important. A wheelchair user can quickly identify a ramp that is too steep, and a technician who has worked with a machine for decades may know why a proposed solution has already failed in practice. Listening across roles helps uncover problems a computer model cannot show. The book also shares the culture and history of engineering: the record-breaking span of Turkey's Çanakkale Bridge, the intentional flexibility of the Golden Gate Bridge, NASA's peanut ritual, and the evergreen tree placed on a building's final beam during a topping-out ceremony. Readers are invited to try the Marshmallow Challenge: build the tallest freestanding tower possible from spaghetti, tape, string, and a marshmallow in 18 minutes. The activity demonstrates the value of quickly building and testing rather than spending the whole time planning a design that has not yet been tried.

How Engineers Help People and the Qualities They Need

Much of engineering's contribution is nearly invisible. Civil and environmental engineers help deliver clean water; electrical engineers support the power grid; engineers design car brakes, seat belts, and incubators for premature babies. Safety is built into designs through factors of safety, which make structures or components stronger than the largest load they are expected to carry. Elisha Otis demonstrated the value of a safety brake in 1854 by cutting the rope supporting an elevator platform, which stopped after dropping only a few inches. Engineers also work on emerging challenges, including flooding, access to the internet, and devices that help people move, hear, or see. The book identifies five core qualities: curiosity about how things work, persistence through setbacks, precision with measurements and units, systems thinking, and responsibility for public safety. Systems thinking means recognizing how a change to one component can affect an entire design—for example, a lighter battery can alter

an electric car's weight, range, safety, and cost. Precision matters because a small measurement or unit error can compromise a part or an entire project. Above all, engineers must put the public's safety first, even when doing so means extra expense, delay, or an uncomfortable conversation.

Unexpected Skills and Famous Engineers

Technical ability is only part of the job. Engineers write reports, instructions, proposals, and test records so other people can understand, build, maintain, and assess their designs. They present ideas to colleagues, managers, clients, and the public, adjusting their explanations for each audience. They also need to understand people: a product that performs perfectly in a lab may still fail if it is confusing, uncomfortable, or difficult to use. Watching real users and listening to their feedback can reveal issues that calculations alone cannot uncover. Profiles of notable engineers show different routes into the field and different forms of impact. Emily Warren Roebling helped oversee the Brooklyn Bridge's construction when her husband became ill; Fazlur Rahman Khan's structural-tube approach helped make taller skyscrapers possible; and Mary Jackson overcame segregation to become NASA's first Black female engineer. Margaret Hamilton led software work for Apollo missions and helped ensure the landing computer prioritized essential tasks. Shuji Nakamura's persistence helped bring practical blue LEDs to the world, while William Kamkwamba built a windmill from salvaged materials as a teenager in Malawi. Their stories highlight ingenuity, perseverance, learning, and the importance of widening who gets to participate in engineering.

Fun Facts and What You Can Do to Prepare Right Now

Engineering appears in surprising details around the world. NASA's Mars Climate Orbiter was lost after teams used different measurement systems, a reminder to label units carefully. A massive steel ball helps steady Taipei 101 in strong winds, and Japan's bullet trains became quieter and more efficient after an engineer modeled their noses on a kingfisher's beak. Engineers stabilized the Leaning Tower of Pisa without making it perfectly straight, account for the Eiffel Tower's expansion in summer heat, and designed the SR-71 with panels that sealed as the aircraft warmed in flight. These examples show how observation, physics, and creative problem-solving shape familiar landmarks and technologies. Readers are encouraged to practice engineering in manageable ways: reverse-engineer an old, unplugged gadget with an adult's permission, build and test a craft-stick bridge or protective egg package, keep an engineering notebook, learn basic coding, help repair something at home, and notice everyday objects that could work better. The book advises students to stay with mathematics even when it feels difficult, since persistence matters more than instant mastery. Its guiding questions include: What problem am I really solving, who will use the solution, how could it fail, and what is the simplest design that will work safely?

Could This Be Your Job? Resources and Glossary

The book invites readers to consider engineering if they enjoy figuring out how things work, building with materials or code, solving practical puzzles, and noticing opportunities to improve everyday life. Being curious when something breaks, collaborating with others, and caring about making people's lives safer and easier are also signs that the field may suit them. It points out that engineering is one path among many related careers, including electrician, engineering technician, inventor, architect, roller-coaster designer, and toy designer. For readers ready to explore further, the book recommends activities and communities such as robotics teams, FIRST LEGO League, Future City, Engineers Week, and organizations including the Society of Women Engineers and the National Society of Black Engineers. A glossary clarifies important terms such as prototype, iteration, constraint, simulation, specification, tolerance, and factor of safety. The overall message is that career exploration can begin with small experiments, questions, and projects rather than waiting until adulthood.

The Author's Note and the Purpose of the Series

Linda Soules frames engineering as a form of care for people we may never meet. The pipes beneath a street, the bridge a school bus crosses, and the power lines serving a home may have been designed years before their users were born. Engineers do careful, often unnoticed work so that strangers can go about their lives safely. Drawing on her previous career as a lawyer, Soules reflects that asking what could go wrong is not inherently gloomy; when it leads to thoughtful prevention, it can be an act of kindness. The author encourages young readers to build, break, ask questions, and try again. A bridge that collapses during a safe test is an opportunity to make a better one, and a design intended to last for generations expresses hope in the future. The series aims to present careers as realistic invitations, including their wonder, difficult parts, and ordinary work, rather than as simplified fantasies. Its goal is to help a child encounter a profession and think, "maybe me."

Notable Quotes

"Engineers are the people who turn science into things you can use."

"Their best work is the disaster that never happens."

"To engineers, a failed test is good news in disguise."

"You don't need a license to ask a good one."

"Every bridge you cross began as a sketch in someone's notebook."

"People you will never meet will trust your math without ever knowing your name."

Full Summary

Look around, and nearly everything you can see has been engineered: the chair beneath you, the light overhead, the pipes behind the walls, even the toilet down the hall. Someone worked out how each should function, how strong it needed to be, and what it could cost. Engineers turn scientific knowledge into things people can use. Their work also depends on imagining what could go wrong before a design reaches the real world: a bridge in a hurricane, a balcony crowded with people, a battery overheating, or a squirrel chewing a power line. When engineers catch a danger early, the result may be a disaster that never happens.

The work begins by defining the problem: who needs help, and what must the solution do? Engineers brainstorm possibilities, choose promising ideas, build a prototype—a first version for testing—and find out how it performs. When something breaks, they investigate, revise, and test again. Each round is an iteration. Designs may need dozens of rounds; one British engineer made 5,127 vacuum-cleaner prototypes before getting the design right. A crack or crash is useful evidence when it happens safely on a test bench. Discovering the same weakness in a finished bridge or a car on the road could be far more costly and dangerous.

Scientists ask why the world works as it does; engineers ask how to use that knowledge to solve practical problems. Civil engineers design bridges, roads, tunnels, dams, and water systems. Mechanical engineers work on machines with moving parts, while electrical engineers deal with everything from computer chips to city power grids. Chemical engineers transform raw materials into products such as medicines and fuels. Biomedical engineers develop devices including artificial knees, heart monitors, and prosthetic hands. Aerospace engineers design aircraft and spacecraft—even a space toilet, which uses moving air to guide waste where it belongs in weightlessness. Environmental engineers address pollution and waste, and software engineers write and test code for systems ranging from games to traffic lights. A hospital, for instance, needs several specialties: civil engineers for its structure, mechanical engineers for airflow, electrical engineers for power, and biomedical engineers for medical equipment.

Every design must meet constraints: limits involving safety, cost, weight, strength, and time. It must also satisfy specifications, the detailed requirements set for the finished product. Improving one feature can make another harder to achieve. A lighter car may use less fuel but offer less protection in a crash; a thinner phone leaves less room for its battery. Engineers weigh these trade-offs and seek the best balance. Much of their work happens away from a building site or lab bench. They calculate, create computer models, write reports, attend meetings, and explain ideas to people without engineering backgrounds. Talking, writing, and checking may take more time than building.

Engineers work in offices, laboratories, factories, power plants, hospitals, and construction sites. Some divide their time between a desk and the field—the real-world place where

something is being built or repaired. Software engineers may work from home; civil engineers may visit sites wearing hard hats and steel-toed boots. In the United States, about 2.6 million people work in architecture and engineering jobs, and engineers work around the world. Many have a four-year engineering degree, study subjects such as math, physics, chemistry, and programming, and gain experience through summer internships. Some later earn a Professional Engineer license, which allows them to approve designs affecting public safety. Engineering also turns up in unexpected settings: food engineers help keep cereal crunchy and ice cream smooth, while sports engineers develop running shoes and safer helmets. Ocean engineers build robots to inspect internet cables on the seafloor.

A pencil and an engineering notebook remain useful tools, even when computers are available. Engineers sketch, record measurements and test results, and note failures; careful, dated records let another engineer repeat the work and can help establish who invented something first. Thomas Edison filled more than 3,500 notebooks. CAD, or computer-aided design, lets engineers create detailed digital models, and simulation software tests how those models might respond to heat, wind, or weight. Virtual testing can save time and money by allowing engineers to compare many ideas before making anything. Then 3D printers can produce real parts for prototypes, while machine shops cut and shape materials to precise tolerances—the permitted difference between a part’s actual size and its design. In some cases, that allowance is thinner than a human hair.

Test labs are places where engineers break things deliberately. Machines stretch metal until it snaps, shake building models to imitate earthquakes, and bend airplane wings until they crack. Cars hit barriers with dummies inside so engineers can study passenger protection. Airplane makers fire dead chickens from an air cannon at windshields to check whether the glass can survive a bird strike; the device is known as a chicken gun. Other tests are just as odd. Toilet testers flush fake waste made from soybean paste and toilet paper, and the best toilets can clear 1,000 grams in one flush. Furniture makers drop a heavy artificial “bottom” onto a chair seat tens of thousands of times. Crash-test dummies come in sizes from babies to large adults, including one shaped like a typical ten-year-old. When a new circuit board is switched on for the first time, engineers call it a smoke test: no smoke means it has passed the first step. Software engineers may explain troublesome code to a rubber duck, line by line, and notice their own mistake as they talk.

Seeing a design in use is one of the job’s pleasures. Engineers may cross a bridge they helped create, spot strangers using a machine they perfected, or watch people tap through an app their team built. Solving a stubborn problem can bring its own celebration: after weeks of failed attempts, a prototype finally works, prompting shouts and high fives. Some teams keep broken prototypes as trophies. The work can also move across industries, and a good team brings different ideas together through argument, laughter, and sketches on a whiteboard. For many engineers, the deepest reward is helping people. Ingeborg Hochmair, an Austrian

electrical engineer, and her husband Erwin built one of the first modern cochlear implants in 1977. The small electronic device sends sound signals to the hearing nerve; today, about a million have been implanted. Families sometimes film the moment an implant is switched on and a child hears a parent’s voice.

That sense of reward comes with serious responsibility. An engineer who approves a design is saying it is safe, so designs are checked, double-checked, and reviewed by others. The four-month-old Tacoma Narrows Bridge in Washington State showed why testing matters. Nicknamed “Galloping Gertie” because its road rose and fell in the wind, it began twisting violently on November 7, 1940, then tore apart and fell into the water. No people died, but a cocker spaniel named Tubby was trapped in a car and did not survive. Engineers studied the collapse for years; major suspension bridges have since been tested in wind tunnels before construction. The replacement Tacoma Narrows Bridge opened in 1950 and still carries cars. Projects can also be canceled after years of work, deadlines can mean long hours, and design reviews can sting when colleagues scrutinize every detail. Taking criticism without treating it as a personal attack is part of the job.

Engineering mishaps sometimes lead to unexpected inventions or costly repairs. In the 1940s, Percy Spencer noticed a candy bar melting in his pocket near a radar machine. Popcorn popped when he tested it; an egg exploded in a coworker’s face. The discovery led toward the microwave oven, though the first model was about six feet tall and weighed roughly 750 pounds. In 1957, Al Fielding and Marc Chavannes trapped air bubbles between two shower curtains, hoping to sell textured wallpaper. After wallpaper and greenhouse plans failed, a computer company used the material to protect equipment in shipping: Bubble Wrap was born. A woodpecker pecked about 200 holes in the foam covering the fuel tank of the space shuttle Discovery in 1995, delaying launch about five weeks while workers repaired it and tried to deter birds with air horns and scary-eye balloons. And when London’s Millennium Bridge opened in 2000, crowds walking across unintentionally fell into step with its sway, making it wobble more. It closed after two days; engineers added shock-absorbing dampers, and the bridge reopened in 2002.

Some of engineering’s biggest surprises come from problems noticed before anyone else sees them. In 1978, Princeton student Diane Hartley questioned how New York’s 59-story Citicorp Center would handle diagonal winds. At the same time, the building’s engineer, William LeMessurier, rechecked his calculations and found that those winds pushed harder than expected, while bolted joints were weaker than welded ones. A powerful storm might bring the tower down. LeMessurier told the owners, and crews secretly worked nights to reinforce the joints. Police and about 2,500 Red Cross volunteers prepared to evacuate ten blocks if a hurricane approached. The repairs were finished before disaster struck; the full story did not become public until 1995. The lesson is not only that engineers must check their work, but that admitting a mistake can protect lives—and a student’s question can matter.

The James Webb Space Telescope offers another example of planning for what could fail. Its enormous mirror had to fold to fit inside a rocket, then unfold a million miles from Earth. Engineers identified 344 single-point failures, any one of which could ruin the mission, and tested those parts repeatedly. They also wore white protective suits to keep dust off the mirror. Webb unfolded successfully and now sends back images of the early universe. Engineering, though, is not the work of solitary geniuses. A major design takes teams, testing, and plenty of snacks. You need not be a math genius, either: engineers must understand which calculations to make and whether the answers make sense. And the work does not end at construction. Bridges need regular inspection, while tunnel teams even name their machines—London’s Elizabeth line used Ada, Phyllis, Victoria, Elizabeth, Mary, Sophia, Jessica, and Ellie; Seattle’s was Bertha, after its first woman mayor.

A day designing prosthetic hands for children shows how those ideas play out. At the morning meeting, a biomedical engineer reports that the thumb slips when gripping round objects. She changes its computer model, adds a small ridge, runs a simulation, and sends the design to a 3D printer. Repeated drops reveal a broken finger; the team cheers because finding the weakness now may keep a child from finding it later. After testing a flexible plastic, the engineer watches an eleven-year-old user try the new hand. He can pick up a ball and water bottle, but struggles to tie a shoe and says the hand feels too heavy by day’s end. His experience guides calculations and trials of lighter materials. At a design review, a senior engineer asks how the joint will wear over a year. The answer is not yet known, so a long-term test goes onto next week’s plan. At home, the engineer is still sketching a finger that might improve the child’s pinch.

Engineers depend on many kinds of expertise. Technicians and technologists build and test prototypes; machinists and welders turn drawings into metal and may spot problems hidden by a computer screen. Scientists explain how materials behave, architects shape buildings’ appearance and feel, and engineers make sure they stand up. Project managers track schedules and budgets, inspectors check safety codes, and construction crews, electricians, and plumbers put designs into the world. Good engineers listen, including when an experienced technician says an idea has already been tried. They also listen to the people who will use a design: a wheelchair user may immediately recognize that a ramp is too steep. Engineers explain proposals at public meetings and in reports, and some volunteer by mentoring robotics teams, making prosthetic hands, or helping communities build wells and footbridges.

Engineering has records and rituals alongside its calculations. Turkey’s Çanakkale Bridge, opened in 2022, has a record 2,023-meter span between its towers; the number honors Turkey’s centenary in 2023. The Golden Gate Bridge can swing sideways as much as 8.4 meters in strong winds. A bridge must sometimes bend rather than fight the wind. At NASA’s Jet Propulsion Laboratory, six Ranger missions had failed in a row. In 1964, engineer Dick

Wallace handed out peanuts on launch day to calm nerves; Ranger 7 succeeded, and peanuts became a mission-control tradition. When a building's final steel beam goes up, crews may sign it and attach an evergreen tree in a "topping out" ceremony, a custom more than a thousand years old. Before calculators, engineers used slide rules; one carried on Apollo 13 is now at the Smithsonian. A quick design challenge captures the value of testing early: with spaghetti, tape, string, and a marshmallow, teams have 18 minutes to build the tallest freestanding tower with the marshmallow on top. Kindergartners often beat business students because they start building and testing right away.

Engineers help people in ways that often go unnoticed: civil and environmental engineers bring clean water through treatment plants and pipes; electrical engineers keep the grid working; engineers design car brakes, seat belts, and incubators for newborns. Designs include a factor of safety, extra strength beyond the expected load. In 1854, inventor Elisha Otis demonstrated his elevator safety brake by cutting the platform's supporting rope before a crowd. It dropped only a few inches before stopping. Modern elevators use several strong cables and backup brakes. Curiosity helps engineers ask how things work; persistence helps them return to failed prototypes and crashed code. Precision matters because a measurement or unit error can wreck a part. Systems thinking means noticing that changing one part can affect everything around it. Above all, public safety comes first, even if that means extra cost, delay, or telling a boss an unwelcome truth.

Other essential skills are less obvious. Engineers write reports, instructions, proposals, emails, and test results; clear instructions can prevent dangerous mistakes, and records help the next engineer understand what was done. They present designs to managers, clients, and the public, adjusting the explanation for each audience—from technical figures to drawings to plain language. And they must understand people. A product that works in a lab may still be uncomfortable or confusing, so engineers observe real users and listen. Some try their own designs with oven mitts or one arm tucked into a shirt, to experience barriers that others face.

The careers of famous engineers show how different paths can lead to useful work. When Washington Roebling was injured while leading construction of the Brooklyn Bridge, his wife, Emily Warren Roebling, learned about cable mathematics and structural stress, carried his directions to the site, and handled questions from engineers, officials, and manufacturers for more than ten years. She managed the work, and before the bridge opened in 1883, she rode across first, carrying a rooster as a sign of victory. Fazlur Rahman Khan, born in Dhaka, came to the United States in 1952 and developed a way to make skyscrapers' outer walls act like strong tubes. His designs used less steel and made taller buildings possible, including Chicago's John Hancock Center and Sears Tower.

Mary Jackson began as a human computer at NASA's Langley research lab in 1951. To train as an engineer, she needed classes at a whites-only high school and special city permission

to attend. In 1958, she became NASA's first Black female engineer, later leaving that title to help women advance. Margaret Hamilton led the MIT team that wrote software for Apollo. After her young daughter accidentally crashed a practice simulation, Hamilton sought a safeguard; an astronaut later made the same mistake. During Apollo 11's landing, the overloaded computer's alarms did not stop the mission because the software prioritized the essential tasks. Meanwhile, Shuji Nakamura kept pursuing gallium nitride for a bright blue LED, rebuilding equipment by hand and continuing secretly after his boss told him to stop. His company announced a daylight-bright blue LED in 1993; he shared the Nobel Prize in Physics in 2014. And William Kamkwamba, unable to afford school during famine in Malawi, studied a library book and built a windmill from scrap, bringing electricity to his family's home before neighbors arrived to charge their phones.

Engineering's surprises can be found in the details. In 1999, NASA lost its $125 million Mars Climate Orbiter because one team entered measurements in US units based on pounds while another expected metric units. The mismatch sent the spacecraft too close to Mars—a lasting reminder to label every unit. At the top of Taipei 101, a steel ball weighing about 660 metric tons sways against the motion of the skyscraper to steady it in strong winds. During a 2015 typhoon, it moved about a meter, its biggest swing yet. And Japan's bullet trains once made a loud boom as they burst from tunnels. Engineer and bird-watcher Eiji Nakatsu copied the kingfisher's beak, which enters water without a splash, to redesign the train's nose. The quieter train also became about 10 percent faster and used about 15 percent less electricity. Copying solutions found in nature is called biomimicry.

Engineers have also made careful choices around materials and motion. From 1990 to 2001, they eased the Leaning Tower of Pisa upright by removing soil beneath its high side, then stopped before it lost its famous tilt. The Eiffel Tower grows about 12 to 15 centimeters taller in summer as its iron expands in the heat; on sunny days, its top leans slightly away from the sun. The panels on the SR-71 Blackbird, the fastest jet-powered plane ever flown by a pilot, were designed to leak fuel on the runway. At flight temperatures, the metal expanded and sealed the gaps. In Canada, many new engineers receive a small iron or steel ring in a ceremony established in 1925. Worn on the little finger of the writing hand, it reminds them of their duty to protect people. Many US engineers make a similar pledge through the Order of the Engineer.

Anyone curious about engineering can start practicing now. With an adult's permission, take apart an old, unplugged gadget and try to work out what each piece does; laying the parts in order may help you rebuild it. Make a bridge from craft sticks, a paper tower, or a foil boat, and test how much weight it holds. You could also design a package to protect a raw egg in a drop, testing it outside. Change one feature at a time, record what happens, and try again. Math classes build useful tools, including algebra, geometry, and eventually calculus, but struggling at first is no reason to quit. Beginner coding programs can teach you to make

games or control robots. Keep a notebook of sketches and results, help an adult fix a wobbly chair or bike chain, and notice everyday objects that are awkward or annoying to use.

A useful engineer’s habit is asking what problem is really being solved, and for whom; how the design might fail, and what that failure would mean for people; and whether a simpler design could do the job safely. It also means imagining uses nobody intended, from a toddler’s curiosity to a puppy’s teeth or a determined raccoon. A child who likes finding out how things work, building with blocks or cardboard, solving practical puzzles, and investigating broken objects may enjoy engineering. So might someone who notices ways to improve everyday designs, can focus alone, works with a team, and cares about making life safer and easier.

Engineering is one path among many for people who like building and figuring things out. Electricians and engineering technicians build and repair systems; inventors turn ideas into objects; architects shape the experience of buildings; and toy designers test how well their products survive. The series also points curious readers toward books about robot building, roller-coaster design, coding, inventing, and architecture, with renewable-energy engineering, electrical work, rocket science, and train engineering among the careers it plans to explore.

The glossary gives names to the ideas behind the work. A prototype is an early version built for testing; an iteration is one round of design, test, and improvement. A constraint is a limit such as cost, weight, time, or safety rules, while a trade-off means giving up some of one quality to gain another. Specifications list what a finished design must meet. A simulation predicts how a design may behave before it is built, and CAD is the software used to create detailed models. A design review is a close examination by other engineers, and a single-point failure is one part whose failure could bring down an entire system. A factor of safety describes how much stronger a design is than the greatest load it is expected to carry. The glossary also defines tolerance, the permitted difference between a part’s designed and actual size; thermal expansion, the way materials grow as they heat; and the Professional Engineer license, which allows qualified engineers to approve designs affecting public safety.

For more learning, readers can turn to Shannon Hunt’s Engineered!, David Macaulay’s The Way Things Work Now, William Kamkwamba’s The Boy Who Harnessed the Wind, or Margot Lee Shetterly’s Hidden Figures. TryEngineering, DiscoverE, NASA JPL Education, and Science Buddies offer activities, challenges, and project ideas. Young people can join Future City, robotics teams, FIRST LEGO League, or events during Engineers Week. Organizations including the Society of Women Engineers, the National Society of Black Engineers, the Society of Hispanic Professional Engineers, and the American Indian Science and Engineering Society offer student programs and connections.

Linda Soules writes that many engineers build things for strangers they will never meet: water pipes, bridges, and power lines that may serve people long after their designers are gone. Their careful work lets others live safe, ordinary days without knowing who made them

possible. Before becoming an author, Soules spent twenty-five years as a lawyer, often asking what could go wrong. She came to see that question not as gloomy but as an expression of care, when it drives people to find and address the answer. She invites aspiring engineers to build, break, learn, and rebuild, seeing the effort to make something last as an act of hope for people in the future.

The series grew from Soules's question: what would she want to put into the hands of a curious child? She wanted books that felt like conversations rather than career guides, and that treated young readers seriously by showing not only the wonder of a job but also its difficult, quiet, and surprising parts. Though designated for ages ten to fourteen, the books are meant to grow with their audience: younger children can explore the illustrations with an adult, middle readers can delve into the details, and older readers can use them for career discovery. Soules describes the research as extensive and fact-checked, and is transparent that the illustrations are AI-assisted, directed and refined with care and selected with attention to ethical practices. Her hope is that a child may encounter work that fascinates them and think, maybe me—and that a shared page might open a conversation neither child nor adult expected.

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