CONCEPT and SKILL ANALYSIS and ALLOCATION OF NGSS STANDARDS ELEMENTARY K – 5

The NGSS standards have been allocated to transferable concepts and skills embedded within comprehensive structures for each.   Both comprehensive structures are organized cognitively according to generality, complexity, and abstractness.

Color code: | K | 1st | 2nd | 3rd | 4th | 5th |

BASIC CONCEPT	SUB-CONCEPT		SUB-SUB-CONCEPT
LANGUAGE OF SCIENCE A • nature of matter	ENTITY, SYSTEM, MATTER A • things and substances (intensive, extensive properties) • delineation, naming • wave as entity • system • environment, context 2-PS1-3 Pieces can be re-assembled to make new objects. 2-ESS2-2 Local landforms and water bodies have distinct types and shapes. 4-ESS2-2 Global surface features can be discerned on maps.	HIERARCHY OF MATTER A • elements, compounds, mixtures • kinetic theory of matter • Periodic table 5-PS1-1 Matter is made of particles too small to be seen. 5-PS1-2 Mass is conserved through any change: heating/cooling, mixing ... 5-PS1-4 Different substances when mixed sometimes form new substances with different properties.	BULK LEVEL A
			MOLECULAR LEVEL B
			ATOMS AND ATOMIC STRUCTURE C
			NUCLEUS AND ELEMENTARY PARTICLES d • Radioactivity
			QUARKS AND LEPTONS e
		HIERARCHY OF LIFE A	MOLECULAR SCALE
			CELLULAR SCALE • Organelles
			TISSUE SCALE
			ORGAN
			ORGAN SYSTEM
			ORGANISM
			POPULATION
			COMMUNITY
	PROPERTY/MEASUREMENT A • observation, value, unit • comparison, difference, similarity • error, accuracy • misc properties: hardness, melting/boiling T^o's, (non)-conductor K-ESS2-1 Local weather is described by patterns of property changes occurring over time. (Also put under *Change/Process*) 1-ESS1-1 Patterns exist in the changing properties of the sun, moon, and stars.	SCALE/SIZE A
			NUMBER B
			PHASE, STRUCTURE B
			COMPOSITION B
			TEMPERATURE B
			DISTANCE, AREA, VOLUME C
			SHAPE, ANGLE, CONFIGURATION c
			SPEED C
			LOCATION, DIRECTION, ORIENTATION c
			TEXTURE d
			HARDNESS, CLEAVAGE d
			POROSITY, PERMEABILITY E
			MASS F
			DENSITY, CONCENTRATION G
			UNIFORMITY h

CONTINUED: LANGUAGE OF SCIENCE A • nature of matter	1-ESS1-2 The amount of daylight is related to the time of year. 2-PS1-1 Materials can be classified by their properties 2-PS1-2 Materials' properties can be matched to a purpose. 2-PS1-4 Heating causes both reversible and irreversible changes. 2-LS4-1 Plants and animals are widely diverse when compared across different habitats. 2-ESS2-3 Earth's water resources are in distinct locations and phases. 3-ESS2-1 Seasons have typical weather conditions. 3-ESS2-2 Different regions of the world have different climates. 5-PS1-3 Materials are identified based on their properties. 5-ESS2-2 Earth's various water reservoirs vary in distribution and composition.	CHARGE, POLARITY h SOLUBILITY h
	CHANGE/ PROCESS B • change-over-time K-ESS2-1 Local weather is described by patterns of property changes occurring over time. (Also put under *Property*) K-PS3-1 Sunlight affects different surfaces on Earth in different ways. K-PS3-2 Sunlight's warming effect can be reduced with designed structures. (Also put under *Skills → Design*) 2-ESS1-1 Earth events happen quickly or slowly. 2-ESS2-1 Wind/water erosion change the land. 4-ESS2-1 Weathering and erosion are caused by water, ice, wind, and vegetation. 5-ESS2-1 The geosphere, biosphere, hydrosphere, and atmosphere constantly interact.	RATIO, PERCENTAGE A SEQUENCE of EVENTS, TIME, RATE A 3-LS1-1 Birth, growth, reproduction and death are common to all life cycles. 4-LS1-2 An animal's sensory information is processed by its brain which guides the response. 4-ESS1-1 The Earth's surface changes over time, evidenced by rocks and fossils. CYCLE B • input-output • dynamic equilibrium 5-LS2 Matter cycles among plants, animals, decomposers, and the environment. CORRELATION, CAUSALITY B • (in)dependent, controlled variable 5-ESS1-1 The apparent brightness of the sun and stars is due to their relative distances from Earth. 5-ESS1-2 Tracking daylight, shadows, and celestial objects daily and seasonally reveals many patterns. GRAPH, EQUATION B

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
INTERDEPENDENCE/ ECOSYSTEM B • predator/prey • food chain/web • symbiosis: parasitism, commensalism, mutualism • natural and mechanical systems	NATURAL ENVIRONMENT A • surroundings, context • biome	HABITAT, NICHE A
		RESOURCE, POLLUTANT A
		DESIGNED or CONSTRUCTED ENVIRONMENT b
		CONSERVATION, RESTORATION B
K-LS1-1 There are patterns in what plants and animals need in order to survive.		
K-ESS2-2 Plants & animals (incl. humans) can change the environment to meet their needs.	DIVERSITY A • community	SPATIAL , TEMPORAL DISTRIBUTION B
		STATISTICAL DISTRIBUTION b • Normal (bell) distribution
K-ESS3-1 Plant/animal needs relate to where they live.	COMPLEMENTARITY B • equilibrium of flows and reservoirs	FORM AND FUNCTION A
K-ESS3-2 Weather forecasts warn of severe weather.		K-2-ETS1-1 Simple problems can often be solved with a new or improved object or tool.
K-ESS3-3 Solutions exist that will reduce human impact on the natural and living environment.		K-2-ETS1-2 An object's shape often helps it solve a given problem.
1-LS1-1 Different parts of organisms help them survive and prosper		K-2-ETS1-3 Tests of objects with the same purpose compare their strengths and weaknesses. (Also put under *Skills → Design*)
1-LS1-2 Behavior of both parent and offspring help their survival.		4-LS1-1 Organisms have structures that support survival, growth, behavior and reproduction.
2-LS2-1 Plants need light and water to grow.		
2-LS2-2 Animals help spread plant seeds.		CARRYING CAPACITY (NATURAL LIMITS) A
3LS4-1 Fossils are evidence of past organisms and environments.		
3-LS4-4 Environmental change induces changes in plant and animal species.		SUCCESSION, CLIMAX a
5-LS1-1 Plants use mostly air and water to grow.		
5-ESS3-1 Communities use science to protect the Earth's resources and environment.		CYCLE B

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
ENERGY & ENERGY RESOURCES B • energy resources and uses 4-ESS3-1 Energy and fuels are derived from natural resources and their uses affect the environment.	ENERGY FORMS & TRANSFORMATION A • groupings: potential, mechanical • photosynthesis • metabolism/respiration 4-PS3-1 An object's energy is related to its speed. 4PS3-2 Energy is transferred by sound, light, heat and electricity. 4PS3-3 Energy transformations occur when objects collide. 4-PS3-4 Many different devices convert energy from one form to another. (Also put under *Skills →Design*) 5-PS3-1 The energy in food that powers the body's processes was derived from sunlight.	POSITION (GRAVITATIONAL) ENERGY, KINETIC ENERGY A • mechanical energy
		THERMAL, CHEMICAL ENERGIES A
		ELASTIC ENERGY A
		WAVE ENERGY B
		ELECTRICAL-MAGNETIC ENERGY B
		NUCLEAR/MASS ENERGY B
	HEAT TRANSFER a	CONDUCTION A
		CONVECTION A
		RADIATION B
		ADVECTION b • transfer thru latent heat
	CONSERVATION OF ENERGY B	
	EFFICIENCY C	
	ENERGY FLOW, WORK C • bulk flow vs. molecular flow	
	POWER D	
	ENERGY DEGRADATION d	ENTROPY A • molecular disorder • 2nd law of thermodynamics

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
WAVES C • representation • type/media: surface, sound, light/radiation, vibration • properties: wavelength, frequency, amplitude, speed, direction, energy	PRODUCTION, ABSORPTION, PROPAGATION A • color of things and substances • transmission and capture of information/energy • transverse, longitudinal, polarized waves • perception & spectra	INTERFACE A partial reflection, transmission, absorption
1-PS4-1 Vibrations produce sound - sound produces vibrations.		SUPERPOSITION, INTERFERENCE, RESONANCE B
		DOPPLER EFFECT C • shock wave, wake
	OPTICS A • focus • optical instruments	
1-PS4-2 Objects are seen when illuminated.	REFLECTION A • luster/sheen • specular, diffuse reflection • scattering	
1-PS4-3 Materials have different transparencies and reflectivities.	REFRACTION B • Snell's Law • total internal reflection	DISPERSION a
1-PS4-4 Devices can be designed for communicating over a distance. (Also put under *Skills → Design*)	DIFFRACTION c	
4-PS4-1 Waves have properties like objects: amplitude, wavelength, energy.		
4-PS4-2 Reflected light allows objects to be seen.		
4-PS4-3 Patterns in transmitted waves can transfer information.		
	DUALITY (WAVE-PARTICLE) a	

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
GROWTH, DEVELOPMENT C	STAGE/PHASE A • embryo, infancy, childhood, adolescence, adult, elder • life cycle	GENESIS A
		MATURATION A
		METAMORPHOSIS A • molting
		DEGENERATION, SENESCENCE a
		REGENERATION b
	DIFFERENTIATION, SPECIALIZATION B • cellular division (mitosis)	
	LINEAR, EXPONENTIAL, GEOMETRICAL INCREASE B	

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
CHEMICAL REACTION D • reactants, products • the mole • number/mass/volume stoichiometry • solutions stoichiometry	PATTERNS IN CHEMICAL REACTIONS a • synthesis/decomposition • single/dbl displacement	COMBUSTION A • reduction/oxidation
		CARBON-BASED REACTIONS B • organic reactions
		ACID/BASE, NEUTRALIZATION b
		POLYMERIZATION b • plastics • organic macro-molecules
	BONDING A • octet rule • ionic/covalent bonds • molecular structure (Lewis, VSEPR) • inter-molecular forces (dipole, hydrogen, metallic and dispersion bonds) • solvent-solute interaction	
	CHEMICAL ENERGY, THERMAL ENERGY b • thermochemistry • sensible, latent heat • ionization energy, bond energy • heat of reaction, heat of formation • activation energy, exo/endothermic reactions • Hess's Law	ENTROPY, FREE ENERGY a
	KINETICS b • catalyst	CHEMICAL EQUILIBRIUM a • Le Chatelier's principle

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
REPRODUCTION, HEREDITY D • inherited traits • dominant/recessive traits • Punnett squares • succession, pedigree 1-LS3-1 Plants and animals resemble their parents. 3-LS3-1 Inherited traits vary among similar organisms. 3-LS3-2 An organism's specific traits are influenced by its environment. 3-LS4-2 Variation in traits may provide individuals with advantages. 3-LS4-3 Variation in traits may threaten individuals' survival	SEXUAL, ASEXUAL REPRODUCTION A • cellular reproduction FERTILITY, FERTILIZATION a • pollination • ovulation, menstruation GENETIC CODE, CODE B • genetic variation, gene/allele	TRANSLATION A ▪ transcription, replication ▪ RNA functions TRANSMISSION b EXPRESSION B • epigenetics MUTATION b • genetic drift • environment affects

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
EVOLUTION D	SELECTION A • natural selection • sexual selection • forced selection	VARIATION, ADAPTATION A EXTINCTION A
	SPECIATION B • convergence • co-evolution	GENETIC CODE (CODE) a

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
MOTION, FORCES E • types of motion (ir/regular, repetitive, accelerated, etc.) • interaction • types of forces (contact, gravity, elastic, electro-magnetic, etc.) • gravity, weight, mass K-PS2-1 Different strengths and directions of pushes or pulls produce changes in an object's motion K-PS2-2 Solutions can be designed to change an object's speed or direction with a push or pull. (Also put under *Skills → Design*) 3-PS2-1 Balanced and unbalanced forces affect an object's motion. 3PS2-2 When an object is moving in a pattern its future motion can be predicted. 5-PS2-1 Earth's gravitational force is directed down.	VELOCITY, DISPLACEMENT A • Displacement versus path distance • speed plus direction	FRAMES OF REFERENCE b
		SPECIAL RELATIVITY c
	FORCES, NET FORCE, NEWTON'S 1st and 3RD LAWS A • types of forces • force vector manipulation: scaled diagram, components	
		FRICTION A
		GRAVITY A • Universal gravitation
		ELECTROSTATIC FORCE b
		STATIC FLUID FORCES b
		DYNAMIC FLUID FORCES b • Lift, drag
		SURFACE TENSION, CAPILLARY EFFECT b
		TORQUE/MOMENTS, CENTER OF GRAVITY b • balance
		PRESSURE b • tension, compression • shear • lift • static fluid forces
		STRENGTH c • stress, strain
	FLUID FLOW a	LAMINAR FLOW, TURBULENCE A • current, streamlines
		BOUNDARY CONDITIONS b
	ACCELERATION, NEWTON'S 2ND LAW B • kinematics • linear dynamics • impulse-momentum	FICTITIOUS FORCE a • Accelerated frames of reference • Coriolis force
	2- & 3-DIMENSIONAL MOTION C • vectors for d, v, & a • central force, universal gravitation	PROJECTILE MOTION A
		CIRCULAR MOTION B
		HARMONIC MOTION b
	CONSERVATION OF MOMENTUM C	
	ROTATIONAL DYNAMICS d • angular motion properties	CONSERVATION OF ANGULAR MOMENTUM, ANGULAR ENERGY A
		ROLLING b
	QUANTUM MECHANICS e	

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
REGULATION (CONTROL) E	SWITCH A • trigger	
	FEEDBACK A • positive, negative feedback • connectivity	
	EQUILIBRIUM B • homeostasis • health	RESTORING MECHANISM A
		SUSTAINABILITY a
		THRESHOLD, CRITICAL MASS b • tipping point
	PERTURBATION, MALFUNCTION B • disease • abnormality	CONTAGION VECTOR A • propagation of perturbation
		EPIDEMIC a
		ADDICTION b

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
ELECTRICITY-and-MAGNETISM E • charge, polarity • conductors, insulators • attraction/repulsion • mapping elec & mag fields 3-PS2-3 Several factors affect electrical or magnetic interactions between objects. 3-PS2-4 Simple design can sometimes be solved with magnets. (Also put under *Skills → Design*)	SIMPLE CIRCUIT, OHM'S LAW A • load, source/supply • current, resistance, voltage • open circuit, short circuit • alternating and direct current	
	CONSERVATION OF CURRENT, VOLTAGE b • Kirchoff's Laws • series, parallel, combination circuits	CONTROL MECHANISM a • relay, diode, transistor/gate, integrated circuit, transformer
	ELECTRIC FORCE FIELD, ELECTRIC POTENTIAL c • Coulomb's Law; Inverse square law	GAUSS'S LAW a • line of force • flux
		CAPACITANCE b
	MOTOR, GENERATOR , TRANSFORMER c	
	MAGNETIC FORCE FIELD d • Force on moving charges • Bio-Savart law	AMPERE'S LAW a
		ELECTROMAGNETIC INDUCTANCE b • Lenz's Law • magnetic flux • transformers • AC inductance
		FARADAY'S LAW c • (Self-) inductance
		LR, LC, LRC CIRCUITS d
		MAXWELL'S EQUATIONS d

BASIC CONCEPT	SUB-CONCEPT	SUB-SUB-CONCEPT
BEHAVIOR E • stimulus-response • classical, operant conditioning • survival, self-interest, cooperation • nature vs. nurture	INSTINCT A	MATING A • female choice
		AGGRESSION A
	COMMUNICATION A	PERSUASION a
	LEARNING b • memory • language	COGNITION A • Accommodation, Assimilation, Adaptation • Thinking and reasoning
		KNOWLEDGE TRANSFER B • higher-order thinking • problem solving, decision making
		MOTIVATION, EMOTION b • curiosity • hierarchy of needs
		COMPETENCE, INTELLIGENCE c
	PERSONALITY b	ALTRUISM b • reciprocity
	STATES OF CONSCIOUSNESS c • sleep and dreams • hypnosis, meditation • drug induced	

TRANSFERABLE SKILLS FOR SCIENCE, TECHNOLOGY, ENGINEERING, AND DESIGN.

MAJOR CATEGORY	SUB-CATEGORY	SUB-SUB-CATEGORY
EXPERIMENTAL DESIGN / INQUIRY	QUESTION, HYPOTHESIS, PURPOSE	INDEPENDENT, DEPENDENT, CONTROLLED VARIABLES
	PROCEDURE, METHOD	OBSERVATION
		TRIAL AND ERROR
		CONTROLLED EXPERIMENT
		SURVEY
		PRIMARY SOURCE • diary & journals, interview, letter, periodical of time, oral tradition, official records.
		SECONDARY SOURCE • texts, reference books, author commentary, library/internet research.
	RESULTS, DATA, OBSERVATIONS	
	ANALYSIS, CONCLUSION	ERROR, VALIDITY, RELIABILITY
LAB SAFETY		
INFERENTIAL & PROCEDURAL PROBLEM SOLVING	SEQUENCE, COORDINATION • dating, timelines	
	AND, OR	
	IF…THEN	
THE DESIGN PROCESSSSS K-PS3-2 Sunlight's warming effect can be reduced with designed structures. (Also put under *Language of Science → Process*) K-PS2-2 Solutions can be designed to change an object's speed or direction with a push or pull. (Also put under *Motion-and-Forces)* 1-PS4-4 Devices can be designed for communicating over a distance. (Also put under *Waves*) K-2-ETS1-3 Tests of objects with the same purpose compare their strengths and weaknesses. (Also put under *Interdependence → Form-and-function*) 3-PS2-4 Simple design can sometimes be solved with magnets. (Also put under *Elec & Mag)* 3-ESS3-1 Solutions can be designed that reduce the impacts of weather-related hazards. 4-PS3-4 Many different devices convert energy from one form to another. (Also put under *Energy transformation*) 4-ESS3-2 Solutions can be designed that reduce the impact of natural Earth processes.	IDENTIFY PROBLEM/GOAL • divide problem into smaller components	CRITERIA, CONSTRAINTS 3-5 ETS1-1 Design problems reflect needs, criteria and constraints. 3-5 ETS1-2 Design solutions vary in how well they meet needs, criteria, and constraints.
		RESOURCES, MATERIALS
	GATHER INFORMATION • evidence	KNOWLEDGE AND SKILL REQUIREMENTS
	DEVELOP MULTIPLE OPTIONS	
	SELECT, REFINE, DESIGN a SOLUTION	
	CONSTRUCT SOLUTION or PROTOTYPE	
	EVALUATE SOLUTION	COSTS, BENEFITS, TRADE-OFFS
		EFFICIENCY, EFFECTIVENESS
	COMMUNICATE SOLUTION	
	RE-DESIGN SOLUTION	

MAJOR CATEGORY	SUB-CATEGORY	SUB-SUB-CATEGORY
MODELING picturing, 3-D modeling faithfulness, accuracy, precision Perspective, labeling, scaling.	MAPPING • incl. topographical, political, social, resource, climatic	
	GRAPHIC ORGANIZERS • diagram, flow chart, web, concept map	
	GRAPHIC DISPLAY • pie, bar, line graphs	
MATHEMATICAL MANIPULATION	BASIC OPERATIONS • Add, subtract, multiply, divide	
	UNIT CONVERSION	
	ALGEBRAIC MANIPULATION	
	GEOMETRY	
	VECTORS, TRIGONOMETRY	
	DIFFERENTIALS, INTEGRALS	
	MISC. MATH SKILLS	