Nature Science Scope & Sequence

Grades 4 through 6

Science · Technology · Engineering · Nature

Column Guide

Science Concepts Core science knowledge & vocabulary **Technology & Engineering** Hands-on builds, design challenges & tech connections **Nature & Outdoor Science** Outside investigations & nature journaling **Diverse Scientists & Voices** Scientists, inventors & knowledge-keepers from all backgrounds

Curriculum Philosophy

In grades 4–6, students transition from exploring the world to investigating it with rigor. This curriculum keeps hands-on, outdoor, and nature-based learning at the center even as concepts grow more complex. Engineering design challenges are research-based and community-connected — students solve real problems for real audiences. The history of science is taught honestly: who has been excluded, whose knowledge has been stolen or ignored, and how diverse scientists are reshaping every field today. Students leave 6th grade understanding that science is a human endeavor — powerful, imperfect, and open to them.

4th Grade

Energy, Waves, Earth Systems & Life Science

Grade Theme: *Fourth graders move into deeper scientific inquiry — designing experiments, collecting and analyzing data, and connecting science to real-world systems. Energy in its many forms, wave behavior, Earth's dynamic systems, and the science of living organisms are explored with increasing complexity. Engineering challenges require research, planning, and iteration. Indigenous knowledge and global science perspectives are woven throughout.*

Unit / Quarter	Science Concepts	Technology & Engineering	Nature & Outdoor Science	Diverse Scientists & Voices
Q1 **Energy: Forms, Transfer & Transformation**	• Forms of energy: thermal, light, sound, electrical, mechanical, chemical • Law of conservation of energy: energy changes form but is never lost • Heat transfer: conduction, convection, radiation • Kinetic vs. potential energy • Energy in everyday systems	• Build a Rube Goldberg machine demonstrating energy transfer • Design & test a solar oven — measure temperature change • Engineering challenge: build an insulated container to keep ice frozen longest • Technology: how do power plants convert energy? (coal, hydro, solar, wind) • Explore: how do batteries store & release chemical energy? • Coding connection: program a simple energy simulation	• Track solar energy: measure temperature in sun vs. shade over time • Observe heat convection in water & air outdoors • Biomass energy: how do plants store chemical energy? • Nature energy audit: where does energy come from in a local ecosystem?	• Lewis Howard Latimer & the electric light bulb industry • Lonnie Johnson: African American inventor & energy engineer • Indigenous solar & wind energy knowledge in architecture (passive heating/ cooling) • Dr. Shirley Ann Jackson: physicist & energy policy leader • Renewable energy innovators from Africa, India & Latin America

Q2 **Waves: Light, Sound & Information**	• Wave properties: amplitude, wavelength, frequency • The electromagnetic spectrum: radio, infrared, visible light, UV, X-ray • How sound waves travel & are absorbed • Reflection, refraction & absorption of light • How waves carry information (radio, WiFi, cell signals)	• Build a spectroscope from a CD to observe the visible spectrum • Engineer a periscope or kaleidoscope using mirrors & refraction • Design a tin can telephone — explore sound wave properties • Technology: how do fiber optics, MRI machines & radio towers use waves? • Coding challenge: program a light pattern or sound sequence using micro:bit • Explore: how does noise-canceling technology work?	• Observe wave behavior: drop a pebble in water & measure ripples • Light spectrum in nature: rainbows, soap bubbles, oil slicks • Animal communication using waves: bats (echolocation), whales, elephants (infrasound) • Study how different surfaces absorb vs. reflect sound & light outdoors	• Marian Croak: African American inventor of VoIP (internet voice calls) • Hidden Figures: Katherine Johnson & electromagnetic calculations for space • Ibn al-Haytham: pioneer of optics from the Islamic Golden Age • Ancient African & Indigenous drum communication systems (information via sound waves) • Gladys West: African American mathematician behind GPS technology
Q3 **Earth's Systems: Atmosphere, Hydrosphere & Geosphere**	• Earth's four systems: atmosphere, hydrosphere, geosphere, biosphere • How Earth's systems interact & affect each other • The carbon cycle & greenhouse effect • Climate vs. weather: long-term patterns • How human activity affects Earth's systems	• Model the carbon cycle with materials & role-play • Design a prototype to reduce household carbon footprint • Engineering challenge: build a model to demonstrate greenhouse effect • Technology: how do scientists use satellites, ocean buoys & weather balloons to monitor Earth's systems? • Data project: graph real climate data & identify trends • Design a green roof or urban garden to address heat islands	• Local weather data collection & long-term graphing project • Soil & water testing: pH, nitrates, turbidity • Observe local evidence of climate: tree rings, seasonal changes, animal behavior shifts • Nature journal: document seasonal changes across the full year	• Dr. Warren Washington: African American climate scientist & pioneer atmospheric researcher • Indigenous climate knowledge — reading land & sky • Vandana Shiva: Indian environmental scientist & seed sovereignty activist • Environmental justice: why climate change hits Black & Indigenous communities hardest • Young African climate activists: Vanessa Nakate (Uganda)

Q4 **Life Science: Cells, Body Systems & Health**	• Cells: the basic unit of life — plant vs. animal cells • Cell functions: nucleus, membrane, mitochondria (introductory) • Body systems overview: skeletal, muscular, digestive, circulatory, respiratory, nervous • How body systems work together • Disease, immunity & how the body defends itself	• Build a 3D model of a cell from craft materials • Technology: how do microscopes, MRI & CT scans help doctors see inside the body? • Engineering challenge: design a prosthetic hand or assistive device • Explore: how does medical technology help people with disabilities? • Research project: how has medical technology changed over 100 years? • Coding connection: program a simple heart rate monitor simulation	• Observe cells: examine onion skin & cheek cells under a microscope if available • Body systems in nature: compare human & animal systems (bird respiratory system, fish circulatory) • Heart rate lab: measure pulse before & after exercise outdoors • Research: how do plants 'breathe'? Observe stomata & transpiration	• Dr. Charles Drew: African American doctor who invented blood banks • Dr. Daniel Hale Williams: first successful open heart surgery (African American) • Dr. Mae Jemison: doctor & astronaut • Rebecca Lee Crumpler: first African American woman to earn medical degree in U.S. • Traditional herbal medicine & healing knowledge from Africa, Asia & the Americas

5th Grade

Matter, Chemical Reactions, Space Science & Ecosystems

Grade Theme: *Fifth graders engage with increasingly abstract scientific concepts — the structure of matter at the atomic level, chemical change, the vastness of space, and the complex relationships within ecosystems. Engineering design is rigorous and research-based, with students solving multi-step, real-world problems. Nature connections shift toward environmental science and stewardship. The history and diversity of science is explored critically.*

Unit / Quarter	Science Concepts	Technology & Engineering	Nature & Outdoor Science	Diverse Scientists & Voices

Q1 **Matter: Atoms, Elements & Chemical Reactions**	• Atoms & molecules: the building blocks of matter • Elements, compounds & mixtures • The periodic table: organization & patterns • Physical vs. chemical changes — review & deepen • Chemical reactions: reactants, products, evidence of change • Conservation of mass in chemical reactions	• Lab: test for chemical reactions using household materials (vinegar, baking soda, milk, lemon juice) • Engineering challenge: design a chemical hand warmer or cold pack • Build a model atom using craft materials • Technology: how do chemists use spectroscopy to identify unknown substances? • Explore: how are new materials engineered? (plastics, graphene, Kevlar) • Research: design a biodegradable alternative to a common plastic product	• Chemistry in nature: photosynthesis, decomposition, rust, digestion as chemical reactions • Soil chemistry: test pH & nutrient levels in garden soil • Natural indicators: use red cabbage juice to test acids & bases outdoors • Observe decomposition over weeks: what organisms are involved? What chemicals are produced?	• Percy Julian: African American chemist who synthesized life-saving medicines from soybeans • Alice Ball: African American chemist who developed first effective leprosy treatment • Marie Curie: radioactivity & Nobel Prizes (examine how she was treated as a woman in science) • Ancient African metallurgy & chemistry: iron smelting, bronze, gold refining • Traditional plant medicine as applied chemistry across world cultures
Q2 **Space Science: Our Solar System & Beyond**	• The solar system: sun, planets, moons, asteroids, comets • Gravity & orbital motion • Moon phases, tides & Earth-moon relationship • Stars: life cycle, size & distance • Galaxies & the scale of the universe • Space exploration: past, present & future	• Scale model of the solar system (outdoors — requires lots of space!) • Engineering challenge: design a Mars habitat for human survival • Build a model rocket or parachute lander • Technology: how do telescopes, space probes & satellites work? • Coding challenge: program a simple planetary orbit simulation • Research & present: design a mission to a planet or moon of your choice	• Moon phase observation journal: document the moon nightly for one month • Star & constellation observation: naked eye astronomy outdoors • Track sunrise & sunset times over a season • Observe shadows & connect to Earth's tilt & seasons	• Katherine Johnson, Dorothy Vaughan & Mary Jackson: Hidden Figures of NASA • Dr. Bernard Harris: first African American to walk in space • Ancient African astronomy: Egyptian pyramids aligned to stars, Malian Dogon people's star knowledge • Indigenous navigation by stars: Polynesian wayfinding, Aboriginal Australian astronomy • Galileo, Copernicus & how scientific ideas challenge authority — lessons for today

Q3 **Ecosystems: Biodiversity, Disruption & Restoration**	• Biodiversity: why variety of life matters • Ecosystem services: what nature provides for free • Invasive species & ecosystem disruption • Extinction: natural vs. human-caused • Habitat fragmentation & wildlife corridors • Ecosystem restoration: can we fix what we break?	• Research & present: design a wildlife corridor for a local or regional ecosystem • Engineering challenge: design a solution to reduce light or noise pollution in a habitat • Technology: how do scientists use drones, GPS collars & environmental DNA (eDNA) to monitor biodiversity? • Citizen science project: contribute to a real biodiversity database (iNaturalist, eBird) • Design a habitat restoration plan for a degraded local space	• Biodiversity survey: document every species observed in a defined outdoor area • Food web mapping from direct observation — who eats whom? • Invasive species field research: identify & learn about local invasive plants • Long-term ecosystem comparison: research what your local landscape looked like 100 years ago	• Wangari Maathai & the Green Belt Movement: planting 51 million trees • Dr. Yvonne Baskin: science writer on ecosystem services • Indigenous conservation: land back movements & traditional ecological knowledge • Environmental racism: communities of color & proximity to ecosystem destruction • African American land & conservation: Booker T. Washington's agricultural work, Black farmers
Q4 **Human Impact & Sustainable Engineering**	• Climate change: causes, evidence & effects • Resource depletion: fossil fuels, freshwater, topsoil • Pollution: air, water, soil & plastic • Sustainable development: meeting needs without destroying the future • Circular economy vs. linear economy	• Capstone engineering challenge: design a sustainable solution to a real local environmental problem • Build & test a solar-powered device (car, water heater, or fan) • Design a zero-waste product or packaging alternative • Technology: how do engineers design for sustainability? (life cycle analysis, biomimicry) • Coding project: build a data dashboard tracking an environmental issue • Present engineering solution to a community audience	• Environmental audit of home or school: measure waste, energy use, water consumption • Plant a native species garden or restore a section of local habitat • Water quality testing of a local water source • Year-end nature journal: document a full year of outdoor science observations & reflections	• Leah Penniman: African American farmer & food sovereignty leader (Soul Fire Farm) • Dr. Robert Bullard: father of environmental justice movement • Isatou Ceesay: Gambian woman who started plastic recycling movement in West Africa • Xiuhtezcatl Martinez: Indigenous youth climate activist • Global youth engineers solving local problems: Africa, Asia & Latin America

6th Grade

Physics, Earth History, Genetics & Advanced Engineering

Grade Theme: *Sixth graders engage with science at the highest level of elementary/middle school transition — Newton's laws, plate tectonics in depth, genetics and heredity, and the history of Earth across deep time. Engineering design is fully research-based and community-connected, with students presenting solutions to real audiences. The nature and history of science itself is examined, including who has been excluded and how that is changing.*

Unit / Quarter	Science Concepts	Technology & Engineering	Nature & Outdoor Science	Diverse Scientists & Voices
Q1 **Forces & Motion: Newton's Laws & Engineering Applications**	• Newton's three laws of motion • Net force & balanced/ unbalanced forces • Gravity, mass & weight (distinction) • Momentum & inertia • Friction, air resistance & drag • Simple & compound machines revisited at greater depth	• Newton's Law labs: egg drop, balloon rocket, inertia demos • Engineering design challenge: build a vehicle that travels as far as possible using only stored energy (rubber band, gravity, or spring) • Design a crash safety system: protect an egg in a car crash simulation • Technology: how do aerospace engineers use Newton's laws to design aircraft & spacecraft? • Coding challenge: program a physics simulation showing forces & motion • Research: how does biomimicry use nature's designs to improve engineering?	• Forces in nature: observe and measure wind speed, water current, slope angle • Newton's laws in animal movement: how do fish, birds & cheetahs use force & motion? • Projectile motion outdoors: measure & graph the path of a thrown ball • Erosion as force in action: observe & measure how water moves soil	• Mae Jemison: doctor, astronaut & applied physicist • Neil deGrasse Tyson: astrophysicist & science communicator • Ancient African physics applications: pyramid construction, Nubian archers' ballistics • Women physicists: Chien-Shiung Wu (proved parity violation), Lise Meitner (nuclear fission) • Indigenous engineering feats using physical principles: Incan suspension bridges, Cambodian Angkor Wat water systems

Q2 **Earth's History: Deep Time, Fossils & Plate Tectonics**	• Geologic time scale: 4.6 billion years of Earth history • Absolute vs. relative dating: how scientists know how old rocks are • Fossils as evidence: what they tell us & their limits • Plate tectonics: evidence, mechanism & consequences • Mountain building, ocean formation & continental drift over deep time • Mass extinction events & their causes	• Create a geologic time scale model (use a roll of toilet paper — each sheet = 10 million years) • Engineering challenge: design a method for collecting & preserving fossils without damage • Technology: how do scientists use radiometric dating, sonar & GPS to study Earth's history? • Build a model of tectonic plate boundaries: convergent, divergent, transform • Research project: investigate a mass extinction event & its causes	• Rock & fossil collection: identify local rocks & research their geologic age • Topographic map reading: connect landforms to plate tectonic history • Erosion time scale: observe current erosion & calculate time for large-scale change • Fossil research: what lived in your region millions of years ago?	• Ancient African geology: oldest known rocks in Africa (Acasta Gneiss, 4 billion years) • Mary Anning: working-class English woman who discovered most important fossils of her era — denied credit for years • Indigenous geological knowledge: reading landscape for resources, water & hazards • Karin Lindqvist & women in paleontology today • African American geologist Nathaniel Hawkins: contributions to geologic mapping

Q3 **Genetics, Heredity & Biotechnology**	• DNA: structure, function & the genetic code • Genes & chromosomes: how traits are inherited • Dominant & recessive traits: Punnett squares • Mutations: causes, effects & role in evolution • Natural selection & evolution: connecting genetics to Darwin • Biotechnology: genetic engineering, CRISPR & GMOs — science, ethics & society	• Extract DNA from a strawberry with household materials • Model DNA replication using craft supplies or beads • Punnett square practice: predict & test trait inheritance in fast-growing plants • Technology: how are GMO crops developed? What are the debates? • Research & debate: is genetic engineering ethical? Who decides? • Coding connection: explore bioinformatics — how computers analyze DNA sequences	• Trait variation study: measure & graph variation in a plant population • Selective breeding observation: compare wild vs. cultivated versions of a plant (wild strawberry vs. commercial) • Adaptation research: find an animal with a notable mutation-driven adaptation & research its history • Grow plants from seed: observe inherited traits vs. environmental influence	• Rosalind Franklin: DNA X-ray crystallography — her work stolen, Watson & Crick got the credit • Dr. Charles R. Drew: blood typing & genetics of blood • CRISPR pioneer Jennifer Doudna & Emmanuelle Charpentier (Nobel Prize 2020) • Gregor Mendel: monk whose careful pea experiments launched genetics • Indigenous seed sovereignty: protecting genetic diversity of traditional crops from corporate patents • African genetic diversity: all human genetic variation traces to Africa

Q4 **Capstone: Science, Society & the Future**	• Science as a human endeavor: who does science, who funds it, who benefits? • The scientific method as one way of knowing — alongside Indigenous & traditional knowledge • Emerging fields: nanotechnology, synthetic biology, artificial intelligence in science • Science & policy: how scientific findings become (or don't become) law • Future of Earth: climate projections, energy transitions, biodiversity targets	• Independent capstone engineering project: student-chosen real problem, full design cycle, community presentation • Explore emerging tech: nanotechnology, 3D bioprinting, AI in medicine & environmental monitoring • Technology ethics seminar: who benefits from new technology? Who is left out or harmed? • Design a science communication piece (podcast, video, poster, zine) explaining your capstone to a public audience • Coding capstone: build a data visualization or simulation connected to their science topic	• Design & execute an original outdoor field study over 4–6 weeks • Contribute final citizen science data to a real database • Nature journal culmination: create a final illustrated field guide of a local ecosystem • Community science event: share outdoor science findings with neighbors, family or local organization	• Who gets to be a scientist? Examining gatekeeping in STEM history & today • Citizen science & community science: science by & for everyday people • African American, Indigenous & Global South scientists leading today's most important research • Science in Indigenous knowledge systems: ethnobotany, astronomy, ecology • Students as scientists: your observations, your questions, your discoveries matter

Planning Notes for Grades 4–6

- Each unit spans approximately 6–8 weeks at this level. Engineering capstone projects in Q4 may extend to 8–10 weeks.
- Nature journals continue as a year-long practice. By 6th grade, students should be conducting original field observations and contributing to citizen science platforms like iNaturalist or eBird.
- Technology & Engineering challenges should involve the full design cycle: research → plan → build → test → redesign → present. Encourage students to document each stage.
- Diverse Scientists are not just highlighted in one column — they are woven into the science history within each topic. Consider biography studies, short documentary clips, and primary source readings.
- This sequence pairs naturally with the Social Studies Scope & Sequence — science units connect to geographic regions, historical periods, and social justice themes studied in social studies.
- Grades 4–5 build toward the Grade 6 capstone, where students conduct independent field studies and present science solutions to a community audience.