Science

Level	Summary	Description
1	**Sensory Observation & Qualitative Descriptions**	Young scientists launch their inquiry journey by harnessing their senses as precise tools for discovery. Students purposefully use sight, touch, hearing, and smell (safe, supervised taste only when appropriate) to explore everyday and natural objects. They notice and describe observable properties in rich detail: size (bigger/smaller than my hand, length comparisons), shape (round, oval, irregular, flat, pointy), color (including shades, patterns, transparency), texture (smooth, rough, bumpy, fuzzy, prickly, sticky, soft/hard), temperature (warm from sunlight, cool in shade, room temp), sound (high/low pitch or volume when tapped/shaken/dropped), and weight/heft by gentle handling. WHY THIS MATTERS: All future scientific thinking rests on accurate, detailed observations. This level builds scientific vocabulary, focused attention, descriptive language, and the foundational habit of recording ideas in a science notebook (drawings with labels + words, or dictated descriptions for emergent writers). It teaches respect for materials, careful/safe handling, and that science starts with curiosity about the real world.
2	**Comparing, Sorting & Classifying by Properties**	Students move from individual observations to comparing objects and events, identifying similarities and differences, and organizing items into logical groups based on shared properties. They sort and classify using one or two properties at a time (color, texture, hardness, flexibility, absorbency, size, shape, or self-chosen rules). Simple tools like sorting mats, Venn diagrams (two overlapping circles for "both/and"), or attribute blocks help visualize groupings. Students explain their reasoning aloud or in writing and identify at least one similarity and one difference between groups. WHY THIS MATTERS: Classification is a core scientific practice that reveals patterns, supports prediction, and lays groundwork for more complex data organization and analysis. It develops logical thinking, evidence-based justification ("I put these together because they all feel rough and don't bend"), and the ability to see relationships—essential for later work with variables, data tables, and scientific claims. It also builds early pattern recognition and set logic.
3	**Measuring & Recording Quantitative Data**	Students transition from purely qualitative descriptions to quantitative observations by measuring and comparing using both non-standard units (linking cubes, paper clips, hand spans, footsteps) and standard tools (rulers, meter sticks, balances or pan scales, thermometers, magnifying glasses). Focus areas include length/distance, mass/weight comparisons (heavier/lighter/same), and temperature (hotter/colder/same, or simple numeric readings with support). They record data in simple tables, tallies, or labeled drawings with numbers, learning to organize information clearly for later analysis. WHY THIS MATTERS: Measurement brings precision, allows comparison across time or conditions, and introduces the idea that numbers and tools extend our senses. It builds foundational data literacy, understanding of units (why we need standard ones for communication), and habits of systematic recording. Directly supports later levels on data collection (7), analysis (8), investigations (6,9), and all content areas involving change (melting, motion, growth, weather).
4	**Predicting, Inferring & Observation vs. Inference**	Building directly on detailed observations, students make simple, evidence-based predictions ("What do I think will happen if…?") and begin forming basic inferences (what the observations might mean). A key distinction is explicitly taught and practiced: Observation = what I can directly see, touch, hear, measure right now ("The ramp is tilted and the car rolled 45 cm"). Inference = what I think or reason from those observations, often using prior knowledge ("I think the car went farther because the ramp was steeper and gravity pulled it harder"). Students label these clearly in notebooks or discussions. WHY THIS MATTERS: Science is fundamentally about using evidence to make sense of the world and test ideas. Distinguishing observation from inference helps students avoid jumping to conclusions, builds critical thinking, and prepares them for hypothesis formation, evidence-based claims (Level 8), and full investigations (Levels 6,9). It makes thinking visible and discussable.
5	**Generating Testable Questions & Scientific Wondering**	Students observe phenomena (in person, via picture, video, or classroom event) and generate "I wonder…" questions that fuel scientific curiosity. They then refine questions to make them testable—meaning they can be answered through investigation, involve changing something (variable), measuring or observing an outcome, and keeping other factors as consistent as possible. Science notebooks become "wonder journals" where questions are recorded, prioritized, and revisited. Not all questions are testable in the classroom (e.g., "Why is the sky blue?" may lead to research but not a simple fair test), so students learn to identify which ones are investigable with available resources. WHY THIS MATTERS: Questions drive science. Learning to ask good, answerable questions is a hallmark of scientific thinking and shifts students from passive recipients to active investigators. This level bridges observation/prediction (Levels 1–4) to planning and conducting controlled investigations (Level 6). It fosters agency, creativity, and the understanding that science begins with genuine wondering.
6	**Planning & Conducting Simple Controlled Investigations**	With teacher support and scaffolding, students plan and carry out simple investigations that approximate a "fair test." They identify what they will change on purpose (independent variable), what they will measure or observe as the result (dependent variable), and what they will keep the same to make the test fair (controlled variables). Focus topics include pushes/pulls, motion, or material properties. Planning includes listing materials, making a prediction, outlining a simple procedure, and deciding how to record results. Investigations are conducted with guidance, often in small groups, with attention to safety, multiple trials where helpful, and basic data collection. WHY THIS MATTERS: Controlled investigation is the heart of experimental science. Learning to isolate one variable while controlling others builds understanding of cause-and-effect relationships and the importance of fair comparisons. This level operationalizes the testable questions from Level 5 and prepares students for more independent and complex inquiries (Levels 7–9). It also reinforces measurement (Level 3),
7	**Systematic Data Collection, Organization & Multiple Representations**	Students collect data systematically during investigations (using tables, tallies, drawings, photos, or simple digital tools if available) and organize findings for analysis. They represent the same data in multiple ways—words, drawings, simple bar graphs, pictographs, or oral explanations—and explain what the representations show. Emphasis is on choosing appropriate representations for the question and audience, labeling clearly (title, axes or categories, units, key), and using data to communicate findings to partners or the class. Topics can include vibration/sound investigations, absorbency tests, plant growth over time, or motion experiments. WHY THIS MATTERS: Raw data becomes meaningful only when organized and shared. Multiple representations help reveal patterns, support different learning styles, and build data literacy foundational to all STEM fields. This level strengthens skills from Levels 3 and 6 and directly feeds analysis and claims in Level 8 and full inquiry in Level 9. Students learn that how we show data affects how clearly others understand our
8	**Analyzing Data, Identifying Patterns & Evidence-Based Claims**	Students examine collected or provided data for patterns, trends, or relationships. They use specific evidence from the data to support simple claims or conclusions and compare results to their original predictions. Cause-and-effect language is introduced and practiced ("Changing the ramp height caused the car to roll farther because…"). Students also suggest one realistic improvement to the investigation. Topics draw from prior investigations (friction/motion, magnets, plant growth, absorbency, etc.) or teacher-provided data tables. WHY THIS MATTERS: Analysis turns data into knowledge. Learning to spot patterns, ground claims in evidence rather than opinion, and reflect on methods builds scientific reasoning and intellectual honesty. This is a critical bridge to full inquiry cycles (Level 9) and to evaluating claims in everyday life or media. It reinforces that science is evidence-based and iterative.

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9	**Full Cycle of Scientific Inquiry & Practices**	Students integrate the complete cycle of scientific inquiry in a mini-investigation on a familiar, accessible topic: Observe → Generate questions → Predict/Hypothesize → Plan (identify variables, fair test) → Investigate/Collect data → Analyze & identify patterns → Draw evidence-based conclusions → Communicate findings → Reflect and iterate (what was learned, what to change next time). Simple models (drawings, diagrams, or physical representations) are introduced as useful tools for thinking and explaining. Science notebooks document the full process as a record of thinking and learning. WHY THIS MATTERS: This capstone of the practices sequence empowers students to experience authentic science as a coherent, iterative process rather than isolated skills. It builds agency, perseverance, and deep understanding that science is a way of knowing—driven by questions, grounded in evidence, and improved through reflection. Students see how earlier levels connect and prepare for applying practices to rich content in Levels 10–20 and real-world problem-solving in Level 20.
10	**Properties of Materials & Suitability for Purpose**	Students deepen their understanding of material properties (color, texture, hardness, flexibility, strength, absorbency, transparency, conductivity of heat/electricity in simple terms, durability) and learn to test and classify materials systematically for intended real-world uses. They collect quantitative and qualitative data on 2–3 properties across 5+ materials, organize results, and use evidence to recommend the "best" material for a specific purpose (e.g., cleaning a spill, building a small bridge or tower that must hold weight, insulating a cup to keep water warm/cold, making a waterproof covering, or creating a sturdy but lightweight package). Data tables and simple graphs provide evidence for recommendations. WHY THIS MATTERS: Materials science is fundamental to engineering, design, and everyday problem-solving. Understanding that properties determine suitability empowers students to make informed choices rather than random guessing. This level applies and extends early practices (observation, measuring, comparing, testing, data, claims) in a meaningful context and directly prepares for engineering design (Level 20)
11	**States of Matter, Phase Changes, Particles & Conservation**	Students investigate the three common states of matter—solids, liquids, and gases—and how matter changes from one state to another (phase changes) primarily through temperature. They observe and measure reversible changes (ice melting to water, water evaporating or condensing on cold surfaces, freezing) versus irreversible changes (burning a candle or paper produces new substances like ash and smoke that cannot easily return to original form). A simple particle model is introduced: all matter is made of tiny building blocks (particles) too small to see; in solids particles are packed tightly and vibrate in place (keeps shape); in liquids particles are slightly farther apart and slide past each other (flows, takes shape of container); in gases particles are very spread out and move quickly in all directions (fills container, compressible). Students discover through careful measurement that the weight (mass) of matter is conserved during phase changes and dissolving—the total amount of "stuff" remains the same even if appearance or location changes. They also practice separating simple mixtures using physical properties (e.g., sand + iron filings with magnet; salt dissolved in water recovered by evaporation).
12	**Forces, Motion, Gravity & Friction**	Students investigate how forces—pushes and pulls—affect the motion of objects. They explore the strength and direction of forces, balanced vs. unbalanced forces (when forces cancel or add up to change motion), and the effects of changing force or mass. Gravity is introduced as a force that pulls objects toward Earth's center ("down")—a predictable, non-contact force that acts on everything with mass. Friction is explored as a force that opposes motion and depends on surfaces (rough vs. smooth) and other factors; students compare how different surfaces affect how far or fast objects travel. Investigations often use ramps (varying height/angle or surface), toy cars, balls, or simple slides. Students predict effects of changing variables and explain results using the concepts of pushes/pulls, gravity, and friction, supported by measured data (distance, time, or speed estimates). WHY THIS MATTERS: Forces and motion are core to physical science, engineering, sports, transportation, and understanding the natural world (why things fall, why cars need tires with tread, why ramps help move
13	**Non-Contact Forces: Magnets & Static Electricity**	Students investigate forces that act at a distance without physical contact—magnetic forces and static electric forces. For magnets: explore attraction and repulsion, identify poles (north/south) and that opposite poles attract while like poles repel, test how strength varies with distance and orientation, and map magnetic fields using iron filings, compasses, or simple sensors. For static electricity: observe and test charged objects (rubbed balloons, plastic rods, or combs) attracting small pieces of paper, hair, or other light objects; explore how charging works (rubbing transfers electrons) and factors affecting strength (humidity, materials). Emphasis is on fair testing of variables (distance, orientation, material type, number of rubs) and explaining patterns using cause-and-effect language. Students learn these are fundamental forces that, like gravity, can act through empty space or materials (with varying strength). WHY THIS MATTERS: Non-contact forces are fascinating, accessible entry points to deeper physics (fields, electromagnetism) and have countless applications (magnets in motors, speakers, MRI, credit cards, fridge
14	**Energy: Sources, Forms, Transformations & Simple Machines**	Students explore energy as the ability to cause change or do work. They identify common sources (sun as primary source for most energy on Earth; also food, fuels, electricity, wind, water) and forms (heat/thermal, light, sound, motion/kinetic, magnetic, chemical, electrical). A central idea is that energy can transform from one form to another but is conserved in quantity (not created or destroyed in ordinary processes). Simple machines (levers, ramps/inclined planes, pulleys, wheels/axles, screws, wedges) are investigated as devices that change the amount or direction of force needed to do work, without creating energy— they trade force for distance or vice versa. Students trace energy flow in simple systems (e.g., rubber-band car: chemical energy in wound rubber band → elastic potential → kinetic motion + sound + heat from friction; solar heater: light from sun → heat absorbed by dark surface; simple circuit: chemical energy in battery → electrical → light in bulb or motion in motor). Food energy is traced ultimately back to the sun via plants (photosynthesis) and food chains.
15	**Wave Properties: Sound (Vibration, Pitch, Volume) & Light (Reflection, Seeing)**	Students investigate the properties of waves through sound and light—two familiar but often mysterious phenomena. For sound: explore how vibrations produce sound and how sound makes matter vibrate (e.g., tuning fork in water, rice on drum, string telephone). Distinguish pitch (how high or low; related to vibration rate/frequency, size, tension, length of vibrating object) from volume/loudness (related to amplitude or force of vibration; bigger vibrations = more energy = louder). For light: investigate that objects are visible only when they produce their own light (sun, bulb, firefly, glow stick) or reflect light from another source to our eyes; explore reflection (angle of incidence ≈ angle of reflection), shadows (light travels in straight lines and is blocked), and why we see the Moon (it reflects sunlight). Simple wave models (rope, slinky, or water ripples) help visualize repeating patterns of motion that carry energy without transporting matter. Students design, build, and test a simple device to communicate over a distance using sound or light (e.g., string telephone, Morse code with flashlight, shadow puppet theater with light source).
16	**Structure & Function in Plants & Animals; Biomimicry & Basic Interdependence**	Students observe and compare external (and introductory internal) structures of plants and animals and analyze how those structures support survival functions: getting resources (food, water, light, air), protection from predators or environment, movement, sensing the surroundings, support, and reproduction. Needs of living things are reviewed with patterns emphasized (animals need food/water/air/shelter; plants need light, air, water, nutrients from soil; all need water). Biomimicry is introduced: humans often solve problems by studying and copying nature's designs (e.g., Velcro from burrs, airplane wings inspired by bird wings, building ventilation from termite mounds, camouflage patterns from animals). Basic interdependence is explored: organisms live in habitats that provide their needs; structures help them survive in specific environments; changes to one part of a system (e.g., removing a predator or food source) can affect others. Simple food chain or web ideas may be introduced through observation or models. WHY THIS MATTERS: Structure-function relationships are a unifying crosscutting concept across biology, engineering, and design. Understanding how organisms are adapted to their environments builds respect for

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17	**Life Cycles, Growth, Development & Heredity (Variation)**	Students observe, document, and compare the life cycles of plants and animals, identifying patterns of change from birth/germination through growth, development, reproduction, and (for many) death or dormancy. They note that young plants and animals resemble their parents but are not identical—introducing the concept of variation within a species. Simple heredity ideas are explored: offspring inherit traits from parents (via seeds, eggs, or live birth), yet variation arises from genetic mixing, environment, or both. Students may grow plants from seed, observe insect or amphibian metamorphosis (with live specimens or time-lapse/video if live not feasible), or compare life cycle diagrams/models of different organisms (e.g., bean plant vs. butterfly or frog). Emphasis is on patterns, change over time, and evidence from observation or secondary sources. WHY THIS MATTERS: Life cycles are fundamental to understanding biology, reproduction, agriculture, and ecology. Recognizing patterns of development and the balance of similarity (heredity) and variation
18	**Organ Systems, Information Processing & Matter/Energy Flow in Living Things**	Students compare major organ systems across vertebrate classes (fish, amphibians, reptiles, birds, mammals) with focus on support (skeletal/muscular), digestion (breaking down food for energy and building blocks), transport/circulatory (moving materials), excretion (removing wastes), response/nervous (sensing and responding via brain/nerves), and reproduction. Animals receive and process information through senses → nervous system/brain → response (behavior or internal change). Plants obtain most of their matter (carbon dioxide, water) and energy (sunlight) from air and water through photosynthesis, not primarily from soil (soil provides minerals and water but the bulk of plant mass comes from air via CO_2). Students trace matter and energy flow: sun → plants (photosynthesis stores chemical energy) → herbivores → carnivores → decomposers recycle nutrients back to soil/air. Simple models or observations (e.g., heart rate before/after activity, lung breathing rate, or celery/carnation in colored water showing transport) help make systems visible. Dissection or virtual/model-based comparison may be used for older students with proper safety and ethics.
19	**Earth-Sky Patterns: Weather, Seasons, Sun/Moon/Stars & Human-Environment Interactions**	Students investigate predictable patterns in the Earth-Sky system: local weather (qualitative descriptions and simple quantitative data—temperature, precipitation, wind—collected over weeks/months), seasons and changing daylight length, the Sun's daily path and role in day/night and seasons, Moon phases and appearance over a month, and stars visible at night (constellations, why they seem to move). They maintain long-term observation journals. Living things (plants, animals, humans) modify their environment to meet needs (beaver dams, bird nests, human agriculture, buildings, irrigation); students argue with evidence how specific activities change the local environment (positive or negative) and identify related natural resources (water, soil, air, plants, animals, minerals). Basic natural hazards (floods, storms, wildfires, earthquakes—local relevance) and human responses are introduced. Water cycle elements (evaporation, condensation, precipitation) connect to phase changes (Level 11) and weather. WHY THIS MATTERS: Understanding Earth-Sky patterns helps students make sense of daily and seasonal rhythms, timekeeping, navigation, and climate concepts. Human-environment interactions introduce systems
20	**Engineering Design Process, Human-Environment Interactions & Integrated Problem-Solving**	This capstone level engages students in the full Engineering Design Process (EDP) to solve authentic, real-world problems while synthesizing scientific inquiry practices, core content knowledge from prior levels, and crosscutting concepts. EDP steps: (1) Define the problem clearly through observation, questioning, research, and gathering information about needs, constraints (materials, cost, time, safety, space), and criteria for success. (2) Develop possible solutions through brainstorming (many ideas, no judgment initially), sketching, and building simple models or prototypes. (3) Optimize through testing, collecting data on effectiveness, analyzing results, identifying strengths/weaknesses, and iterating (improving the design). (4) Communicate the solution, evidence of success, and reflection on the process to a "client" (class, teacher, school admin, or community member). Human-environment interactions are central: students consider how their solutions affect land, water, air, living things, and resources, and aim to reduce negative impacts (sustainability, resilience). Natural hazards or resource challenges may provide context. The problem should be student-identified or co-defined (e.g., school garden area too hot/shaded/wet; cafeteria food waste; noisy hallway communication; playground erosion or flooding; need for better outdoor learning space; local water conservation).