IDAHO CONTENT STANDARDS FOR SCIENCE

Learning Progressions

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HOW TO READ THE STANDARDS

The coding for each standard labels the grade level, science domain, unit number, and standard number as shown below:

Abbreviations

K – Kindergarten

MS – Middle School

HS – High School

LS – Life Science

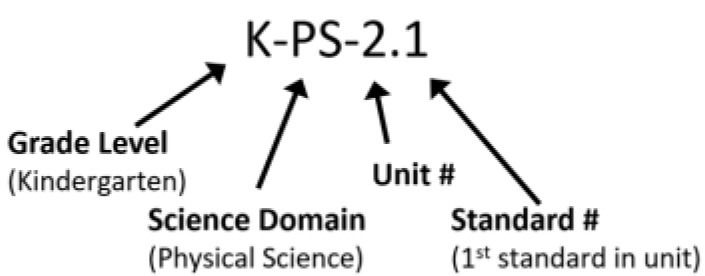
ESS – Earth and Space Science

PS – Physical Science

PSC – Physical Science Chemistry

PSP – Physical Science Physics

ETS – Engineering and Technology



SCIENCE CONTENT PROGRESSIONS

The progressions document is broken into three science content areas that can be used to help students understand the world around them, Physical Science, Life Science and Earth Science. The three content areas reflect the major branches in science and help to group key knowledge together in a progression for students to work through K-12. This section shows how these science content areas progress throughout K-12 education. The concepts are grouped into grade bands: K-2, 3-5, 6-8, and 9-12. Each grade band provides "key knowledge" for the concept, describing how students should engage with a science content area at the completion of this grade band.

The three science content areas can be broken down further into more specific areas, described below:

- **Physical Science**
  - Matter and It's Interactions
  - Motion and Stability: Forces and Interactions
  - Energy
  - Waves
- **Life Science**
  - From Molecules to Organisms: Structure and Processes
  - Ecosystems: Interactions, Energy, and Dynamics
  - Heredity: Inheritance and Variation of Traits
  - Biological Adaptation: Unity and Diversity
- **Earth Science**
  - Earth's Place in the Universe
  - Earth's Systems
  - Earth and Human Activity

Physical Science

	K-2	3-5	6-8	9-12
Physical Science *Matter and Its Interactions*	Different substances have different properties. Different substances are used for different purposes. Objects can be assembled from smaller pieces. Heating and cooling substances causes changes. Sometimes these can be reversed, sometimes not.	Matter is made of particles that are too small to be seen. Chemical reactions can change matter from one type to another. The mass is the same before and after a chemical reaction.	Matter is composed of atoms and molecules. Atoms rearrange themselves in a chemical reaction. The number and type of atoms is conserved in chemical reactions. Some reactions absorb energy, others release energy.	The interactions between electric charges can be used to explain the structure and interactions of matter. A stable molecule has less energy than those same atoms separated. This amount of energy must be provided to take a molecule apart. Chemical reactions involve collisions of molecules, and changes in energy.
Standards	• 2-PS-1.1 • 2-PS-1.2 • 2-PS-1.3 • 2-PS-1.4	• 5-PS-1.1 • 5-PS-1.2 • 5-PS-1.3 • 5-PS-1.4	• MS-PS-1.1 • MS-PS-1.2 • MS-PS-1.3 • MS-PS-1.4 • MS-PS-1.5 • MS-PS-1.6	• HS-PSC-1.1 • HS-PSC-1.2 • HS-PSC-1.3 • HS-PSC-1.4 • HS-PSC-1.5

	K-2	3-5	6-8	9-12
Physical Science *Motion and Stability: Forces and Interactions*	Pushes and pulls can move objects, change their direction, or change their speed.	When forces are in balance, objects do not move. When forces are not in balance, they move. Electric and magnetic forces do not have to contact an object to move it.	The change in motion of an object depends on two factors - the mass of the object and the amount of force applied. Electric and magnetic forces involve fields. The strength of these forces can be affected by a variety of factors.	Newton's second law can be used to predict changes in motion of objects. For changes within a system, momentum is conserved. Electric charges at the atomic scale can explain the structure and the contact forces between them. Mathematical models can describe and predict the effects of electrostatic forces between objects.
Standards	• K-PS-1.1 • K-PS-1.2	• 3-PS-1.1 • 3-PS-1.2 • 3-PS-1.4 • 3-PS-1.4	• MS-PS-2.1 • MS-PS-2.2 • MS-PS-2.3 • MS-PS-2.4 • MS-PS-2.5	• HS-PSC-1.1 • HS-PSC-1.2 • HS-PSC-1.3 • HS-PSC-1.4 • HS-PSC-1.5

	K-2	3-5	6-8	9-12
Physical Science *Energy*	Sunlight energy warms the Earth's surface	The faster an object is moving, the more energy it has. When objects collide, the transferred energy can change the object's motion. Energy can be transferred from one object to another and can transform from one type to another. Energy can be produced through the process of photosynthesis.	Kinetic energy is related to the mass and speed of an object. Objects can have stored potential energy depending on their location. Temperature is based on the kinetic energy of particles, and is determined by the type of matter, state of matter, and amount of matter. Energy moves from warmer to colder regions.	Energy within a system is conserved. The amount of energy within a system depends on the interactions of matter and the radiation within that system. The availability of energy limits what can occur within a system. When objects acting through a field change position, the energy stored in the field is changed.
Standards	• K-PS-2.1 • K-PS-2.2	• 4-PS-1.1 • 4-PS-1.2 • 4-PS-1.3 • 4-PS-1.4 • 5-PS-3.1	• MS-PS-3.1 • MS-PS-3.2. • MS-PS-3.3 • MS-PS-3.4 • MS-PS-3.5	• HS-PSP-2.1 • HS-PSP-2.2 • HS-PSP-2.3 • HS-PSP-2.4 • HS-PSP-2.5

	K-2	3-5	6-8	9-12
Physical Science *Waves*	Vibrations cause sound and sound can cause objects to vibrate. Objects can only be seen when light illuminates them. Devices that use light and sound can be used to communicate.	Waves are regular patterns of motion that can differ in terms of amplitude and wavelength. Waves can make objects move. Objects can be seen when light is reflected from and object and enters the eye. Patterns of waves can be used as signals to send information.	Mechanical waves require a medium to transmit information, and can be measured in terms of wavelength, amplitude, and frequency. Electromagnetic waves do not require a medium. The behavior of a wave can vary depending on the material it interacts with. Waves can transfer digital information in a pattern of 0s and 1s.	Wavelength and frequency are related to each other by the speed of the wave. The speed of a wave depends on the type of wave and the medium it is traveling through. Waves can be used to transfer and store information. Electromagnetic radiation can be described as both a particle and a wave and can be absorbed by matter.
Standards	• 1-PS-1.1 • 1-PS-1.2 • 1-PS-1.3 • 1-PS-1.4	• 4-PS-2.1 • 4-PS-2.2 • 4-PS-2.3	• MS-PS-4.1 • MS-PS-4.2 • MS-PS-4.3	• HS-PSP-3.1 • HS-PSP-3.2 • HS-PSP-3.3 • HS-PSP-3.4 • HS-PSP-3.5

Life Science

	K-2	3-5	6-8	9-12
Life Science *From Molecules to Organisms: Structure and Processes*	All organisms have external parts that they use to perform daily functions. Parents and offspring show patterns of behavior that help the offspring survive. Living organisms have characteristics that are different from non-living objects.	Organisms have structures that allow for growth, survival, behavior, and reproduction. Different kinds of organisms have unique life cycles. Food provides animals with the materials and energy they need for growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and acquire energy from sunlight. Sense receptors are specialized for different kinds of information; Animals use this input to guide their actions.	All living things are made of one or more cells. This is one way to determine if an organism is living or nonliving. Cells work together to form tissues and organs that are specialized for particular body functions. Plants use the energy from light to make sugars through photosynthesis. Animals break down food through a series of chemical reactions that rearrange molecules to release energy.	Specialized cells help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions. Growth and division of cells in organisms occurs by mitosis and differentiation. The hydrocarbons produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through an organism; elements are recombined to form new products and transfer energy.
Standards	• K-LS-1.1 • 1-LS-1.1 • 1-LS-1.2 • 1-LS-1.3	• 3-LS-1.1 • 4-LS-1.1 • 4-LS-1.2 • 5-LS-1.1	• MS-LS-1.1 • MS-LS-1.2 • MS-LS-1.3 • MS-LS-1.4 • MS-LS-1.5 • MS-LS-1.6	• HS-LS-1.1 • HS-LS-1.2 • HS-LS-1.3 • HS-LS-1.4 • HS-LS-1.5 • HS-LS-1.6 • HS-LS-1.7

	K-2	3-5	6-8	9-12
Life Science *Ecosystems: Interactions, Energy, and Dynamics*	Plants need water and light to grow. Plants depend on other organisms to pollinate flowers or to disperse seeds.	Being part of a group helps animals obtain food and defend themselves. Matter cycles between the air, soil, plants, and animals throughout an organism's life cycle. When the environment changes some organisms survive and reproduce, some move to new locations, and some do not survive.	The populations of organisms can vary depending on their interactions with both living and nonliving factors. Interactions among species can be competitive, predatory, or mutually beneficial. Atoms are cycled repeatedly between the living and nonliving parts of the ecosystem. Models can explain how matter and energy are transferred among producers, consumers, and decomposers as these groups interact. Ecosystems change over time, and disruptions can lead to shifts in populations of organisms. An ecosystem's biodiversity is often used as a measure of its health.	Ecosystems have carrying capacities based on the biotic and abiotic factors present. Resource availability and population numbers affect the abundance of species in any given ecosystem. Photosynthesis and cellular respiration provide the energy for life processes. They are also important parts of the global carbon cycle. Not all the energy consumed by an organism is transferred to the next trophic system, which affects the number of organisms at each feeding level. If a disturbance to an ecosystem occurs, it may return to its original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
Standards	• 2-LS-1.1 • 2-LS-1.2	• 3-LS-2.1 • 5-LS-2.4 • 5-LS-2.3	• MS-LS-2.1 • MS-LS-2.2 • MS-LS-2.3 • MS-LS-2.4 • MS-LS-2.5 • MS-LS-2.6	• HS-LS-2.1 • HS-LS-2.2 • HS-LS-2.3 • HS-LS-2.4 • HS-LS-2.5 • HS-LS-2.6 • HS-LS-2.7

	K-2	3-5	6-8	9-12
Life Science *Heredity: Inheritance and Variation of Traits*	Offspring resemble their parents but are not exactly alike them. Organisms have many characteristics in common with others of the same kind.	Organisms vary in how they look and function because they have different inherited information. The environment affects the traits that an organism develops.	In sexual reproduction, each parent contributes half of the genes in an offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations. These may result in beneficial, negative, or no change to proteins in or traits of an organism.	DNA carries instructions for forming a species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ. Genes determine which specific protein is made, which affects an individual's traits. The variation and distribution of traits in a population depend on both genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.
Standards	1-LS-2.1	• 3-LS-3.1 • 3-LS-3.2	• MS-LS-3.1 • MS-LS-3.2	• HS-LS-3.1 • HS-LS-3.2 • HS-LS-3.3

	K-2	3-5	6-8	9-12
Life Science *Biological Adaptation: Unity and Diversity*	Different organisms live in different places around the world.	Different organisms have traits that allow them to survive in particular environments. Some living organisms resemble organisms that are now extinct. Fossils can provide evidence about the range of organisms and environments that existed long ago. Organisms inherit different characteristics, which sometimes provide an advantage in surviving and reproducing. A change in an ecosystem can affect the organisms that live there.	The fossil record documents the diversity, extinction, and change of many life forms and their environments. Comparisons of anatomical similarities between organisms allows us to infer relationships and classify organisms, both living and extinct. Natural selection results in certain traits giving some individuals an advantage in surviving and reproducing, leading to certain traits being more popular in a population. Humans have created technologies to allow us to influence the inheritance of desired traits in organisms. Changes in traits in a population happen over long periods of time in response to environmental conditions.	DNA sequences, amino acid sequences, and anatomical similarities all help identify common lines of descent. Genetic variation within a species and competition for resources leads to natural selection, where traits that positively affect survival will become more common within a population. Species adapt over long periods of time when the distribution of traits in a population change, as well as species expansion, emergence or extinction. These are influenced by change in environmental conditions.
Standards	2-LS-2.1	• 3-LS-3.3 • 5-LS-2.1 • 5-LS-2.2 • 5-LS-2.3	• MS-LS-4.1 • MS-LS-4.2 • MS-LS-4.3 • MS-LS-4.4 • MS-LS-4.5 • MS-LS-4.6	• HS-LS-4.1 • HS-LS-4.2 • HS-LS-4.3 • HS-LS-4.4 • HS-LS-4.5

Earth and Space Science

	K-2	3-5	6-8	9-12
Earth and Space Science *Earth's Place in the Universe*	Movements of the Sun, moon, and stars can be observed, described, and predicted. Some events on Earth occur very quickly; some occur very slowly.	Features in Earth's crust can be used to explain what happened in the past and how a landscape has changed. The brightness of stars as viewed from Earth can be explained by their size and their distance from Earth. There are observable and identifiable patterns in Earth's orbit around the Sun, and the moon's orbit around Earth.	The solar system contains many celestial bodies held near the Sun by gravity. Models of the solar system can be used to explain and predict events such as eclipses, lunar phases, and seasons. The solar system is part of the Milky Way, which is one of billions of galaxies. Rock strata can be used as evidence to organize the major historical events in Earth's history.	Light spectra from stars are used to determine their characteristics and life cycles. Stars create elements through nuclear fusion. Hubble's Law and CMB radiation provide empirical evidence for the Big Bang theory. Kepler's laws explain the motions of orbiting objects. Tectonic and other geological processes, the resulting rock record, and objects from the solar system can provide evidence of Earth's formation, early history, and the relative ages of major geologic formations.
Standards	• 1-ESS-1.1 • 1-ESS-1.2 • 2-ESS-1.1	• 4-ESS-1.1 • 5-ESS-1.1 • 5-ESS-1.2	• MS-ESS-1.1 • MS-ESS-1.2 • MS-ESS-1.3 • MS-ESS-1.4	• HS-ESS-1.1 • HS-ESS-1.2 • HS-ESS-1.3 • HS-ESS-1.4 • HS-ESS-1.5 • HS-ESS-1.6

	K-2	3-5	6-8	9-12
Earth and Space Science *Earth's Systems*	Weather varies throughout the year in predictable patterns. Plants and animals interact with their environment to meet their needs. Land formations can be changed by wind and water. Creating a map can show the shapes and kinds of land and water in an area. Water can be found in different forms on Earth.	When weather patterns are displayed graphically, they can be analyzed to make predictions. Climate varies around the world. Geological events occur in patterns. Maps of the physical features on Earth can be used to predict these events. Rain, wind, and ice break sediments down into smaller pieces and move them around. Earth has four major systems that interact: geosphere, biosphere, hydrosphere, and/or atmosphere. The distribution of fresh and salt water across Earth can be analyzed graphically.	Energy flows and matter cycles within the Earth. This drives the rock cycle, shapes landforms, and the movement of Earth's crust. Plate tectonics is the theory that explains movements of Earth's crust. Maps of the continents and seafloor structures are analyzed for evidence of plate movement. Water cycles among the geosphere, atmosphere, and hydrosphere, driven by energy from the Sun and gravity. Interactions between the energy from the Sun and the rotation of the Earth influence ocean and atmospheric currents. These determine local weather patterns and influence climate.	Changes to Earth's systems can cause feedbacks that change other systems. Earth's interior contributes to thermal convection in the mantle. The planet's dynamics are greatly influenced by water's unique chemical and physical properties. The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Carbon cycles through Earth's four major systems. Earth's systems have many interact continually which causes coevolution of Earth's surface and life on it
Standards	• K-ESS-1.1 • K-ESS-1.2 • 2-ESS-2.1 • 2-ESS-2.2 • 2-ESS-2.3	• 3-ESS-1.1 • 4-ESS-2.1 • 4-ESS-2.2 • 5-ESS-2.1 • 5-ESS-2.2	• MS-ESS-2.1 • MS-ESS-2.2 • MS-ESS-2.3 • MS-ESS-2.4 • MS-ESS-2.5 • MS-ESS-2.6	• HS-ESS-2.1 • HS-ESS-2.2 • HS-ESS-2.3 • HS-ESS-2.4 • HS-ESS-2.5 • HS-ESS-2.6 • HS-ESS-2.7

	K-2	3-5	6-8	9-12
Earth and Space Science *Earth and Human Activity*	Some regions have more severe weather events than others. Forecasts allow people to prepare for severe weather. Things people do can affect the environment but they can make choices to make positive impacts.	Severe weather or geological hazards from Earth processes cannot be eliminated, but humans can reduce their impacts. Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable, others are not.	Humans depend on Earth's land, ocean, and atmosphere for different resources, many of which are not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes. Analyzing data about the history of natural hazards in a region can help predict future events. Human activity affects the Earth's systems. Technology can be engineered to increase the beneficial effects. Many factors interact to cause climate variability over time.	Human activity is altered by natural hazards, resource availability, and changes in climate. Energy and mineral resource procurement can be evaluated by their associated costs, risks, and benefits. Human activities are affecting the relationship among Earth's four major systems. For human societies to be sustainable, responsible management of natural resources, including technological development must be considered. Climate variability affects Earth at a regional and a global level.
Standards	• K-ESS-2.2 • K-ESS-2.3	• 3-ESS-2.1 • 4-ESS-3.1 • 4-ESS-3.2 • 5-ESS-3.1	• MS-ESS-3.1 • MS-ESS-3.2 • MS-ESS-3.3 • MS-ESS-3.4 • MS-ESS-3.5	• HS-ESS-3.1 • HS-ESS-3.2 • HS-ESS-3.3 • HS-ESS-3.4 • HS-ESS-3.5 • HS-ESS-3.6

SCIENCE SKILLS PROGRESSIONS

There are eight science ***skills*** that can be used to help students build skills necessary for conducting and engaging in authentic science experiences. Found embedded within each standard, these skills represent the skills that real-world scientists possess and use to solve problems in the world around them.

This next section of this document shows how these science skills progress throughout K-12 education. The concepts are grouped into grade bands: K-2, 3-5, 6-8, and 9-12. Each grade band provides "task demands" for the skills, describing how a student should engage with a science skill at the completion of this grade band.

The eight science skills are briefly described below:

- **Asking and Defining Problems:** Asking and refining questions lead to descriptions and explanations of how the world works. Both scientists and engineers also ask questions to clarify ideas.
- **Developing and Using Models:** Using and constructing models is a helpful tool for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Measurements and observations are used to revise models and designs.
- **Analyzing and Interpreting Data:** Investigations produce data that must be analyzed to derive meaning. Scientists use a range of tools to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results.
- **Planning and Carrying Out Investigations:** Planning and carrying out investigations in the field or laboratory requires clarification on what counts as data and the identification of variables or parameters.
- **Using Mathematics and Computational Thinking:** Mathematics and computation are fundamental tools for representing physical variables and their relationships. Mathematical and computational approaches enable scientists and engineers to predict and/or determine validity for the behavior of systems.
- **Constructing Explanations and Designing Solutions:** Explanations are one of the end products of science. One of the goals of science is the creation of scientific theories that provide accounts of phenomena in the world. Theories must be supported by multiple lines of empirical evidence and data. Scientists design solutions to solve complex, real-world problems.
- **Obtaining, Evaluating, and Communicating Information:** Clear communication is necessary to present ideas and methods. Critiquing and communicating ideas is a critical professional activity.
- **Engaging in Argument from Evidence:** Argumentation is a process by which scientists develop evidence-based conclusions. Reasoning and argument are important to identifying the explanations for a natural phenomenon.

Asking Questions and Defining Problems

K-2	3-5	6-8	9-12
Asking questions and defining problems *in K–2 builds on students' past experiences and progresses to simple questions that might be tested.* Use observations to ***ask questions*** about the world. ***Ask questions*** to gather extra information about a topic. ***Ask*** and/or identify ***questions*** that can be answered by conducting an investigation or experiment ***Define a problem*** that can be solved through developing a new or improved technology.	***Asking questions and defining problems*** *in 3–5 builds on K–2 skills and progresses to include qualitative relationships.* ***Ask questions*** about changing variables. Identify scientific and non-scientific ***questions***. ***Ask questions*** that can be investigated and predict possible outcomes, based on patterns. Use past knowledge to explain ***problems*** that can be solved. ***Define a simple problem*** that might be solved through the development of a technology or procedure and includes several constraints (materials, time, cost) and success criteria.	***Asking questions and defining problems*** *in 6–8 builds on K–5 skills and progresses to include relationships between variables and clarifying arguments/models.* ***Ask questions…*** • that come from observations, phenomena, models, or results, to clarify and/or seek extra information. • to identify, clarify evidence, and/or the premise(s) of arguments. • to determine relationships between variables (independent/dependent) and relationships in models. • to clarify and/or refine a model, explanation, or engineering problem. • that require empirical evidence to answer. • that can be investigated with available resources and, when appropriate, frame a hypothesis. • that challenge arguments or interpretations of a data set. ***Define a problem*** that can be solved through the development of a technology or procedure and includes several constraints (scientific knowledge that may limit possible solutions) and success criteria.	***Asking questions and defining problems*** *in 9–12 builds on K–8 skills and progresses to include formulating, refining, and evaluating testable questions and designing problems using models and simulations.* ***Ask questions…*** • that come from observation of phenomena or results, to clarify and/or seek extra information. • that arise from observing models or theories to clarify and/or extra additional information and relationships. • to define relationships (quantitative, independent/dependent variables). • to clarify a model, explanation, or engineering problem. Evaluate a ***question*** to determine if it is testable and relevant. ***Ask questions*** that can be investigated with available resources and, when appropriate, frame a hypothesis based on a model or theory. ***Ask*** and/or evaluate ***questions*** that challenge an argument, the interpretation of data sets, or the suitability of designs. ***Define a problem*** that can be solved through the development of a technology or procedure and includes several constraints (social, technical and/or environmental considerations) and success criteria.

Developing and Using Models

K-2	3-5	6-8	9-12
Modeling *in K–2 builds on students' past experiences and progresses to include developing and using models that represent concrete events or designs.* Differentiate a ***model*** and an actual object, process, and/or event the model represents. Compare ***models*** to identify common components and differences. ***Develop and/or use a model*** to represent quantity, relationships, scales (bigger, smaller), and/or patterns in the world. ***Develop a model*** based on evidence to represent a proposed technology.	***Modeling*** *in 3–5 builds on K–2 skills and progresses to include building and revising models and using models to represent events and designs.* Identify limitations of ***models***. Collaboratively develop and/or revise a ***model,*** using evidence, that shows relationships among variables for regular/frequent events. ***Develop a model*** using an analogy, example, or abstract representation to describe a scientific principle or design. ***Develop and/or use models*** to describe and/or predict phenomena. ***Develop*** a diagram or simple physical prototype to convey a proposed technology or procedure. ***Use a model*** to test cause and effect relationships and/or interactions of the functioning of a system.	***Modeling*** *in 6–8 builds on K–5 skills and progresses to include developing, using, and revising models to describe, test, and predict abstract phenomena and designs.* Evaluate limitations of a ***model*** for a proposed model. ***Develop or modify a model***, based on evidence, to match what happens if a variable or component of a system is changed. ***Use and/or develop a model*** of systems with uncertain and/or unpredictable factors. ***Develop and/or revise a model*** to show the relationships among variables (observable and not observable) and predict observable phenomena. ***Develop and/or use a model*** to predict and/or describe phenomena. ***Develop a model*** to describe unobservable processes. ***Develop and/or use a model*** to generate data to test ideas about phenomena in systems (inputs/outputs) and ideas at unobservable scales.	***Modeling*** *in 9–12 builds on K–8 skills and progresses to include using, synthesizing, and developing models to predict and represent relationships between variables and system components in the world.* Evaluate merits and limitations of two different ***models*** of the same proposed technology or procedure to select or revise a model that fits the evidence or criteria best. Design a test of a ***model*** to determine reliability. ***Develop, revise, and/or use a model***, based on evidence, to illustrate and/or predict relationships between systems or components of a system. Develop and/or use multiple types of ***models*** to predict phenomena, demonstrate flexibility based merits and limitations. Develop a ***model*** that allows for manipulation and testing of a proposed process or system. ***Develop and/or use a model*** (including mathematical and computational) to produce data that supports explanations, predicts phenomena, analyzes systems, and/or solves problems.

Analyzing and Interpreting Data

K-2	3-5	6-8	9-12
Analyzing data *in K–2 builds on students' past experiences and progresses to include collecting, recording, and sharing observations.* Record information (observations, thoughts, and ideas). Use and share representations of observations. Use observations to describe patterns and/or relationships in the world to answer scientific questions and solve problems. Compare predictions, based on prior experiences, to what occurred in an observable event. Analyze ***data*** from tests of a technology to determine if it works.	***Analyzing data*** *in 3–5 builds on K–2 skills and progresses to include introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.* When possible, digital tools should be used. Represent ***data*** in tables and/or various graphical displays to reveal patterns and relationships. ***Analyze and interpret data*** to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Compare and contrast ***data*** collected by different groups to discuss similarities and differences in findings. ***Analyze data*** to refine a statement of problem or the design of a proposed technology or procedure. ***Use data*** to evaluate and refine solutions.	***Analyzing data*** *in 6–8 builds on K–5 skills and progresses to include quantitative analysis of investigations, differentiating correlation and causation, and statistical techniques of data analysis.* Construct, analyze, and/or interpret graphical displays of ***data*** to identify linear and nonlinear relationships. Use graphical displays of large ***data*** sets to identify temporal and spatial relationships. Differentiate causal and correlational relationships in ***data***. ***Analyze and interpret data*** to provide evidence for phenomena. Apply concepts of statistics and probability to ***analyze data***, using digital tools when possible. Consider limitations of ***data analysis*** and/or seek to improve precision and accuracy of data with improved technology and methods. ***Analyze and interpret data*** to determine similarities and differences in findings. ***Analyze data*** to optimize the operational range for a technology or procedure that meets success criteria the best.	***Analyzing data*** *in 9–12 builds on K–8 skills and progresses to include introducing detailed statistical analysis, comparisons of data sets for consistency, and the use of models to generate and analyze data.* ***Analyze <u>data</u>*** **using tools, technology, and/or models to make valid scientific claims or optimize a solution.** Apply concepts of statistics and probability to scientific/engineering questions and problems, using digital tools when possible. **Consider limitations of *<u>data analysis</u>* when analyzing and interpreting data.** Compare and contrast various types of ***<u>data</u>*** sets to examine consistency of measurements and observations. **Evaluate the impact of new *<u>data</u>* on a working explanation and/or model of a proposed procedure.** ***<u>Analyze data</u>*** to identify design features or characteristics of the components of a proposed procedure for optimization.

Planning and Carrying Out Investigations

K-2	3-5	6-8	9-12
Planning and carrying out investigations *in K–2 builds on past experiences and progresses to include simple investigations, based on fair tests, which provide data that supports explanations or solutions.* **With guidance, *plan and conduct an investigation* in collaboration with peers (for K).** Collaboratively***, plan and conduct an investigation*** to produce data that serves as evidence to answer a question. **Evaluate different ways of observing and/or measuring a phenomenon to determine how a question can be answered.** Make observations and/or make measurements to collect data for comparisons. **Make observations and/or make measurements of a proposed technology or solution to determine if it solves a problem or meets a goal.** Make predictions based on prior experiences.	***Planning and carrying out investigations*** *in 3–5 builds on K– 2 skills and progresses to include investigations that control variables and provide evidence for explanations or solutions.* **Collaboratively, *plan and conduct an investigation* to produce data that serves as the basis for evidence.** When ***planning and conducting an investigation***, use fair tests in which variables are controlled and the number of trials considered. **Evaluate appropriate methods and/or tools for collecting data.** Make observations and/or make measurements to produce data that supports explanations of a phenomenon or tests a design solution. **Make predictions about what would happen if a variable changes.** Test two different models of the same proposed technology or process to determine which better meets the success criteria.	***Planning and carrying out investigations*** *in 6-8 builds on K-5 skills and progresses to include investigations with multiple variables and providing evidence to support explanations or solutions.* ***Plan an investigation* individually and collaboratively, and in the design…** • **identify independent and dependent variables** • **identify controls** • **explain what tools are needed to do the gathering data** • **explain how measurements will be recorded** • **determine how much data is needed to support a claim** ***Conduct an investigation***, evaluate, and/or revise the experimental design to produce data that serves as evidence for meeting the goal(s) of the investigation. **Evaluate the accuracy of various methods for data collection.** Collect data to produce data that serves as the basis for evidence to scientific questions or tests solutions under a range of conditions. **Collect data about the performance of a proposed technology or procedure under a range of conditions.**	***Planning and carrying out investigations*** *in 9-12 builds on K-8 skills and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.* **Individually, *plan an investigation* or test a design to produce data that serves as evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems.** Consider possible confounding variables to 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** • **consider limitations to data precision (e.g., number of trials, cost, risk, time), and refine the design accordingly.** ***Plan and conduct an investigation*** or test a solution in a safe and ethical manner including external considerations. **Select appropriate tools to collect, record, analyze, and evaluate data.**

Using Mathematics and Computational Thinking

K-2	3-5	6-8	9-12
Mathematical and computational thinking *in K–2 builds on past experience and progresses to include recognizing that mathematics can be used to describe the world.* Determine when to use qualitative vs. quantitative data. Use counting and numbers to identify and describe patterns in the world. Describe, measure, and/or compare quantitative elements of different objects and use simple graphs to display data. Use quantitative data to compare two differing solutions to a problem.	***Mathematical and computational thinking*** *in 3–5 builds on K–2 skills and progresses to include using quantitative measurements with physical properties and using mathematics to analyze data and compare different solutions.* Determine if qualitative or quantitative data are best to determine whether a proposed technology meets success criteria. Organize simple data sets to reveal patterns and relationships. Describe, measure, estimate, and/or graph quantities to address questions and problems. Create and/or use graphs and/or charts generated from simple algorithms to compare different solutions to problems.	***Mathematical and computational thinking*** *in 6–8 builds on K–5 skills and progresses to include identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.* Use digital tools to analyze very large data sets for patterns and trends. Use ***mathematical*** representations to describe and/or support scientific conclusions and solutions. Create algorithms to solve a problem. Apply ***mathematical*** concepts and/or processes to questions and problems. Use digital tools and/or ***mathematical*** concepts and arguments to test and compare proposed solutions to an engineering problem.	***Mathematical and computational thinking*** *in 9- 12 builds on K-8 skills and progresses to include using algebraic thinking and analysis, linear and nonlinear functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data.* Simple ***computational*** simulations are created and used based on ***mathematical*** models of basic assumptions. Create and/or revise a ***computational*** model or simulation of a phenomenon, technology or procedure. Use ***mathematical, computational***, and/or algorithmic representations of phenomena or solutions to describe and/or support claims and/or explanations. Apply techniques of algebra and functions to represent and solve problems. Use simple limit cases to test ***mathematical*** expressions, computer programs, algorithms, or simulations of a process or system to see if a model matches outcomes defined by the real world. Apply ratios, rates, percentages, and unit conversions in the context of measurement problems involving quantities with derived or compound units.

Constructing Explanations and Designing Solutions

K-2	3-5	6-8	9-12
Constructing explanations and designing solutions *in K–2 builds on past experiences and progresses to include the use of evidence and ideas in constructing evidence- based accounts of phenomena and solutions.* Make observations to construct an evidence-based account for phenomena. Use tools and/or materials to ***design*** and/or build a device that solves a problem or ***design*** a solution to a specific problem. Generate and/or compare multiple solutions to a problem.	***Constructing explanations and designing solutions*** *in 3–5 builds on K–2 skills and progresses to include the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to problems.* ***Construct an explanation*** of observed relationships. Use evidence to ***construct an explanation*** or design a solution to a problem. Identify evidence that supports specific elements of an explanation. Apply scientific ideas to solve design problems. Generate and compare multiple solutions to a problem based on how they meet success criteria and constraints.	***Constructing explanations and designing solutions*** *in 6–8 builds on K– 5 skills and progresses to include constructing explanations and designing solutions supported by multiple sources of scientific evidence.* ***Construct an explanation*** that includes qualitative or quantitative relationships between variables that predict and/or describe phenomena. ***Construct an explanation*** using models. ***Construct an explanation*** based on valid and reliable evidence and the assumptions that scientific theories and laws use to describe the natural world. Apply scientific ideas, principles, and/or evidence to ***construct, revise and/or use an explanation*** for phenomena, examples, or events. Apply scientific reasoning to demonstrate why data or evidence are adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of a technology or procedure. Engage in a project that includes in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. Optimize the performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.	***Constructing explanations and designing solutions*** *in 9–12 builds on K–8 skills and progresses to include explanations and designs that are supported by student-generated sources of evidence consistent with scientific evidence.* Make quantitative and/or qualitative claims regarding the relationship between dependent and independent variables. ***Construct and revise an explanation*** based on valid and reliable evidence from a variety of sources and assumptions that scientific theories and laws use to describe the natural world. Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve problems, taking into account unexpected events. Apply scientific reasoning, theory, and/or models to link evidence to the claims that assess the extent to which the reasoning and data support an explanation. ***Design, evaluate, and/or refine a solution*** to a real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.

Obtaining, Evaluating, and Communicating Information

K-2	3-5	6-8	9-12
Obtaining, evaluating, and communicating information *in K–2 builds on past experiences and uses observations and texts to communicate new information.* Read grade-appropriate texts and/or use media to ***obtain information*** to determine patterns in and/or evidence about the world. Describe how specific images support a scientific or engineering idea. ***Obtain information*** using various texts, text features, and other media that will be useful in answering a scientific question and/or supporting a scientific claim. Collaboratively, ***communicate information*** or ideas and/or solutions with others in oral, written, and/or visual ways about scientific ideas and/or design ideas.	***Obtaining, evaluating, and communicating information*** *in 3–5 builds on K–2 skills and progresses to include evaluating the quality and accuracy of ideas and methods.* Read and comprehend grade-appropriate texts and/or other reliable media to summarize and obtain scientific ideas and describe how they are supported by evidence. Compare and/or combine across texts and/or other reliable media to support engagement in other scientific and/or engineering practices. Combine information in texts with corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. ***Obtain*** and combine information from books and/or other reliable media to explain phenomena or solutions. ***Communicate*** scientific and/or technical information in oral, written, visual ways.	***Obtaining, evaluating, and communicating information*** *in 6–8 builds on K–5 skills and progresses to include evaluating the quality and validity of ideas and methods.* **Read scientific texts (adapted for classroom use) to determine the central ideas and/or *obtain information* to describe patterns in and/or evidence about the world.** Integrate qualitative and/or quantitative information found in written text with that contained in media and visual displays to ***communicate*** claims and findings. **Gather, read, and synthesize information from multiple sources and assess…** • **credibility** • **Accuracy** • **possible bias of each publication and methods used** • **how they are supported or not supported by evidence** ***Evaluate*** data, hypotheses, and/or conclusions in scientific and technical texts when competing accounts occur. ***Communicate* information in oral and written presentations.**	***Obtaining, evaluating, and communicating information*** *in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.* **Read scientific literature (adapted for classroom use) to determine the central ideas, determine conclusions, and/or *obtain information* to summarize…** • **complex evidence** • **concepts** • **processes** • **information presented in a text** **by paraphrasing them in simpler terms.** Compare, integrate, and ***evaluate sources of information*** presented in different media or formats as well as in words to address a question or solve a problem. **Gather, read, and evaluate information from multiple credible 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 information* or ideas in multiple formats.**

Engaging in Argument for Evidence

<table>
<tr><th>K-2</th><th>3-5</th><th>6-8</th><th>9-12</th></tr>
<tr>
<td>Engaging in argument from evidence in K–2 builds on past experiences and progresses to comparing ideas and representations about the world.

Identify arguments supported by evidence.

Distinguish between explanations that account for gathered evidence and those that do not.

Analyze why some evidence is relevant to a question and some is not.

Distinguish between opinions and evidence in one's own explanations.

Listen actively to arguments and indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument.

Construct an argument with evidence to support a claim.

Make a claim about the effectiveness of technology or procedure that is supported by relevant evidence.</td>
<td>Engaging in argument from evidence in 3–5 builds on K–2 skills and progresses to include critiquing the scientific explanations or solutions proposed by peers, by citing relevant evidence.

Compare and refine arguments based on an evaluation of evidence.

Distinguish among facts, reasoned judgment, and opinions in an argument.

Respectfully provide and receive criticism from peers about a proposed procedure, explanation, or model by citing evidence and posing specific questions.

Construct and/or support an argument with evidence, data, and/or a model.

Use data to evaluate claims about cause and effect.

Make a claim about the merit of a solution to a problem by citing evidence about how it meets the success criteria and constraints.</td>
<td>Engaging in argument from evidence in 6–8 builds on K–5 skills and progresses to include constructing an argument that supports or refutes claims for either explanations or solutions.

Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.

Respectfully provide and receive criticism about one's explanations, procedures, models, and questions by citing evidence and posing/responding to questions that elicit elaboration.

Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation, model for a phenomenon, or a solution to a problem.

Make oral or written arguments that support or refute the advertised performance of a technology, based on empirical evidence for whether it meets success criteria and constraints.</td>
<td>Engaging in argument from evidence in 9–12 builds on K–8 skills and progresses to include using sufficient evidence and scientific reasoning to defend and critique claims/explanations.
<u>Arguments</u> may also come from current or historical events.
Compare and evaluate competing <u>arguments</u> or design solutions in light of currently accepted explanations, new evidence, limitations, and constraints.
Evaluate the claims, evidence, and/or reasoning behind current explanations or solutions to determine the merits of <u>arguments.</u>
Respectfully provide and/or receive critiques on scientific <u>arguments</u> by…
probing reasoning and evidence
challenging ideas and conclusions
responding thoughtfully to diverse perspectives
determining additional information required to resolve contradictions
Construct, use, and/or present oral and written <u>argument</u> or counterarguments based on evidence.
Make and defend a claim, based on evidence, about the world or the effectiveness of a technology that reflects scientific knowledge and student-generated evidence.</td>
</tr>
</table>

SCIENCE CONCEPT PROGRESSIONS

There are seven science ***concepts*** that can be used to help students recognize and make deep connections between various fields and seemingly disparate topics. These concepts enrich student practices that enhance their understanding of core ideas and content knowledge.

This section shows how these science concepts progress throughout K-12 education. The concepts are grouped into grade bands: K-2, 3-5, 6-8, and 9-12. Each grade band provides “task demands” for the concept, describing how students should engage with a science concept at the completion of this grade band.

The seven science concepts are briefly described below:

- **Patterns:** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
- **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering these relationships, and the mechanisms by which they happen, is a major activity of science and engineering.
- **Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
- **Systems and System Models:** A system is an organized group of related objects or components. Models can be used for understanding and predicting the behavior of systems.
- **Energy and Matter:** Tracking energy and matter flows, into, out of, and within systems helps one understand their system’s behavior.
- **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions.
- **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

Patterns

K-2	3-5	6-8	9-12
Patterns *in K–2 build students' ability to recognize that patterns in the world can be observed, used to describe phenomena, and used as evidence.* ***Patterns*** in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	***Patterns*** *in 3–5 builds on K–2 skills and progresses to include similarities and differences in patterns, predictions and evidence.* Similarities and differences in ***patterns*** can be used to sort, classify, communicate and analyze natural and designed phenomena. ***Patterns*** of change can be used to make predictions. ***Patterns*** can be used as evidence to support an explanation.	***Patterns*** *in 6–8 builds on K–5 skills and progresses to include relationships between variables and clarifying arguments/models.* Large scale ***patterns*** are related to the nature of small scale and atomic-level structure. ***Patterns*** in rates of change and other numerical relationships can provide information about natural and human designed systems. ***Patterns*** can be used to identify cause and effect relationships. Graphs, charts, and images can be used to identify ***patterns*** in data.	***Patterns*** *in 9–12 builds on K–8 skills and progresses to include students observing patterns in systems at different scales, using patterns as empirical evidence, and in analyzing and redesigning systems.* Different ***patterns*** may be observed at each of the scales at which a system is studied and can provide evidence for explanations of phenomena. Recognize ***pattern*** classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. Mathematical representations are needed to identify some ***patterns.*** Empirical evidence is needed to identify ***patterns.*** ***Patterns*** of performance of designed systems can be analyzed and reengineered to improve the system.

Cause and Effect

K-2	3-5	6-8	9-12
Cause and Effect** in K–2 build students' ability to recognize that events have causes that generate observable patterns.* ***Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about ***causes***.	***Cause and Effect** in 3–5 builds on K–2 skills and progresses to where students routinely identify and test causal relationships and use these relationships to explain change.* ***Cause and effect*** relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not signify a ***cause and effect*** relationship.	***Cause and Effect** in 6–8 builds on K–5 skills and progresses to classifying relationships as causal or correlational and recognizes that correlation does not necessarily imply causation.* Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. ***Cause and effect*** relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one ***cause***, and some ***cause and effect*** relationships in systems can only be described using probability.	***Cause and Effect** in 9–12 builds on K–8 skills and progresses to include students understanding that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects.* Empirical evidence is required to differentiate between ***cause*** and correlation and make claims about specific ***causes and effects***. ***Cause and effect*** relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms with the system. Changes in systems may have various ***causes*** that may not have equal ***effects.***

Scale, Proportion, and Quantity

K-2	3-5	6-8	9-12
Scale, Proportion, and Quantity *in K–2 build students' ability to use relative scales (bigger and smaller; hotter and colder; faster and slower) as well as standard units to measure length.* Relative ***scales*** allow objects and events to be compared and described (bigger and smaller; hotter and colder; faster and slower). Standard units are used to ***measure*** length.	***Scale, Proportion, and Quantity*** *in 3–5 builds on K–2 skills and progresses to include students recognizing natural objects and observable phenomena exist from the very small to the immensely large as well as continuing to use stand units to measure and describe physical quantities.* Natural objects and/or observable phenomena exist from the very small to immensely large or from very short to very long time periods. Standard units are used to ***measure*** and describe physical ***quantities*** such as weight, time, temperature, and volume. .	***Scale, Proportion, and Quantity*** *in 6–8 builds on K–5 skills and progresses to include students observing time, space, and energy phenomena at various scales using models to study systems that are too large or too small.* Time, space, and energy phenomena can be observed at various ***scales*** using models to study systems that are too large or too small. Phenomena observed at one ***scale*** may not be observable at another ***scale***, and the function of natural and designed systems may change with ***scale.*** ***Proportional relationships*** (speed as the ratio of distance traveled to time taken) is used to gather information about the magnitude of properties and processes. Scientific relationships are represented through the use of algebraic expressions and equations.	***Scale, Proportion, and Quantity*** *in 9–12 builds on K–8 skills and progresses to include students understanding the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.* The significance of a phenomenon is dependent on the ***scale, proportion and quantity*** at which it occurs. Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Patterns observable at one ***scale*** may not be observable or exist at other ***scales.*** Using the concept of orders of magnitude allows one to understand how a model at one ***scale*** relates to a model at another ***scale.*** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (linear growth vs. exponential growth).

Systems and System Models

K-2	3-5	6-8	9-12
Systems and System Models *in K–2 build students' ability to recognize that objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.* Objects and organisms can be described in terms of their parts. ***Systems*** in the natural and designed world have parts that work together.	***Systems and System Models*** *in 3–5 builds on K–2 skills and progresses to include that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.* A ***system*** is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A ***system*** can be described in terms of its components and their interactions.	***Systems and System Models*** *in 6–8 builds on K–5 skills and progresses to include that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.* ***Systems*** may interact with other ***systems;*** they may have ***sub-systems*** and be a part of larger complex ***systems.*** ***Models*** can be used to represent ***systems*** and their interactions - such as inputs, processes, and outputs - and energy, matter, and information flows within ***systems.*** ***Models*** are limited in that they only represent certain aspects of the system under study.	***Systems and System Models*** *in 9–12 builds on K–8 skills and progresses to include investigation and/or analyzing a system by defining its boundaries and initial conditions, as well as its inputs and outputs.* When investigating or describing a ***system,*** the boundaries and initial conditions of the ***system*** need to be defined and their inputs and outputs analyzed and described using ***models.*** ***Models*** (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions - including energy, matter, and information flows - within and between ***systems*** at different scales. ***Models*** can be used to predict the behavior of a ***system***, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in ***models.*** ***Systems*** can be designed to do specific tasks.

Energy and Matter

K-2	3-5	6-8	9-12
Energy and Matter *in K–2 build students' ability to recognize and observe objects may break into smaller pieces, but put together into larger pieces, or change shapes.* Objects may break into smaller pieces, be put together into larger pieces, or change shapes.	***Energy and Matter*** *in 3–5 builds on K–2 skills and progresses to include recognizing matter is made of particles and energy can be transferred in various ways and between objects. .* ***Matter*** is made of particles. ***Energy*** can be transferred in various ways and between objects. ***Matter flows and cycles*** can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by ***conservation of matter.*** ***Matter*** is transported into, out of, and with systems.	***Energy and Matter*** *in 6–8 builds on K–5 skills and progresses to include recognizing matter is conserved because atoms are conserved in physical and chemical processes.* ***Matter*** is conserved because atoms are conserved in physical and chemical processes. Within a natural or designed system, the transfer of ***energy*** drives the motion and/or cycling of matter. ***Energy*** may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of ***energy*** can be tracked as ***energy*** flows through a designed or natural system.	***Energy and Matter*** *in 9–12 builds on K–8 skills and progresses to include recognizing the relationship between energy and matter and that energy cannot be created or destroyed.* The total amount of ***energy and matter*** in closed systems is conserved. Changes of ***energy and matter*** in a system can be described in terms of ***energy and matter*** flows into, out of, and with that system. ***Energy*** cannot be created or destroyed - only moves between one place and another place, between objects and/or fields, or between systems. ***Energy*** drives the cycling of ***matter*** within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Structure and Function

K-2	3-5	6-8	9-12
Structure and Function *in K–2 build students' ability to observe and recognize the shape and stability of structures of natural and designed objects are related to their function(s).* The shape and stability of ***structures*** of natural and designed objects are related to their ***function(s).***	***Structure and Function*** *in 3–5 builds on K–2 skills and progresses to include different materials and substructures.* Different materials have different ***substructures***, which can sometimes be observed. ***Substructures*** have shapes and parts that serve ***functions.***	***Structure and Function*** *in 6–8 builds on K–5 skills and progresses to include models of complex and microscopic structures and systems and visualizing how their function depends on the shapes, composition, and relationships among its parts.* Complex and microscopic ***structures*** and systems can be visualized, modeled, and used to describe how their ***function*** depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed ***structures/systems*** can be analyzed to determine how they ***function.*** ***Structures*** can be designed to serve particular ***functions*** by taking into account properties of different materials, and how materials can be shaped and used.	***Structure and Function*** *in 9–12 builds on K–8 skills and progresses to include investigating systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem.* Investigating or designing new systems or ***structures*** requires a detailed examination of the properties of different materials, the ***structure*** of different components, and connections of components to reveal its ***function*** and/or solve a problem. The ***functions*** and properties of natural and designed objects and systems can be inferred from their overall ***structure***, the way their components are shaped and used, and the molecular substructures of its various materials.

Stability and Change

K-2	3-5	6-8	9-12
Stability and Change *in K–2 build students' ability to observe and recognize that some things stay the same while other things change, and things may change slowly or rapidly.* Some things stay the ***same*** while other things ***change.*** Things may change slowly or rapidly.	***Stability and Change*** *in 3–5 builds on K–2 skills and progresses to include the measurement of change in terms of differences over time, and observe that change may occur at different rates.* ***Change*** is measured in terms of differences over time and may occur at different rates. Some systems appear ***stable***, but over long periods of time will eventually ***change.***	***Stability and Change*** *in 6–8 builds on K–5 skills and progresses to include explaining stability and change in natural or designed systems by examining changes over time, and considering forces at different scales.* Explanations of ***stability and change*** in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. Small ***changes*** in one part of a system might cause large ***changes*** in another part. ***Stability*** might be disturbed either by sudden events or gradual changes that accumulate over time. Systems in dynamic equilibrium are ***stable*** due to a balance of feedback mechanisms.	***Stability and Change*** *in 9–12 builds on K–8 skills and progresses to include students understanding that much of science deals with constructing explanations of how things change and how they remain stable.* Much of science deals with constructing explanations of how things ***change*** and how they remain ***stable.*** ***Change*** and rates of change can be quantified and modeled over very short or very long periods of time. Some system ***changes*** are irreversible. Feedback (negative or positive) can ***stabilize*** or ***destabilize*** a system. Systems can be designed for greater or lesser ***stability.***