|  |  |  |  |
| --- | --- | --- | --- |
| Nature of Science & Engineering: The integration of scientific and engineering practices, disciplinary core ideas, and crosscutting concepts sets the stage for learning about the nature of scientific knowledge, understanding the world, and using technology to change or adapt to the environment for different purposes. | | | |
| HS comp | Student will work collaboratively and individually to generate testable questions or define problems, plan and conduct investigations using a variety of research methods in a various settings, analyze and interpret data, reason with evidence to construct explanations in light of existing theory and previous research, and effectively communicate the research processes and conclusions. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #1 | **Students will work collaboratively to make observations and predictions in order to answer testable questions and use tools and materials to find possible solutions to simple engineering problems.** | **Students will work collaboratively and individually to generate testable questions or to define problems in terms of a given situation; research, plan, and conduct investigations or apply engineering design practices; analyze and interpret data; and construct and communicate evidence-based explanations or best possible solutions.** | **Students will work collaboratively and individually to generate testable questions or define problems in terms of given constraints and criteria; plan and conduct investigations or apply engineering design practices to analyze and interpret data, and construct and communicate evidence-based explanations**  **or possible optimal solutions.** |
| * I can use tools and my senses to make observations (e.g., comparing plants and animals; movement of objects in the sky) and develop drawings, explanations, or demonstrations to represent what I’ve learned (e.g., predicable patterns in how things move or grow). * I can use tools and materials to design and create a model or device to solve a specific problem (e.g., using light or sound to communicate over a distance). * I can support my predictions and conclusions using evidence (facts, observations, or measurements). | * I can develop testable questions, make logical predictions, collect and analyze data, and use specific evidence to draw conclusions and communicate findings from an investigation. * I can observe and define engineering problems, and use relevant research, concepts, and materials to develop a plan to improve or solve problems using evidence. | * I can develop testable questions, make logical predictions, collect and analyze data, and use specific evidence to draw conclusions, communicate findings, and develop scientific explanations. * I can observe and define engineering problems, given specific constraints and criteria, and use relevant research, concepts, and materials to apply the engineering design process to optimally improve or solve problems using evidence. * I can utilize scientific hypotheses, theories and laws to objectively explore and describe the natural and engineered world, investigate changes over time and revise or reinterpret knowledge based on new evidence. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Patterns:** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. | | | |
| HS comp | Students will observe and describe patterns in natural and human- designed phenomena and use those patterns to support claims about the observed or predicted relationships among phenomena. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #2 | **Students will observe patterns in the natural world (including human), develop questions to investigate, make connections, and support connections with evidence.** | **Students will observe, describe, and use patterns to make predictions and support evidence–based explanations about natural and human-designed phenomena.** | **Students will observe, predict, and analyze patterns in order to support evidence-based claims about relationships among natural and human-designed phenomena.** |
| * I can investigate using observations, reading, media, etc. to describe patterns of living things (e.g., how they grow and survive how parents help offspring). * I can investigate using observations, reading, media, etc. to describe or compare patterns in the natural world (e.g., changing seasons, local weather conditions, movement of sun and moon, Earth features). * I can use observations (e.g., observable patterns or properties) to support classifications of or claims about different materials. | * I can use patterns of change as evidence for making predictions and supporting explanations (e.g., force and interactions, waves, inheritance and variation of traits, weather and climate, Earth’s systems, space systems). * I can use similarities and differences in patterns to classify natural phenomena or designed products by observable features or properties (e.g., waves, inheritance and variation of traits). * I can use graphic displays to describe patterns and communicate simple rates of change for natural phenomena (e.g., Earth or space systems). | * I can find macroscopic patterns that are related to the nature of microscopic and atomic-level structure. * I can identify patterns in rates of change and other numerical relationships that provide information about natural and human-designed systems. * I can use patterns to identify, analyze, and predict cause and effect relationships. * I can create and use graphic displays to predict trends and explain patterns in data that support my claims. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Cause-Effect:** Events have causes, sometimes simple, sometimes multi-faceted.A major activity of science is investigation and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts. | | | |
| HS comp | Students will investigate, explain, and evaluate potential causal relationships by using evidence to support claims and predictions about the mechanisms that drive those relationships. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #3 | **Students will investigate relationships between cause and effect as observed with objects, events, and living things and communicate outcomes about change.** | **Students will investigate cause and effect relationships to make predictions and support evidenced-based explanations or claims about change.** | **Students will investigate, explain, and evaluate potential causal relationships, using evidence to support claims and predictions about the mechanisms that drive those relationships.** |
| * I can conduct investigations and use data to support my conclusions about cause-effect relationships (e.g., effects of push-pull forces, heating, cooling, adding nutrients or sunlight). * I can analyze observations and data to determine if a model or design solution works as intended (e.g., to change the speed or direction of an object, which materials have the properties best suited for an intended purpose). | * I can use observational data to predict or draw conclusions about cause and effect relationships (e.g., forces and interactions, properties of matter, energy, interdependent relationships in ecosystems). * I can locate and use evidence from a variety of sources to develop and support explanations or claims about cause-effect relationships (e.g., inheritance and variation of traits, weather and climate, Earth’s systems, space systems). | * I can classify relationships as causal or correlational using evidence to support my claim. * I can investigate cause and effect relationships in order to explain the mechanisms driving change. * I can use cause and effect relationships to predict phenomena in natural or designed systems. * I can describe cause and effect relationships using probability concepts. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale, Proportion, and Quantity:**  In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, time and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance. | | | |
| HS comp | Students will describe and represent the significance of changes in observable and non-observable phenomena in terms of relative scale, proportion, and quantity. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #4 | **Students will describe and compare objects, situations, or events using standard and nonstandard measurement tools, units, and attributes when making observations or solving problems.** | **Students will use relative scale and quantity to describe, compare, or represent data in order to answer questions about observable and non-observable phenomena.** | **Students will describe and interpret models that represent the proportional relationships in observable and non-observable phenomena in terms of relative scale and quantity.** |
| * I can use appropriate tools, techniques, and units while solving problems involving changes in measurement of objects or events (time, money, length, height, weight). * I can describe and compare objects, situations, or events using relative scale and sizes of objects using terms such as: short-long, short-tall, heavy-light, more-less, large-small, thick-thin, etc. | * I can use scale models to represent natural objects from the very small to immensely large (e.g., structure and properties of matter, space systems). * I can analyze and interpret data to provide evidence that observable phenomena exist from very short to very long time periods and very small to vast distances (e.g., interdependent relationships in ecosystems, space systems). * I can use appropriate tools (e.g., measurement tools, visual displays, graphs, tables) and standard units to describe or compare physical quantities (weight, time, temperature, volume) when answering questions about structure and properties of matter, Earth’s systems, etc.. | * I can determine an appropriate scale to observe time, space, and energy phenomena using models to study systems that are quite large or small. * I can use a variety of methods, tools and mathematical representations (algebraic expressions and equations) to make measurements, observations, and predictions of phenomena. * I can observe that the function of natural and designed systems may change with scale. * I can find and describe proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities and use the relationship to predict the magnitude of properties and processes. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Systems and System Models**: Defining the system under study- specifying its boundaries and making explicit a model of that system- provides tools for understanding and testing ideas that are applicable throughout science and engineering. | | | |
| **HS comp** | Students will investigate and analyze a natural or human designed system in terms of its boundaries, inputs, outputs, interactions, and behaviors and use this information to develop a system model that can be used to understand and empirically evaluate the accuracy of models in terms of representing the underlying system. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #5 | **Students will describe how the parts of system work together (e.g., an environment, including the animals and plants) and observe and document how changes may affect the efficiency of system.** | **Students will investigate and use models of natural or human- designed systems in order to describe a system, how its parts function together, and how internal and external factors affect the system or its parts.** | **Students will investigate and analyze a natural or human designed system in order to develop and justify a model that accurately represents the system or aspects of the system (boundaries, inputs, outputs, interactions, and behaviors).** |
| * I can construct an argument supported by evidence for how living things (plants, animals, humans) use resources in the environment and sometimes change the environment to meet their needs. * I can use a model to represent the interrelationships among the living and non-living things of in a given environment. | * I can develop a model to describe how a natural system functions in terms of its components and their interactions (e.g., matter and energy within organisms or ecosystems, Earth’s systems). * I can design solutions to address internal and external factors that affect a natural or human-designed system (e.g., interdependent relationships in ecosystems, Earth’s systems). | * I can describe the structure and interactions of systems that may exist independently, be composed of sub-systems, or be a part of larger complex systems. * I can model systems and their interactions, including inputs, processes, and outputs. * I can design and utilize a model to explain and justify the possible effects of change within a system (e.g., cycling of matter and the flow of energy). * I can determine the limitations of a model when it represents only certain aspects of the system under study. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Energy and Matter in Systems**: Tracking fluxes of energy and matter into, out of and within systems helps one understand the system’s possibilities and limitations. | | | |
| **HS comp** | Students willanalyze evidence from a variety of sources (investigations, models) to predict, connect and/or evaluate the cycling of matter and flow of energy within and between systems in order to understand, describe, or predict possibilities and limitations of systems. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #6 | **Students will observe and describe solids, liquids, and gases, and what happens when matter is manipulated (heated, cooled, disassembled, re-assembled).** | **Students will investigate and use models to make predictions and support evidence-based explanations about the cycling of matter and flow of energy within and between systems.** | **Students will analyze evidence (e.g., investigations, models, theories, scenarios) to predict and track changes in the cycling of**  **matter and flow of energy within and between systems in order to identify their possibilities and limitations.** |
| * I can use observations to construct an evidence-based account of how heat, light, motion, or sound energy affects other things. * I can plan and conduct an investigation to see what happens when I change the amount of energy in a system. | * I can explain how energy can be transferred in various ways (e.g., sound, light, heat, electrical currents - energy). * I can demonstrate that energy can be transferred between objects (e.g., object speed and collision - energy). * I can create a device that demonstrates how energy can be converted from one form to another (e.g., passive solar heater converting light into heat, electrical currents converting electrical energy into motion energy). * I can explain how matter is conserved and transported into, out of, and within systems (e.g. matter & energy in organisms and ecosystems). | * I can provide evidence that matter is conserved in physical and chemical processes. * I can explain how the transfer of energy drives the motion and/or cycling of matter within a natural or designed system,. * I can interpret the effects of different forms of energy within and between systems (e.g. energy in fields, thermal energy, energy of motion). * I can predict possible changes within the system by tracking the transfer of energy flow through a designed or natural system. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Structure and Function**: The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. | | | |
| **HS comp** | Students will use evidence to support claims about the relationship among structure and function of natural and human designed objects | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #7 | **Students will observe, demonstrate, and explain how the external structures of organisms help them to survive and/or how properties of different materials support an intended purpose.** | **Students will investigate the structure and function of natural organisms and human-designed objects in order to analyze relationships and support evidence-based explanations about survival or performance.** | **Students will analyze the relationship among structure and function of natural or human designed objects, using evidence to redesign or support claims about survival and/or improved performance.** |
| * I can develop simple models that mimic various structures and functions of living things (e.g., how structures of a plant or animal disperse seeds, how body structures help animals communicate, move, or meet their needs). * I can analyze how the structures of man-made materials or objects make them useful for specific purposes/functions. | * I can use observations from investigations or models to support explanations of how structures of plants or animals function to support survival and/or performance. * I can use investigations and engineering processes to redesign structures of human-made products to enhance or change performance. | * I can use models to describe complex and microscopic structures and systems. * I can visualize function and how it depends on the shapes, composition, and relationships among its parts. * I can analyze complex natural and designed structures/systems to determine how they function. * I can use functional and structural evidence to develop or improve natural or human-designed structures by taking into account properties of different materials and how materials can be shaped and used. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Stability and Change of Systems:** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study. | | | |
| **HS comp** | Students will investigate and analyze static and dynamic conditions of natural and human designed systems in order to explain and predict changes over time. | | |
|  | **Grades K-2** | **Grades 3-5** | **Grades 6-8** |
| Competency #8 | **Students will distinguish between changes in natural systems that happen rapidly and changes that happen over time.** | **Students will investigate natural systems in order to make predictions, analyze, and explain how slow or rapid changes may affect the system over time.** | **Students will analyze and evaluate the stability of natural and human designed systems in order to develop evidence-based explanations and predictions of changes over time.** |
| * I can use information from multiple sources, including observations of models, to provide evidence of Earth events that occur quickly or slowly (e.g., life cycles, seasons, weather-related events that change the land). | * I can use evidence from observations, data, and maps to make predictions and support evidence-based explanations about how systems change over time (e.g., weather and climate, Earth’s systems). * I can explain simple rates of change for natural phenomena (e.g. space systems). | * I can use evidence to analyze and evaluate of stability of natural or designed systems. * I can examine changes over time and forces at different scales, including the atomic scale, to explain and predict the stability of a system. * I can use evidence to predict how small changes in one part of a system may influence large changes in another part. * I can use evidence to explain how stability might be disturbed either by sudden events or gradual changes that accumulate over time. * I can use evidence to explain that a system in dynamic equilibrium is stable due to a   balance of feedback mechanisms. |