| **Test Content Categories**  | **How well do I know the content? (scale 1–5)** | **What resources do I have/need for this content?** | **Where can I find the resources I need?** | **Dates I will study this content** | **Date completed** |
| --- | --- | --- | --- | --- | --- |
| I . Nature and Impact of Science and Engineering |  |  |  |  |  |
| 1. Nature of Science
 |  |  |  |  |  |
| 1. Nature of scientific knowledge
 |  |  |  |  |  |
| 1. Based on empirical evidence collected through observation or experimentation
 |  |  |  |  |  |
| 1. How major concepts develop and change over time based on new evidence
 |  |  |  |  |  |
| 1. Asking questions and forming hypotheses
 |  |  |  |  |  |
| 1. Use of laws and theories to describe and explain natural phenomena
 |  |  |  |  |  |
| 1. Development and application of models to explain natural phenomena
 |  |  |  |  |  |
| 1. Process skills (e.g., observing, categorizing, comparing, generalizing, inferring, and concluding)
 |  |  |  |  |  |
| 1. Investigation design, data collection, and analysis
 |  |  |  |  |  |
| 1. Standard units of measurement, dimensional analysis, and unit conversion
 |  |  |  |  |  |
| 1. Scientific notation and use of significant figures
 |  |  |  |  |  |
| 1. Investigation design, including identifying variables, planning data collection, and how design supports answering the question or testing the hypothesis
 |  |  |  |  |  |
| 1. Processing, organizing, and reporting of data
 |  |  |  |  |  |
| 1. Error analysis, including accuracy and precision, mean, and percent error
 |  |  |  |  |  |
| 1. Identifying the sources and effects of error (e.g., systematic, random, sampling)
 |  |  |  |  |  |
| 1. Interpreting, extrapolating, and drawing conclusions from data
 |  |  |  |  |  |
| 1. Appropriate and safe use of materials and equipment in the laboratory and field
 |  |  |  |  |  |
| 1. Preparation, use, storage, and disposal of materials
 |  |  |  |  |  |
| 1. Selection, use, calibration, and maintenance of equipment
 |  |  |  |  |  |
| 1. Safety procedures and precautions
 |  |  |  |  |  |
| 1. Science, Engineering, Technology, Society, and the Environment
 |  |  |  |  |  |
| 1. Interdependence of science, engineering, and technology
 |  |  |  |  |  |
| 1. Engineering advances leading to important discoveries in science
 |  |  |  |  |  |
| 1. How science and technology drive each other forward
 |  |  |  |  |  |
| 1. Engineering design
 |  |  |  |  |  |
| * Defining problems, including identifying the success criteria and the constraints
 |  |  |  |  |  |
| * Designing solutions, including proposing and evaluating in terms of criteria, constraints, and limitations
 |  |  |  |  |  |
| * Optimizing the design, including systematic modification and refinement
 |  |  |  |  |  |
| 1. Use of science and engineering to identify and address adverse impacts on the environment and society
 |  |  |  |  |  |
| 1. Acid rain
 |  |  |  |  |  |
| 1. Air and water pollution (e.g., eutrophication)
 |  |  |  |  |  |
| 1. Greenhouse gases (e.g., global climate change, ocean acidification, rising sea levels)
 |  |  |  |  |  |
| 1. Ozone layer depletion (e.g., causes, environmental effects)
 |  |  |  |  |  |
| 1. Polymers and plastics
 |  |  |  |  |  |
| 1. Waste disposal and recycling
 |  |  |  |  |  |
| 1. Invasive species, loss of habitat and biodiversity
 |  |  |  |  |  |
| 1. Issues associated with the use and extraction of energy and natural resources
 |  |  |  |  |  |
| 1. Sustainable energy use
 |  |  |  |  |  |
| 1. Renewable and nonrenewable energy resources
 |  |  |  |  |  |
| 1. Advantages and disadvantages of energy resources (e.g., fossil fuels, nuclear, hydro, solar, wind, and geothermal)
 |  |  |  |  |  |
| 1. Global distribution, extraction, and use of resources (e.g., ores and groundwater, mineral, and energy resources)
 |  |  |  |  |  |
| 1. Land surface use (e.g., urban development, agricultural practices, degradation of soil, deforestation)
 |  |  |  |  |  |
| 1. Consumer products and lifecycle cost analysis (e.g., production, use, disposal, and recycling)
 |  |  |  |  |  |
| 1. Applications and contributions of science and technology in daily life
 |  |  |  |  |  |
| 1. Scientific ethics and decision making
 |  |  |  |  |  |
| 1. Chemistry (e.g., water purification, soaps, plastics, batteries)
 |  |  |  |  |  |
| 1. Physics (e.g., communications technology, telescopes, medical imaging)
 |  |  |  |  |  |
| 1. Life science (e.g., medicine, public health, biotechnology)
 |  |  |  |  |  |
| 1. Earth and space science (e.g., satellites, GPS, identification and prediction of natural hazards)
 |  |  |  |  |  |
| II. Physical Science |  |  |  |  |  |
| 1. Principles and Models of Matter and Energy
 |  |  |  |  |  |
| 1. Atomic and nuclear structure and processes
 |  |  |  |  |  |
| 1. Current model of atomic structure
 |  |  |  |  |  |
| * Description of basic model, including location of protons, neutrons, and electrons
 |  |  |  |  |  |
| * Atomic number, atomic mass, isotopes
 |  |  |  |  |  |
| * Electron configurations of the elements
 |  |  |  |  |  |
| * Uses of absorption and emission spectra in science
 |  |  |  |  |  |
| 1. Characteristics, processes, and effects of radioactivity
 |  |  |  |  |  |
| * Radioactivity and radioactive decay processes
 |  |  |  |  |  |
| * Alpha particles, beta particles, and gamma radiation
 |  |  |  |  |  |
| * Half-life
 |  |  |  |  |  |
| * Fission and fusion
 |  |  |  |  |  |
| * Balancing nuclear reactions
 |  |  |  |  |  |
| 1. Relationships between energy and matter
 |  |  |  |  |  |
| 1. Organization of matter
 |  |  |  |  |  |
| * Pure substances (elements and compounds)
 |  |  |  |  |  |
| * Mixtures (homogeneous, heterogeneous, solutions, suspensions, colloids)
 |  |  |  |  |  |
| * States of matter (solid, liquid, gas, and plasma)
 |  |  |  |  |  |
| * Atoms, ions, molecules
 |  |  |  |  |  |
| 1. Difference between chemical and physical properties and changes
 |  |  |  |  |  |
| * Chemical versus physical properties
 |  |  |  |  |  |
| * Chemical versus physical changes
 |  |  |  |  |  |
| * Intensive versus extensive properties
 |  |  |  |  |  |
| 1. Conservation of energy and matter
 |  |  |  |  |  |
| * Conservation of matter in chemical and physical processes
 |  |  |  |  |  |
| * Conservation of energy in chemical and physical processes
 |  |  |  |  |  |
| * Mechanical energy (kinetic and potential energy)
 |  |  |  |  |  |
| * Other forms of energy including chemical, electrical, thermal, electromagnetic, and nuclear
 |  |  |  |  |  |
| * Transformations between different forms of energy (e.g., chemical to electrical)
 |  |  |  |  |  |
| 1. Temperature, thermal energy, and heat capacity
 |  |  |  |  |  |
| * Temperature scales
 |  |  |  |  |  |
| * Mechanisms of energy transfer (conduction, convection, radiation)
 |  |  |  |  |  |
| * Heat capacity and specific heat
 |  |  |  |  |  |
| * Calorimetry
 |  |  |  |  |  |
| 1. Energy concepts and calculations involving phase changes, including particulate and mathematical models
 |  |  |  |  |  |
| * Interpreting phase diagrams
 |  |  |  |  |  |
| * Heats of vaporization and fusion
 |  |  |  |  |  |
| * Heating curves
 |  |  |  |  |  |
| 1. Kinetic molecular theory, including particulate and mathematical models
 |  |  |  |  |  |
| * Assumptions and applications of the kinetic molecular theory
 |  |  |  |  |  |
| * Ideal gas behavior and the ideal gas laws
 |  |  |  |  |  |
| 1. Relationship between thermodynamics and chemical and physical processes
 |  |  |  |  |  |
| * Changes in entropy (second law of thermodynamics)
 |  |  |  |  |  |
| * Exothermic and endothermic processes
 |  |  |  |  |  |
| * Reaction progress diagrams based on potential energy of reactants and products
 |  |  |  |  |  |
| * Energy absorbed in breaking bonds and energy released in forming bonds
 |  |  |  |  |  |
| 1. Chemistry
 |  |  |  |  |  |
| 1. Chemical composition, bonding, and structure
 |  |  |  |  |  |
| 1. Chemical composition
 |  |  |  |  |  |
| * Mole concept and application to chemical systems
 |  |  |  |  |  |
| * Avogadro’s number, molar mass, and mole conversions
 |  |  |  |  |  |
| * Percent composition and chemical formulas
 |  |  |  |  |  |
| 1. Names and chemical formulas for simple compounds
 |  |  |  |  |  |
| * Interpreting chemical formulas
 |  |  |  |  |  |
| * Naming compounds based on formulas
 |  |  |  |  |  |
| * Writing formulas based on names
 |  |  |  |  |  |
| * Structural formulas (e.g., Lewis electron-dot diagrams)
 |  |  |  |  |  |
| 1. Properties and models of bonding
 |  |  |  |  |  |
| * Ionic bonding
 |  |  |  |  |  |
| * Covalent bonding (polar, nonpolar)
 |  |  |  |  |  |
| * Metallic bonding
 |  |  |  |  |  |
| * Relative bond strengths
 |  |  |  |  |  |
| 1. How bonding, structure, and interparticle interactions are related to physical properties of pure substances
 |  |  |  |  |  |
| * Intermolecular forces (e.g., hydrogen bonding, dipole-dipole, London dispersion forces)
 |  |  |  |  |  |
| * Boiling points and melting points
 |  |  |  |  |  |
| * Solubility
 |  |  |  |  |  |
| 1. The periodic table
 |  |  |  |  |  |
| 1. The periodic table as a model
 |  |  |  |  |  |
| * Arranged in groups and periods
 |  |  |  |  |  |
| * Identifying symbols, atomic numbers, and atomic masses given the periodic table of the elements
 |  |  |  |  |  |
| * Location of metals, nonmetals, metalloids, and transition elements
 |  |  |  |  |  |
| 1. Trends in properties of the elements based on their position on the periodic table
 |  |  |  |  |  |
| * Atomic radius
 |  |  |  |  |  |
| * Ionization energy
 |  |  |  |  |  |
| * Electronegativity
 |  |  |  |  |  |
| * Physical properties
 |  |  |  |  |  |
| * Chemical properties and reactivity
 |  |  |  |  |  |
| 1. Basic principles of chemical reactions
 |  |  |  |  |  |
| 1. Using chemical equations for simple chemical reactions
 |  |  |  |  |  |
| * Writing equations
 |  |  |  |  |  |
| * Balancing equations
 |  |  |  |  |  |
| * Simple mass-mole calculations based on balanced equations
 |  |  |  |  |  |
| 1. Types of reactions (e.g., combustion, neutralization, synthesis, decomposition, single and double replacement reactions, oxidation-reduction)
 |  |  |  |  |  |
| 1. Factors affecting reaction rate (e.g., concentration, surface area, temperature, pressure, activation energy and catalysts)
 |  |  |  |  |  |
| 1. Factors that affect equilibrium in chemical systems (Le Chatelier’s principle)
 |  |  |  |  |  |
| 1. Solutions and solubility
 |  |  |  |  |  |
| 1. Types of solutions
 |  |  |  |  |  |
| * Dilute, concentrated, unsaturated, saturated, and supersaturated
 |  |  |  |  |  |
| * Identification of solute and solvent
 |  |  |  |  |  |
| * Concentration units (e.g., molarity, percent by mass or volume)
 |  |  |  |  |  |
| * Simple calculations needed to prepare solutions, including dilutions
 |  |  |  |  |  |
| 1. Factors affecting solubility
 |  |  |  |  |  |
| * Rate of dissolving (temperature, pressure, surface area, stirring)
 |  |  |  |  |  |
| * Solubility and solubility curves (temperature and pressure dependence, precipitation)
 |  |  |  |  |  |
| * Polar and nonpolar solutes and solvents
 |  |  |  |  |  |
| * Characteristics of electrolytes and nonelectrolytes, (e.g., electrical conductivity of solutions; freezing-point depression and boiling-point elevation)
 |  |  |  |  |  |
| 1. Acids and bases
 |  |  |  |  |  |
| * Distinguishing between acids and bases (Arrhenius and Brønsted-Lowry; strong versus weak)
 |  |  |  |  |  |
| * Understanding the pH scale, including simple calculations
 |  |  |  |  |  |
| * Definition and applications of buffers
 |  |  |  |  |  |
| * Use of acid-base indicators (e.g., phenolphthalein, pH paper, litmus paper)
 |  |  |  |  |  |
| 1. Physics
 |  |  |  |  |  |
| 1. Mechanics
 |  |  |  |  |  |
| 1. Description of motion in one and two dimensions
 |  |  |  |  |  |
| * Scalar quantities (e.g., mass, speed, time, distance, energy)
 |  |  |  |  |  |
| * Vector quantities (e.g., displacement, velocity, acceleration, force, momentum)
 |  |  |  |  |  |
| 1. Newton’s laws of motion
 |  |  |  |  |  |
| * First law (mass, inertia)
 |  |  |  |  |  |
| * Second law (net force, mass, acceleration)
 |  |  |  |  |  |
| * Third law (action-reaction pairs)
 |  |  |  |  |  |
| 1. Mass, weight, and gravity
 |  |  |  |  |  |
| * Distinguish between weight and mass
 |  |  |  |  |  |
| * Newton’s law of universal gravitation and gravity fields
 |  |  |  |  |  |
| * Acceleration due to gravity
 |  |  |  |  |  |
| 1. Analysis of motion and forces
 |  |  |  |  |  |
| * Contact forces (e.g., friction, normal force, and tension)
 |  |  |  |  |  |
| * Projectile motion
 |  |  |  |  |  |
| * Uniform circular motion and centripetal acceleration
 |  |  |  |  |  |
| * Rotational motion and torque
 |  |  |  |  |  |
| * Periodic motion (e.g., Hooke’s law; pendulum and spring oscillations)
 |  |  |  |  |  |
| * Work, mechanical energy, and power (e.g., conservation of energy, mechanical advantage, efficiency)
 |  |  |  |  |  |
| * Conservation of linear momentum (one dimension)
 |  |  |  |  |  |
| * Properties of fluids (e.g., buoyancy, density, pressure)
 |  |  |  |  |  |
| 1. Electricity and magnetism
 |  |  |  |  |  |
| 1. Electrical nature of common materials
 |  |  |  |  |  |
| * Electric charge and charge separation (attractive and repulsive forces)
 |  |  |  |  |  |
| * Coulomb’s law and electric fields
 |  |  |  |  |  |
| * Conductors and insulators
 |  |  |  |  |  |
| 1. Basic electrical concepts
 |  |  |  |  |  |
| * Current, resistance, capacitance, potential difference (sometimes called voltage), and power
 |  |  |  |  |  |
| * Ohm’s law
 |  |  |  |  |  |
| * Distinguish between direct current and alternating current
 |  |  |  |  |  |
| * Sources of potential difference (e.g., batteries, generators, photocells)
 |  |  |  |  |  |
| * Analysis of simple series and parallel circuits
 |  |  |  |  |  |
| 1. Magnetic fields, forces, and materials
 |  |  |  |  |  |
| * Magnetic forces and fields (magnetic poles, attractive and repulsive forces)
 |  |  |  |  |  |
| * Magnets (e.g., permanent magnets, electromagnets)
 |  |  |  |  |  |
| * Magnetic field generated by steady current
 |  |  |  |  |  |
| * Electric current generated by a changing magnetic field
 |  |  |  |  |  |
| * Motors and generators
 |  |  |  |  |  |
| 1. Waves and optics
 |  |  |  |  |  |
| 1. Electromagnetic waves and the electromagnetic spectrum
 |  |  |  |  |  |
| * Nature of light (e.g., electric and magnetic fields, speed of light, energy, photons)
 |  |  |  |  |  |
| * Electromagnetic spectrum, including the visible spectrum (colors)
 |  |  |  |  |  |
| 1. Types of waves and their characteristics
 |  |  |  |  |  |
| * Distinguish between transverse and longitudinal waves
 |  |  |  |  |  |
| * Distinguish between mechanical and electromagnetic waves
 |  |  |  |  |  |
| * Relationships between amplitude, wavelength, frequency, period, wave speed, and energy
 |  |  |  |  |  |
| 1. Wave phenomena
 |  |  |  |  |  |
| * Reflection, refraction, dispersion, and total internal reflection
 |  |  |  |  |  |
| * Diffraction, interference, superposition (standing waves), polarization
 |  |  |  |  |  |
| * Scattering, absorption, transmission
 |  |  |  |  |  |
| * Doppler effect, including apparent frequency and wavelength, moving source or observer
 |  |  |  |  |  |
| 1. Basic geometric optics
 |  |  |  |  |  |
| * Mirrors (plane, convex, concave)
 |  |  |  |  |  |
| * Lenses and their applications (e.g., human eye, microscope, telescope)
 |  |  |  |  |  |
| 1. Sound
 |  |  |  |  |  |
| * Sound as a longitudinal (compression) wave
 |  |  |  |  |  |
| * Pitch (frequency) and loudness (intensity)
 |  |  |  |  |  |
| * Applications of Doppler effect
 |  |  |  |  |  |
| III. Life Science |  |  |  |  |  |
| 1. Cells and Processes, Including Genetics
 |  |  |  |  |  |
| 1. Basic structure and function of cells and their organelles
 |  |  |  |  |  |
| * Structure and function of cell membranes (e.g., phospholipid bilayer, passive and active transport, homeostasis)
 |  |  |  |  |  |
| * Structure and function of eukaryotic cell organelles
 |  |  |  |  |  |
| * Structure and function of prokaryotic cell organelles
 |  |  |  |  |  |
| * Levels of organization (cells, tissues, organs, organ systems)
 |  |  |  |  |  |
| * Major features of common animal cell types (e.g., blood, muscle, nerve, epithelial, gamete)
 |  |  |  |  |  |
| * Prokaryotes (eubacteria and archaea) and eukaryotes (animals, plants, fungi, protists)
 |  |  |  |  |  |
| 1. Key aspects of cell reproduction and division
 |  |  |  |  |  |
| 1. Cell cycle phases
 |  |  |  |  |  |
| 1. Mitosis
 |  |  |  |  |  |
| 1. Meiosis
 |  |  |  |  |  |
| 1. Cytokinesis
 |  |  |  |  |  |
| 1. Binary fission
 |  |  |  |  |  |
| 1. Basic biochemistry of life
 |  |  |  |  |  |
| 1. Aerobic and anaerobic cellular respiration
 |  |  |  |  |  |
| 1. Photosynthesis
 |  |  |  |  |  |
| 1. Biological molecules (e.g., nucleic acids, carbohydrates, proteins, lipids)
 |  |  |  |  |  |
| 1. Basic genetics and protein synthesis
 |  |  |  |  |  |
| 1. Structure, function, and replication of DNA and structure and function of RNA
 |  |  |  |  |  |
| 1. Central dogma: transcription and translation
 |  |  |  |  |  |
| 1. Chromosomes, genes, alleles
 |  |  |  |  |  |
| 1. Dominant and recessive traits
 |  |  |  |  |  |
| 1. Mendelian inheritance (e.g., genotype, phenotype, use of Punnett squares, sex-linked traits, pedigrees, probability)
 |  |  |  |  |  |
| 1. Non-Mendelian inheritance (e.g., incomplete dominance, codominance)
 |  |  |  |  |  |
| 1. Mutations, chromosomal abnormalities, and common genetic disorders, genetic counseling
 |  |  |  |  |  |
| 1. Evolution, Diversity of Life, and Ecology
 |  |  |  |  |  |
| 1. Theory and key mechanisms of evolution
 |  |  |  |  |  |
| 1. Natural selection as the mechanism of evolution (e.g., adaptations and reproductive fitness)
 |  |  |  |  |  |
| 1. Speciation, extinction, and selection pressures
 |  |  |  |  |  |
| 1. Supporting evidence (e.g., fossil record, comparative amino acid and nucleotide sequences, homologous structures, embryology)
 |  |  |  |  |  |
| 1. Artificial selection, contemporary evolution (rapid microevolution)
 |  |  |  |  |  |
| 1. Genetic diversity (e.g., mutation, sexual reproduction, genetic drift)
 |  |  |  |  |  |
| 1. Organismal classification and relationships
 |  |  |  |  |  |
| 1. Use and interpretation of cladograms and phylogenetic trees
 |  |  |  |  |  |
| 1. Defining characteristics of prokaryotes, animals, plants, fungi, and protists
 |  |  |  |  |  |
| 1. Basic structures of plants and plant growth
 |  |  |  |  |  |
| 1. Structure and function of roots, leaves, and stems (e.g., stomata, xylem, phloem) in vascular plants
 |  |  |  |  |  |
| 1. Asexual (budding) and sexual reproduction (flowers, fruit, seeds, spores)
 |  |  |  |  |  |
| 1. Relationship between photosynthesis and growth
 |  |  |  |  |  |
| 1. Responses to stimuli (e.g., light, temperature, water, gravity)
 |  |  |  |  |  |
| 1. Basic structure and function of animal systems
 |  |  |  |  |  |
| * Homeostasis and response to stimuli; negative and positive feedback loops
 |  |  |  |  |  |
| * Exchange with the environment (e.g., respiratory, circulatory, nervous, endocrine, excretory, and digestive systems)
 |  |  |  |  |  |
| * Reproduction, development, and growth
 |  |  |  |  |  |
| * Immune system and disease (e.g., antibodies, vaccines, autoimmune disorders)
 |  |  |  |  |  |
| 1. Key aspects of ecology
 |  |  |  |  |  |
| 1. Hierarchical structure of the biosphere (e.g., organisms, populations, communities, ecosystems, biomes)
 |  |  |  |  |  |
| 1. Intraspecific relationships (e.g., competition and altruism)
 |  |  |  |  |  |
| 1. Interspecific relationships (e.g., symbiotic relationships including mutualism, parasitism, and commensalism; predation)
 |  |  |  |  |  |
| 1. Influence of biotic and abiotic components of an ecosystem on populations (e.g., niche, resource availability, limiting factors, population growth and carrying capacity, critical population size)
 |  |  |  |  |  |
| 1. Ecosystem function and stability (e.g., energy flow; biodiversity; ecological succession; phenology; water, nitrogen, and carbon cycles)
 |  |  |  |  |  |
| 1. Ecosystem disturbances and change (e.g., climate change; ocean acidification; cascading effects such as loss of pollinators; keystone species; invasive species)
 |  |  |  |  |  |
| IV. Earth and Space Science |  |  |  |  |  |
| 1. Astronomy
 |  |  |  |  |  |
| 1. The Sun-Earth-Moon System
 |  |  |  |  |  |
| 1. Earth’s motions and their characteristics and consequences
 |  |  |  |  |  |
| * Rotation and revolution
 |  |  |  |  |  |
| * Effects of axial tilt (e.g., seasons, solstices, and equinoxes)
 |  |  |  |  |  |
| 1. Relationships within the Sun-Earth-Moon system
 |  |  |  |  |  |
| * Tides (e.g., causes, cycles, spring, neap)
 |  |  |  |  |  |
| * Eclipses (solar, lunar)
 |  |  |  |  |  |
| * Phases of the Moon
 |  |  |  |  |  |
| * Effects of solar wind on Earth (e.g., communication satellites, blackouts, auroras)
 |  |  |  |  |  |
| 1. The solar system
 |  |  |  |  |  |
| 1. Formation and organization of the solar system
 |  |  |  |  |  |
| 1. Structure and characteristics of the Sun (e.g., layers, sunspots, nuclear fusion)
 |  |  |  |  |  |
| 1. Location and orbits of the planets and the Moon (e.g., Kepler’s laws of planetary motion)
 |  |  |  |  |  |
| 1. Characteristics of solar-system objects (e.g., planets, asteroids, moons, comets, dwarf planets)
 |  |  |  |  |  |
| 1. The universe and its stars
 |  |  |  |  |  |
| 1. Life cycle of stars (e.g., main sequence, white dwarf, supernova, black holes)
 |  |  |  |  |  |
| 1. Characteristics of stars (e.g., mass, color, temperature, brightness, Hertzsprung-Russell diagram)
 |  |  |  |  |  |
| 1. Nuclear fusion and the formation of elements (e.g., carbon, iron)
 |  |  |  |  |  |
| 1. Characteristics of the universe and galaxies (e.g., Milky Way)
 |  |  |  |  |  |
| 1. Big Bang theory and evidence for the origin and evolution of the universe (e.g., redshift, cosmic background radiation)
 |  |  |  |  |  |
| 1. Earth Science
 |  |  |  |  |  |
| 1. Tectonics and internal Earth processes
 |  |  |  |  |  |
| 1. Theory of plate tectonics and its supporting evidence
 |  |  |  |  |  |
| * Plate movement and potential driving forces (e.g., slab pull and ridge push; convection)
 |  |  |  |  |  |
| * Types of plate boundaries (convergent, divergent, and transform)
 |  |  |  |  |  |
| * Evidence for plate tectonics (e.g., seismic, geomagnetic reversals, fossil)
 |  |  |  |  |  |
| 1. Deformation of Earth’s crust and resulting features (e.g., mountains, trenches)
 |  |  |  |  |  |
| 1. Characteristics of earthquakes and how they provide information about Earth’s interior (e.g., distribution, magnitude, seismic waves)
 |  |  |  |  |  |
| 1. Types, features, and distribution of volcanoes (e.g., shield, hot spots, Ring of Fire)
 |  |  |  |  |  |
| 1. Layered structure of Earth and related processes
 |  |  |  |  |  |
| * Characteristics and composition of the layers
 |  |  |  |  |  |
| * Magnetic field
 |  |  |  |  |  |
| 1. Earth’s minerals and rocks
 |  |  |  |  |  |
| 1. Properties of minerals (e.g., density, streak, hardness, cleavage, luster, crystal structure)
 |  |  |  |  |  |
| 1. Rocks and the rock cycle
 |  |  |  |  |  |
| * Types of rocks (i.e., igneous, metamorphic, sedimentary)
 |  |  |  |  |  |
| * Rock-cycle processes (e.g., weathering, erosion, deposition, melting)
 |  |  |  |  |  |
| 1. Evidence for the history of Earth
 |  |  |  |  |  |
| 1. Principles of relative dating (e.g., superposition, fossil succession)
 |  |  |  |  |  |
| 1. Principles of absolute (radiometric) dating (e.g., radioactive decay, Earth’s age)
 |  |  |  |  |  |
| 1. Earth’s hydrosphere
 |  |  |  |  |  |
| 1. Properties of water (e.g., density changes, polar solvent, high heat capacity)
 |  |  |  |  |  |
| 1. The water cycle
 |  |  |  |  |  |
| 1. Groundwater (e.g., water table, aquifers)
 |  |  |  |  |  |
| 1. Rivers and watersheds (e.g., deltas; erosion and deposition)
 |  |  |  |  |  |
| 1. Glaciers, ice sheets, and sea ice (e.g., features, change over time)
 |  |  |  |  |  |
| 1. Characteristics and processes of the oceans
 |  |  |  |  |  |
| * Ocean circulation (e.g., Gulf Stream)
 |  |  |  |  |  |
| * Waves (e.g., energy)
 |  |  |  |  |  |
| * Seawater composition
 |  |  |  |  |  |
| 1. Hazards (e.g., flooding, sinkholes, storm surge, sea-level rise)
 |  |  |  |  |  |
| 1. Earth’s atmosphere
 |  |  |  |  |  |
| 1. Basic structure and composition of the atmosphere
 |  |  |  |  |  |
| * Chemical composition
 |  |  |  |  |  |
| * Layers and their physical properties (e.g., stratosphere, troposphere, thermosphere)
 |  |  |  |  |  |
| 1. Basic concepts in meteorology
 |  |  |  |  |  |
| * Absolute and relative humidity
 |  |  |  |  |  |
| * Cloud types and formation
 |  |  |  |  |  |
| * Precipitation types and formation
 |  |  |  |  |  |
| * Barometric pressure, wind (e.g., sea and land breezes)
 |  |  |  |  |  |
| * Air masses, fronts, storms, and severe weather
 |  |  |  |  |  |
| * Interpreting weather maps
 |  |  |  |  |  |
| 1. Factors and processes that influence climate
 |  |  |  |  |  |
| * Latitude, geographical location, and elevation (e.g., climate belts, rain shadow effect)
 |  |  |  |  |  |
| * Atmospheric circulation (e.g., global wind belts, Coriolis effect)
 |  |  |  |  |  |
| * Characteristics and locations of climate zones (e.g., Tropics, Arctic)
 |  |  |  |  |  |
| * Effects of natural phenomena on climate change (e.g., volcanic eruptions, asteroid impacts, variations in solar radiation)
 |  |  |  |  |  |
| **Science and Engineering Practices** |  |  |  |  |  |
| The S​E​Ps represent eight practices that scientists and engineers—and students and teachers—use to investigate the world and to design and build systems. Many test questions will integrate one or more of these practices. |  |  |  |  |  |
| 1. Asking questions (for science) and defining problems (for engineering)
 |  |  |  |  |  |
| * Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
 |  |  |  |  |  |
| * Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
 |  |  |  |  |  |
| * Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.
 |  |  |  |  |  |
| * Ask questions to clarify and refine a model, an explanation, or an engineering problem.
 |  |  |  |  |  |
| * Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
 |  |  |  |  |  |
| * Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
 |  |  |  |  |  |
| 1. Developing and using models
 |  |  |  |  |  |
| * Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria.
 |  |  |  |  |  |
| * Design a test of a model to ascertain its reliability.
 |  |  |  |  |  |
| * Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
 |  |  |  |  |  |
| * Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
 |  |  |  |  |  |
| * Develop a complex model that allows for manipulation and testing of a proposed process or system.
 |  |  |  |  |  |
| * Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
 |  |  |  |  |  |
| 1. Planning and carrying out investigations
 |  |  |  |  |  |
| * Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation’s design to ensure variables are controlled.
 |  |  |  |  |  |
| * Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
 |  |  |  |  |  |
| * Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
 |  |  |  |  |  |
| * Select appropriate tools to collect, record, analyze, and evaluate data.
 |  |  |  |  |  |
| * Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
 |  |  |  |  |  |
| * Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.
 |  |  |  |  |  |
| 1. Analyzing and interpreting data
 |  |  |  |  |  |
| * Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
 |  |  |  |  |  |
| * Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
 |  |  |  |  |  |
| * Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
 |  |  |  |  |  |
| * Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.
 |  |  |  |  |  |
| * Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.
 |  |  |  |  |  |
| * Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
 |  |  |  |  |  |
| 1. Using mathematics and computational thinking
 |  |  |  |  |  |
| * Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.
 |  |  |  |  |  |
| * Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
 |  |  |  |  |  |
| * Apply techniques of algebra and functions to represent and solve scientific and engineering problems.
 |  |  |  |  |  |
| * Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world.
 |  |  |  |  |  |
| * Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as , , acre-feet, etc.).
 |  |  |  |  |  |
| 1. Constructing explanations (for science) and designing solutions (for engineering)
 |  |  |  |  |  |
| * Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.
 |  |  |  |  |  |
| * Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
 |  |  |  |  |  |
| * Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
 |  |  |  |  |  |
| * Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
 |  |  |  |  |  |
| * Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
 |  |  |  |  |  |
| 1. Engaging in argument from evidence
 |  |  |  |  |  |
| * Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.
 |  |  |  |  |  |
| * Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
 |  |  |  |  |  |
| * Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions.
 |  |  |  |  |  |
| * Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
 |  |  |  |  |  |
| * Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.
 |  |  |  |  |  |
| * Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).
 |  |  |  |  |  |
| 1. Obtaining, evaluating, and communicating information
 |  |  |  |  |  |
| * Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
 |  |  |  |  |  |
| * Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.
 |  |  |  |  |  |
| * Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.
 |  |  |  |  |  |
| * Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.
 |  |  |  |  |  |
| * Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
 |  |  |  |  |  |
| * Obtaining, evaluating, and communicating information
 |  |  |  |  |  |
| **Tasks of Teaching Science** |  |  |  |  |  |
| This list includes instructional tasks that teachers engage in that are essential for effective General Science teaching. Many test questions will measure content through application to one or more of these tasks  |  |  |  |  |  |
| **Scientific Instructional Goals, Big Ideas, and Topics** |  |  |  |  |  |
| 1. Selecting or sequencing appropriate instructional goals or big ideas for a topic
 |  |  |  |  |  |
| 1. Identifying the big idea or instructional goal of an instructional activity
 |  |  |  |  |  |
| 1. Choosing which science ideas or instructional activities are most closely related to a particular instructional goal
 |  |  |  |  |  |
| 1. Linking science ideas to one another and to particular activities, models, and representations within and across units
 |  |  |  |  |  |
| **Scientific Investigations and Demonstrations** |  |  |  |  |  |
| 1. Selecting investigations or demonstrations, including virtual, that facilitate understanding of disciplinary core ideas, scientific practices, or crosscutting concepts
 |  |  |  |  |  |
| 1. Evaluating investigation questions for quality (e.g., testable, empirical)
 |  |  |  |  |  |
| 1. Determining the variables, techniques, or tools that are appropriate for use by students to address a specific investigation question
 |  |  |  |  |  |
| 1. Critiquing scientific procedures, data, observations, or results for their quality, accuracy, or appropriateness
 |  |  |  |  |  |
| 1. Supporting students in generating questions for investigation or identifying patterns in data and observations
 |  |  |  |  |  |
| **Scientific Resources (texts, curriculum materials, journals, and other print and media-based resources)** |  |  |  |  |  |
| 1. Evaluating instructional materials and other resources for their ability to address scientific concepts; engage students with relevant phenomena; develop and use scientific ideas; promote students’ thinking about phenomena, experiences, and knowledge; take account of students’ ideas and background; and assess student progress
 |  |  |  |  |  |
| 1. Choosing resources that support the selection of accurate, valid, and appropriate goals for science learning
 |  |  |  |  |  |
| **Student Ideas (including common misconceptions, alternate conceptions, and partial conceptions)** |  |  |  |  |  |
| 1. Analyzing student ideas for common misconceptions regarding intended scientific learning
 |  |  |  |  |  |
| 1. Selecting diagnostic items and eliciting student thinking about scientific ideas and practices to identify common student misconceptions and the basis for those misconceptions
 |  |  |  |  |  |
| 1. Developing or selecting instructional moves, approaches, or representations that provide evidence about common student misconceptions and help students move toward a better understanding of the idea, concept, or practice
 |  |  |  |  |  |
| **Scientific Language, Discourse, Vocabulary, and Definitions** |  |  |  |  |  |
| 1. Selecting scientific language that is precise, accurate, grade-appropriate, and illustrates key scientific concepts
 |  |  |  |  |  |
| 1. Anticipating scientific language and vocabulary that may be difficult for students
 |  |  |  |  |  |
| 1. Modeling the use of appropriate verbal and written scientific language in critiquing arguments or explanations, in describing observations, or in using evidence to support a claim, etc.
 |  |  |  |  |  |
| 1. Supporting and critiquing students’ participation in and use of verbal and written scientific discourse and argumentation
 |  |  |  |  |  |
| **Scientific Explanations (includes claim, evidence, and reasoning)** |  |  |  |  |  |
| 1. Critiquing student-generated explanations or descriptions for their generalizability, accuracy, precision, or consistency with scientific evidence
 |  |  |  |  |  |
| 1. Selecting explanations of natural phenomena that are accurate and accessible to students
 |  |  |  |  |  |
| **Scientific Models and Representations (analogies, metaphors, simulations, illustrations, diagrams, data tables, performances, videos, animations, graphs, and examples)** |  |  |  |  |  |
| 1. Evaluating or selecting scientific models and representations that predict or explain scientific phenomena or address instructional goals
 |  |  |  |  |  |
| 1. Engaging students in using, modifying, creating, and critiquing scientific models and representations that are matched to an instructional goal
 |  |  |  |  |  |
| 1. Evaluating student models or representations for evidence of scientific understanding
 |  |  |  |  |  |
| 1. Generating or selecting diagnostic questions to evaluate student understanding of specific models or representations
 |  |  |  |  |  |
| 1. Evaluating student ideas about what makes for good scientific models and representations
 |  |  |  |  |  |