KINDERGARTEN - SECOND GRADE

SCIENCE STANDARDS GUIDANCE
WI Science Standards

Crosscutting Concepts	
Patterns	SCI.CC1.K-2 Students recognize that patterns in the natural and human-designed world can be observed, used to describe phenomena, and used as evidence.
Cause & Effect	SCI.CC2.K-2 Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	SCI.CC3.K-2 Students use relative scales (e.g., bigger and smaller, hotter and colder, faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	SCI.CC4.K-2 Students understand objects and organisms can be described in terms of their parts and that systems in the natural and designed world have parts that work together.
Energy and Matter	SCI.CC5.K-2 Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Structure and Function	SCI.CC6.K-2 Students observe the shape and stability of structures of natural and designed objects are related to their function(s).
Stability and Change	SCI.CC7.K-2 Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Science and Engineering Practices	
Defining Problems	SCI.SEP1.A.K-2 Students ask simple descriptive questions that can be tested. This includes the following: Ask questions based on observations to find more information about the natural world. Ask or identify questions that can be answered by an investigation. SCI.SEP1.B.K-2 Students define simple problems that can be solved through the development of a new or improved object or tool.
Developing and Using Models	SCI.SEP2.K-2 Students use and develop models (i.e., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent concrete events or design solutions. This includes the following: Distinguish between a model and the actual object, process, or events the model represents. Compare models to identify common features and differences. Develop or use models to represent amounts, relationships, relative scales (bigger, smaller), and patterns in the natural and designed world(s). Develop a simple model based on evidence to represent a proposed object or tool.
Planning and Conducting Investigations	SCI.SEP3.K-2 Students plan and carry out simple investigations, based on fair tests, which provide data to support explanations or design solutions. This includes the following: With guidance, plan and conduct an investigation in collaboration with peers (for K). Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Evaluate different ways of observing and measuring a phenomenon to determine which way can answer the question being studied. SCI.SEP3.K-2 Make observations (firsthand or from media) and measurements to collect data that can be used to make comparisons. Make observations (firsthand or from media) and measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
Analyzing and Interpreting Data	SCI.SEP4.K-2 Students collect, record, and share observations. This includes the following: Record information (observations, thoughts, and ideas). Use and share pictures, drawings, or writings of observations. Use observations (firsthand or from media) to describe patterns or relationships in the natural and designed worlds in order to answer scientific questions and solve problems. Compare predictions (based on prior experiences) to what occurred (observable events). Analyze data from tests of an object or tool to determine if the object or tool works as intended.
Using Mathematics and Computational Thinking	SCI.SEP5.K-2 Students recognize that mathematics can be used to describe the natural and designed world. This includes the following: Use counting and numbers to identify and describe patterns in the natural and designed worlds. Describe, measure, or compare quantitative attributes of different objects and display the data using simple graphs. Use qualitative and/or quantitative data to compare two alternative solutions to a problem.

Constructing an Explanation & Designing Solutions	SCI.SEP6.A.K-2 Students use evidence and ideas in constructing evidence-based accounts of natural phenomena. This includes the following: Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.
	SCI.SEP6.B.K-2 Students use evidence and ideas in designing solutions. This includes the following: Use tools and materials to design and/or build a device that solves a specific problem or a solution to a specific problem. Generate and compare multiple solutions to a problem.
Arguing from Evidence	SCI.SEP7.K-2 Students compare ideas and representations about the natural and designed world. This includes the following: Identify arguments that are supported by evidence. Distinguish between explanations that account for all gathered evidence and those that do not. Analyze why some evidence is relevant to a scientific question and some is not. Distinguish between opinions and evidence in one's own explanations. Listen actively to arguments to indicate agreement or disagreement based on evidence, 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 an object, tool, or solution that is supported by relevant evidence.
Obtaining, Evaluating, and Communicating Information	SCI.SEP8.K-2 Students use observations and texts to communicate new information. This includes the following: Read developmentally appropriate texts or use media to obtain scientific and technical information. Use the information to determine patterns in or evidence about the natural and designed worlds. Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering scientific questions or supporting scientific claims. Communicate information or design ideas and solutions with others in oral or written forms. Use models, drawings, writing, or numbers that provide detail about scientific ideas, practices, or design ideas.
Disciplinary Core Ideas	
Structure and Processes	SCI.LS1.A.1 All organisms have external parts that they use to perform daily functions.
	SCI.LS1.B.1 Parents and offspring often engage in behaviors that help the offspring survive.
	SCI.LS1.C.K Animals obtain food they need from plants or other animals. Plants need water and light.
	SCI.LS1.D.1 Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.
Interactions, Energy, and Dynamics Within Ecosystems	SCI.LS2.A.2 Plants depend on water and light to grow. Plants depend on animals for pollination or to move their seeds around.
	[redacted]
Heredity	SCI.LS3.A.1 Young organisms are very much, but not exactly, like their parents, and also resemble other organisms of the same kind.
	SCI.LS3.B.1 Individuals of the same kind of plant or animal are recognizable as similar, but can also vary in many ways.
Biological Evolution	[redacted]
	SCI.LS1.D.2 There are many different kinds of living things in any area, and they exist in different places on land and in water.

Matter and Its Interactions	SCI.PS1.A.2 Matter exists as different substances that have different observable properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.
	SCI.PS1.B.2 Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.
	[redacted]
Forces, Interactions, Motion, and Stability	SCI.PS2.A.K Pushes and pulls can have different strengths and directions, and can change the speed or direction of an object's motion, or start or stop it. A bigger push or pull makes things speed up or slow down more quickly.
	SCI.PS2.B.K When objects touch or collide, they push on one another and can result in a change of motion.
Energy	[redacted]
	SCI.PS3.C.K Bigger pushes and pulls cause bigger changes in an object's motion or shape.
	SCI.PS3.D.K Sunlight warms Earth's surface.
Waves and Their Applications in Technologies for Information Transfer	SCI.PS4.A.1 Sound can make matter vibrate, and vibrating matter can make sound.
	SCI.PS4.B.1 Objects can be seen only when light is available to illuminate them.
	SCI.PS4.C.1 People use devices to send and receive information.
Earth's Place in the Universe	SCI.ESS1.A.1 Patterns of movement of the sun, moon, and stars, as seen from Earth, can be observed, described, and predicted.
	SCI.ESS1.B.1 Seasonal patterns of sunrise and sunset can be observed, described, and predicted.
	SCI.ESS1.C.2 Some events on Earth occur very quickly; others can occur very slowly.
Earth's Systems	SCI.ESS2.A.2 Wind and water change the shape of the land.
	SCI.ESS2.B.2 Maps show where things are located. One can map the shapes and kinds of land and water in any area.
	SCI.ESS2.C.2 Water is found in many types of places and in different forms on Earth.
	SCI.ESS2.D.K Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.
	SCI.ESS2.E.K Plants and animals can change their local environment.
Earth and Human Activity	SCI.ESS3.A.K Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.
	SCI.ESS3.B.K In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.
	SCI.ESS3.C.K Things people do can affect the environment but they can make choices to reduce their impacts.
	[redacted]
Engineering, Technology, and the Application of Science - Engineering Design	SCI.ETS1.A.K-2 A situation that people want to change or create can be approached as a problem to be solved through engineering. Asking questions, making observations, and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem.
	SCI.ETS1.B.K-2 Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people
	SCI.ETS1.C.2 Because there is more than one possible solution to a problem, it is useful to compare and test designs.
Engineering, Technology, and the Application of Science - Links Among Engineering, Technology, Science, and Society	SCI.ETS2.A.K-2 Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
	SCI.ETS2.B.K-2 Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Taking natural materials to make things impacts the environment.

Engineering, Technology, and the Application of Science - Nature of Science and Engineering	SCI.ETS3.A.K-2 People of diverse backgrounds can become scientists and engineers. People have practiced science and engineering for a long time. Creativity and imagination are important to science and engineering.
	SCI.ETS3.B.K-2 Scientists use evidence to explain the natural world. Science assumes natural events happen today as they happened in the past. Engineers solve problems to meet the needs of people and communities.
	SCI.ETS3.C.K-2 Science and engineers use many approaches to answer questions about the natural world and solve problems. Scientific explanations are strengthened by being supported with evidence. An engineering problem can have many solutions. The strength of a solution depends on how well it solves the problem.

THIRD - FIFTH GRADE

SCIENCE STANDARDS GUIDANCE

WI Science Standards

Crosscutting Concepts	
Patterns	SCI.CC1.3-5 Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and use these patterns to make predictions
Cause & Effect	SCI.CC2.3-5 Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity may or may not signify a cause-andeffect relationship.
Scale, Proportion, and Quantity	SCI.CC3.3-5 Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as mass, time, temperature, and volume.
Systems and System Models	SCI.CC4.3-5 Students understand a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They also describe a system in terms of its components and their interactions.
Energy and Matter	SCI.CC5.3-5 Students understand matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes, recognizing the total mass of substances does not change. Note: In this grade band, students are not expected to be able to differentiate between mass and weight.
Structure and Function	SCI.CC6.3-5 Students understand different materials have different substructures, which can sometimes be observed, and substructures have shapes and parts that serve functions.
Stability and Change	SCI.CC7.3-5 Students measure change in terms of differences over time and observe that change may occur at different rates. They understand some systems appear stable, but over long periods of time they will eventually change.
Science and Engineering Practices	
Defining Problems	SCI.SEP1.A.3-5 Students ask questions that specify qualitative relationships. This includes the following: Ask questions about what would happen if a variable is changed. Identify scientific (testable) and non-scientific (nontestable) questions. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
	SCI.SEP1.B.3-5 Students use prior knowledge to describe and define simple design problems that can be solved through the development of an object, tool, process, or system. They include several criteria for success and constraints on materials, time, or cost.
Developing and Using Models	SCI.SEP2.3-5 Students build and revise simple models and use models to represent events and design solutions. This includes the following: Identify limitations of models. Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. Develop and/or use models to describe or predict phenomena. Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and Conducting Investigations	SCI.SEP3.3-5 Students plan and carry out investigations that control variables and provide evidence to support explanations or design solutions. This includes the following: Collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Evaluate appropriate methods and tools for collecting data. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. Make predictions about what would happen if a variable changes. Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.

Analyzing and Interpreting Data	SCI.SEP4.3-5 Students begin to use quantitative approaches to collect data and conduct multiple trials of qualitative observations. (When possible, digital tools should be used.) This includes the following: Represent data in tables or various graphical displays (bar graphs, pictographs, and pie charts) to reveal patterns that indicate relationships. Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, or computation. Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. Analyze data to refine a problem statement or the design of a proposed object, tool, or process. Use data to evaluate and refine design solutions.
Using Mathematics and Computational Thinking	SCI.SEP5.3-5 Students extend quantitative measurements to a variety of physical properties, using computation and mathematics to analyze data and compare alternative design solutions. This includes the following: Organize simple data sets to reveal patterns that suggest relationships. Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. Create and use graphs or charts generated from simple algorithms to compare alternative solutions to an engineering problem.
Constructing an Explanation & Designing Solutions	SCI.SEP6.A.3-5 Students use evidence to construct explanations that specify variables that describe and predict phenomena. This includes the following: Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. Identify the evidence that supports particular points in an explanation.
	SCI.SEP6.B.3-5 Students use evidence to create multiple solutions to design problems. This includes the following: Apply scientific ideas to solve design problems. Generate multiple solutions to a problem and compare how well they meet the criteria and constraints.
Arguing from Evidence	SCI.SEP7.3-5 Students critique the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world. This includes the following: Compare and refine arguments based on an evaluation of the evidence presented. Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. Construct and/or support an argument with evidence, data, 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 relevant evidence about how it meets the criteria and constraints of the problem.
Obtaining, Evaluating, and Communicating Information	SCI.SEP8.3-5 Students evaluate the merit and accuracy of ideas and methods. This includes the following: Read and comprehend grade-appropriate complex texts and other reliable media to summarize and obtain scientific and technical ideas, and describe how they are supported by evidence. Compare and/or combine information across complex texts and other reliable media to support the engagement in scientific and engineering practices. Combine information in written text with that contained in corresponding tables, diagrams, or charts to support the engagement in other scientific and engineering practices. Obtain and combine information from books or other reliable media to explain phenomena or solutions to a design problem. Communicate scientific and technical information orally or in written formats, including various forms of media, which may include tables, diagrams, and charts.
Disciplinary Core Ideas	
Structure and Processes	SCI.LS1.A.4 Plants and animals have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.
	SCI.LS1.B.3 Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.
	SCI.LS1.C.5 Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter, and obtain energy from sunlight, which is used to maintain conditions necessary for survival.
	SCI.LS1.D.4 Different sense receptors are specialized for particular kinds of information; animals use their perceptions and memories to guide their actions.
Interactions, Energy, and Dynamics Within Ecosystems	SCI.LS2.A.5 The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.
	SCI.LS2.B.5 Matter cycles between the air and soil and among organisms as they live and die.

Within Ecosystems	SCI.LS2.C.3 When the environment changes, some organisms survive and reproduce, some move to new locations, some move into transformed environments, and some die.
	SCI.LS2.D.3 Being part of a group helps animals obtain food, defend themselves, and cope with changes.
Heredity	SCI.LS3.A.3 Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment. Many characteristics involve both inheritance and environment.
	SCI.LS3.B.3 Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.
Biological Evolution	SCI.LS4.A.3 Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago.
	SCI.LS4.B.3 Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.
	SCI.LS4.A.3 Particular organisms can only survive in particular environments.
	SCI.LS4.D.3 Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.
Matter and Its Interactions	SCI.PS1.A.4 Matter exists as particles that are too small to see. Matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.
	SCI.PS1.B.5 Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties. In chemical reactions the total mass remains the same. Note: At this level, students are not expected to differentiate between mass and weight.
	[redacted]
Forces, Interactions, Motion, and Stability	SCI.PS2.A.3 Qualities of motion and changes in motion require description of both size and direction. The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion.
	SCI.PS2.B.3 Some forces act through contact, some forces (e.g. magnetic, electrostatic) act even when the objects are not in contact. SCI.PS2.B.5 The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet' s center.
Energy	SCI.PS3.A.4 Moving objects contain energy. The faster the object moves, the more energy it has.
	SCI.PS3.B.4 Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.
	SCI.PS3.C.4 When objects collide, contact forces transfer energy so as to change objects' motions.
	SCI.PS3.D.4, 5 Plants capture energy from sunlight which can be used as fuel or food. Stored energy in food or fuel can be converted to useable energy.
Waves and Their Applications in Technologies for Information Transfer	SCI.PS4.A.4 Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.
	SCI.PS4.B.4 Objects can be seen when light reflected from their surface enters our eyes.
	SCI.PS4.C.4 Patterns can encode, send, receive, and decode information.
Earth's Place in the Universe	SCI.ESS1.A.5 Stars range greatly in size and distance from Earth, and this can explain their relative brightness.
	SCI.ESS1.B.5 The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.
	SCI.ESS1.C.4 Certain features on Earth can be used to order events that have occurred in a landscape.
Earth's Systems	SCI.ESS2.A.4,5 Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.
	SCI.ESS2.B.4 Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.
	SCI.ESS2.C.5 Most of Earth's water is in the ocean, and much of the Earth's freshwater is in glaciers or underground.

	SCI.ESS2.D.3 Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.
	SCI.ESS2.E.4 Living things can affect the physical characteristics of their environment.
Earth and Human Activity	SCI.ESS3.A.4 Energy and fuels humans use are derived from natural sources, and their use affects the environment. Some resources are renewable over time, others are not.
	SCI.ESS3.B.3,4 A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.
	SCI.ESS3.C.5 Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.
	[redacted]
Engineering, Technology, and the Application of Science - Engineering Design	SCI.ETS1.A.3-5 Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
	SCI.ETS1.B.3-5 Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
	SCI.ETS1.C.4 Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
Engineering, Technology, and the Application of Science - Links Among Engineering, Technology, Science, and Society	SCI.ETS2.A.3-5 Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
	SCI.ETS2.B.3-5 People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.
Engineering, Technology, and the Application of Science - Nature of Science and Engineering	SCI.ETS3.A.3-5 Science and engineering knowledge have been created by many cultures. People use the tools and practices of science and engineering in many different situations (e.g. land managers, technicians, nurses, and welders). Science and engineering affect everyday life.
	SCI.ETS3.B.3-5 Science and engineering are both bodies of knowledge and processes that add new knowledge to our understanding. Scientific findings are limited to what can be supported with evidence from the natural world. Basic laws of nature are the same everywhere in the universe (e.g. gravity, conservation of matter, energy transfer, etc.). Engineering solutions often have drawbacks as well as benefits.
	SCI.ETS3.C.3-5 The products of science and engineering are not developed through one set "scientific method" or "engineering design process." Instead, they use a variety of approaches described in the Science and Engineering Practices. Science explanations are based on a body of evidence and multiple tests, and describe the mechanisms for natural events. Science explanations can change based on new evidence. There is no perfect design in engineering. Designs that are best in some ways (e.g. safety or ease of use) may be inferior in other ways (e.g. cost or aesthetics).

SIXTH - EIGHTH GRADE

SCIENCE STANDARDS GUIDANCE

WI Science Standards

Crosscutting Concepts	
Patterns	SCI.CC1.m Students recognize macroscopic patterns are related to the nature of microscopic and atomiclevel structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human-designed systems. They use patterns to identify cause and effect relationships and use graphs and charts to identify patterns in data.
Cause & Effect	SCI.CC2.m Students classify relationships as causal or correlational, and recognize correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be explained using probability.
Scale, Proportion, and Quantity	SCI.CC3.m Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	SCI.CC4.m Students understand systems may interact with other systems: They may have sub-systems and be a part of larger complex systems. They use models to represent systems and their interactions — such as inputs, processes, and outputs — and energy, matter, and information flows within systems. They also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	SCI.CC5.m Students understand matter is conserved because atoms are conserved in physical and chemical processes. They also understand that within a natural or designed system the transfer of energy drives the motion and cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.
Structure and Function	SCI.CC6.m Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among their parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
Stability and Change	SCI.CC7.m Students explain stability and change in natural or designed systems by examining changes over time and considering forces at different scales, including the atomic scale. They understand changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.
Science and Engineering Practices	
Defining Problems	SCI.SEP1.A.m Students ask questions to specify relationships between variables and clarify arguments and models. This includes the following: Ask questions that arise from careful observation of phenomena, models, or unexpected results to clarify or seek additional information. Ask questions to identify and clarify evidence and the premise(s) of an argument. Ask questions to determine relationships between independent and dependent variables and relationships in models. Ask questions to clarify or refine a model, an explanation, or an engineering problem. Ask questions that require sufficient and appropriate empirical evidence to answer. Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. Ask questions that challenge the premise(s) of an argument or the interpretation of a data set.

	SCI.SEP1.B.m Students define a design problem that can be solved through the development of an object, tool, process, or system, and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
Developing and Using Models	SCI.SEP2.m Students develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. This includes the following: Evaluate limitations of a model for a proposed object or tool. Develop or modify a model — based on evidence — to match what happens if a variable or component of a system is changed. Use and develop a model of simple systems with uncertain and less predictable factors. Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. Develop and use a model to predict and describe phenomena. Develop a model to describe unobservable mechanisms. Develop and use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.
Planning and Conducting Investigations	SCI.SEP3.m Students plan and carry out investigations that use multiple variables and provide evidence to support explanations or solutions. This includes the following: Individually and collaboratively plan an investigation, identifying: independent and dependent variables and controls, tools needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Conduct an investigation. Evaluate and revise the experimental design to produce data that serve as the basis for evidence to meet the goals of the investigation. Evaluate the accuracy of various methods for collecting data. Collect data under a range of conditions that serve as the basis for evidence to answer scientific questions or test design solutions. Collect data about the performance of a proposed object, tool, process, or system under a range of conditions.
Analyzing and Interpreting Data	SCI.SEP4.m Students extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. This includes the following: Construct, analyze, or interpret graphical displays of data and large data sets to identify linear and nonlinear relationships. Use graphical displays (e.g., maps, charts, graphs, and tables) of large data sets to identify temporal and spatial relationships. Distinguish between causal and correlational relationships in data. Analyze and interpret data to provide evidence for explanations of phenomena. Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. Consider limitations of data analysis (e.g., measurement error), and seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process, or system that best meets criteria for success.
Using Mathematics and Computational Thinking	SCI.SEP5.m Students identify patterns in large data sets and use mathematical concepts to support explanations and arguments. This includes the following: Decide when to use qualitative vs. quantitative data. Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. Use mathematical representations to describe and support scientific conclusions and design solutions. Create algorithms (a series of ordered steps) to solve a problem. Apply mathematical concepts and processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems. Use digital tools and mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.
Constructing an Explanation & Designing Solutions	SCI.SEP6.A.m Students construct explanations supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: Construct an explanation that includes qualitative or quantitative relationships between variables that predict and describe phenomena. Construct an explanation using models or representations. Construct a scientific explanation based on valid and reliable evidence obtained from sources, including the students' own experiments. Solutions should build on the following assumption: Theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Apply scientific ideas, principles, and evidence to construct, revise, or use an explanation for real world phenomena, examples, or events.
	SCI.SEP6.B.m Students design solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process, or system. Undertake a design project, engaging in the design cycle, to construct and implement a solution that meets specific design criteria and constraints. Optimize performance of a design by prioritizing criteria, making trade-offs, testing, revising, and retesting.

Arguing from Evidence	SCI.SEP7.m Students construct a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. This includes the following. Compare and critique two arguments on the same topic. Analyze whether they emphasize similar or different evidence and interpretations of facts. Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system. Based the argument on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.
Obtaining, Evaluating, and Communicating Information	SCI.SEP8.m Students evaluate the merit and validity of ideas and methods. This includes the following: Critically read scientific texts adapted for classroom use to determine the central ideas, to obtain scientific and technical information, and to describe patterns in and evidence about the natural and designed world(s). Clarify claims and findings by integrating text-based qualitative and quantitative scientific information with information contained in media and visual displays. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication. Describe how they are supported or not supported by evidence and evaluate methods used. Evaluate data, hypotheses, and conclusions in scientific and technical texts in light of competing information or accounts. Communicate scientific and technical information (e.g. about a proposed object, tool, process, or system) in writing and through oral presentations.
Disciplinary Core Ideas	
Structure and Processes	SCI.LS1.A.m All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.
	SCI.LS1.B.m Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.
	SCI.LS1.C.m Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy
	SCI.LS1.D.m Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain resulting in immediate behavior or memories.
Interactions, Energy, and Dynamics Within Ecosystems	SCI.LS2.A.m Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.
	SCI.LS2.B.m The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
	SCI.LS2.C.m Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.
	SCI.LS2.D.m Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on — for example, water purification and recycling.
Heredity	SCI.LS3.A.m Genes chiefly regulate a specific protein, which affect an individual's traits.
	SCI.LS3.B.m In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.
Biological Evolution	SCI.LS4.A.m The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.
	SCI.LS4.B.m Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.

Biological Evolution	SCI.LS4.C.m Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.
	SCI.LS4.D.m Changes in biodiversity can influence humans' resources and ecosystem services they rely on.
Matter and Its Interactions	SCI.PS1.A.m The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.
	SCI.PS1.B.m Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.
	[redacted]
Forces, Interactions, Motion, and Stability	SCI.PS2.A.m Motion and changes in motion can be qualitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force (Newton's first and second law). For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
	SCI.PS2.B.m Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.
Energy	SCI.PS3.A.m Kinetic energy can be distinguished from the various forms of potential energy.
	SCI.PS3.B.m Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.
	SCI.PS3.C.m When two objects interact, each one exerts a force on the other, and these forces can transfer energy between the interacting objects.
	SCI.PS3.D.m Sunlight is captured by plants and used in a chemical reaction to produce sugar molecules for storing this energy. This stored energy can be released by respiration or combustion, which can be reversed by burning those molecules to release energy.
Waves and Their Applications in Technologies for Information Transfer	SCI.PS4.A.m A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.
	SCI.PS4.B.m The construct of a wave is used to model how light interacts with objects.
	SCI.PS4.C.m Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s.
Earth's Place in the Universe	SCI.ESS1.A.m The solar system is part of the Milky Way, which is one of many billions of galaxies.
	SCI.ESS1.B.m The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
	SCI.ESS1.C.m Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.
Earth's Systems	SCI.ESS2.A.m Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
	SCI.ESS2.B.m Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.
	SCI.ESS2.C.m Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.
	SCI.ESS2.D.m Complex interactions determine local weather patterns and influence climate, including the role of the ocean.
	SCI.ESS2.E.m The fossil record documents the existence, diversity, extinction, and change of many life forms throughout history (linked to content in LS4.A).

Earth and Human Activity	SCI.ESS3.A.m Humans depend on Earth's land, oceans, fresh water, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.
	SCI.ESS3.B.m Patterns can be seen through mapping the history of natural hazards in a region and understanding related geological forces.
	SCI.ESS3.C.m Human activities have altered the hydrosphere, atmosphere, and lithosphere which in turn has altered the biosphere. Changes to the biosphere can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.
	SCI.ESS3.D.m Evidence suggests human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.
Engineering, Technology, and the Application of Science - Engineering Design	SCI.ETS1.A.m The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.
	SCI.ETS1.B.m A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.
	SCI.ETS1.C.m Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process — That is, some of those characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.
Engineering, Technology, and the Application of Science - Links Among Engineering, Technology, Science, and Society	SCI.ETS2.A.m A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
	SCI.ETS2.B.m All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies are driven by people's needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Technology use varies over time and from region to region.
Engineering, Technology, and the Application of Science - Nature of Science and Engineering	SCI.ETS3.A.m Individuals and teams from many nations, cultures, and backgrounds have contributed to advances in science and engineering. Scientists and engineers are persistent, use creativity, reasoning, and skepticism, and remain open to new ideas. Science and engineering are influenced by what is valued in society.
	SCI.ETS3.B.m Science asks questions to understand the natural world and assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Science carefully considers and evaluates anomalies in data and evidence. Engineering seeks solutions to human problems, including issues that arise due to human interaction with the environment. It uses some of the same practices as science and often applies scientific principles to solutions. Science and engineering have direct impacts on the quality of life for all people. Therefore, scientists and engineers need to pursue their work in an ethical manner that requires honesty, fairness, and dedication to public health, safety, and welfare. Engineers develop solutions using multiple approaches and evaluate their solutions against criteria such as cost, safety, time, and performance. This evaluation often involves trade-offs between constraints to find the optimal solution. Engineers develop solutions using multiple approaches and evaluate their solutions against criteria such as cost, safety, time, and performance. This evaluation often involves trade-offs between constraints to find the optimal solution.
	SCI.ETS3.C.m A theory is an explanation of some aspect of the natural world. Scientists develop theories by using multiple approaches. Validity of these theories and explanations is increased through a peer review process that tests and evaluates the evidence supporting scientific claims. Theories are explanations for observable phenomena based on a body of evidence developed over time. A hypothesis is a statement that can be tested to evaluate a theory. Scientific laws describe cause and effect relationships among observable phenomena. Engineers develop solutions using multiple approaches and evaluate their solutions against criteria such as cost, safety, time, and performance. This evaluation often involves trade-offs between constraints to find the optimal solution.

NINTH - TWELFTH GRADE

SCIENCE STANDARDS GUIDANCE

WI Science Standards

Crosscutting Concepts	
Patterns	SCI.CC1.h Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.
Cause & Effect	SCI.CC2.h Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	SCI.CC3.h Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	SCI.CC4.h Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.
Energy and Matter	SCI.CC5.h Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It 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	SCI.CC6.h Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Stability and Change	SCI.CC7.h Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
Science and Engineering Practices	

Defining Problems	SCI.SEP1.A.h Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following: Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. Ask questions to clarify and refine a model or an explanation. Evaluate a question to determine if it is testable and relevant. Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design.
	SCI.SEP1.B.h Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. Clarify and refine an engineering problem.
Developing and Using Models	SCI.SEP2.h Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. Design a test of a model to ascertain its reliability. Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.
Planning and Conducting Investigations	SCI.SEP3.h Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: Individually and collaboratively plan an investigation or test a design to produce data that can serve as evidence to build and revise models, support explanations for phenomena, and refine solutions to problems. Consider possible variables or effects and evaluate the investigation's design to ensure variables are controlled. Individually and collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence. In the design, decide on types, how much, and accuracy of data needed to produce reliable measurements. Consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly. Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. Select appropriate tools to collect, record, analyze, and evaluate data. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points, or to improve performance relative to criteria for success.
Analyzing and Interpreting Data	SCI.SEP4.h Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. Evaluate the impact of new data on a working explanation or model of a proposed process or system. Analyze data to optimize design features or characteristics of system components relative to criteria for success.

Using Mathematics and Computational Thinking	SCI.SEP5.h Students use algebraic thinking and analysis, a range of linear and nonlinear functions (including trigonometric 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. This includes the following: Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. Apply techniques of algebra and functions to represent and solve scientific and engineering problems. Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).
Constructing an Explanation & Designing Solutions	SCI.SEP6.A.h Students create explanations that are supported by multiple and independent studentgenerated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including students' own investigations, models, theories, simulations, and peer review. Explanations should reflect the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Apply scientific ideas, principles, and evidence to provide an explanation of phenomena taking into account possible, unanticipated effects. Apply scientific reasoning, theory, and models to link evidence to the claim and to assess the extent to which the reasoning and data support the explanation.
	SCI.SEP6.B.h Students create designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: Design, evaluate, and refine a solution to a complex realworld problem, based on scientific knowledge, student-generated sources of evidence, and prioritized criteria. Consider tradeoffs. Apply scientific ideas, principles, and evidence to solve design problems, taking into account possible unanticipated effects.
Arguing from Evidence	SCI.SEP7.h Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. This includes the following: Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Respectfully provide and receive critiques on scientific arguments by probing reasoning and evidence, by challenging ideas and conclusions, by responding thoughtfully to diverse perspectives, and by determining what additional information is required to resolve contradictions. Construct, use, and present oral and written arguments or counter-arguments based on data and evidence. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments. Consider relevant factors (e.g. economic, societal, environmental, and ethical considerations).
Obtaining, Evaluating, and Communicating Information	SCI.SEP8.h Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.

Disciplinary Core Ideas	
Structure and Processes	SCI.LS1.A.h Systems of specialized cells within organisms 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 within certain limits and mediate behaviors.
	SCI.LS1.B.h Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
	SCI.LS1.C.h The molecules 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 different organizational levels of an organism as elements are recombined to form different products and transfer energy.
	SCI.LS1.D.h Organisms can process and store a variety of information through specific chemicals and interconnected networks.
Interactions, Energy, and Dynamics Within Ecosystems	SCI.LS2.A.h Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. The combination of the factors that affect an organism's success can be measured as a multidimensional niche.
	SCI.LS2.B.h Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways, and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
	SCI.LS2.C.h If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
	SCI.LS2.D.h Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
Heredity	SCI.LS3.A.h DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ.
	SCI.LS3.B.h The variation and distribution of traits in a population depend on 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.
Biological Evolution	SCI.LS4.A.h The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.
	SCI.LS4.B.h Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.
	SCI.LS4.C.h Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence, or extinction, can change when conditions change.
	SCI.LS4.D.h Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.
Matter and Its Interactions	SCI.PS1.A.h The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
	SCI.PS1.B.h Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
	SCI.PS1.C.h Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.
Forces, Interactions, Motion, and	SCI.PS2.A.h Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.

Stability	SCI.PS2.B.h Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.
Energy	SCI.PS3.A.h Systems move towards more stable states.
	SCI.PS3.B.h The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).
	SCI.PS3.C.h Fields contain energy that depends on the arrangement of the objects in the field.
	SCI.PS3.D.h Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, but it can be converted to less useful forms.
Waves and Their Applications in Technologies for Information Transfer	SCI.PS4.A.h The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.
	SCI.PS4.B.h Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation
	SCI.PS4.C.h Large amounts of information can be stored and shipped around as a result of being digitized.
Earth's Place in the Universe	SCI.ESS1.A.h Light spectra from stars are used to determine their characteristics, processes, and lifecycles. Solar activity creates the elements through nuclear fusion. The development of technologies has provided the astronomical data that provide the empirical evidence for the Big Bang theory.
	SCI.ESS1.B.h Kepler's laws describe common features of the motions of orbiting objects. Observations from astronomy and space probes provide evidence for explanations of solar system formation. Cyclical changes in Earth's tilt and orbit, occurring over tens to hundreds of thousands of years, cause cycles of ice ages and other gradual climate changes.
	SCI.ESS1.C.h The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
Earth's Systems	SCI.ESS2.A.h Feedback effects exist within and among Earth's systems.
	SCI.ESS2.B.h Radioactive decay within Earth's interior contributes to thermal convection in the mantle.
	SCI.ESS2.C.h The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
	SCI.ESS2.D.h The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.
	SCI.ESS2.E.h The biosphere and Earth's other systems have many interconnections that cause a continual coevolution of Earth's surface and life on it.
Earth and Human Activity	SCI.ESS3.A.h Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.
	SCI.ESS3.B.h Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.
	SCI.ESS3.C.h Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
	SCI.ESS3.D.h Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.
[illegible]	SCI.ETS1.A.h Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Engineering, Technology, and the Application of Science - Engineering Design	SCI.ETS1.B.h When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical. They are also useful in making a persuasive presentation to a client about how a given design will meet his or her needs.
	SCI.ETS1.C.h Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
Engineering, Technology, and the Application of Science - Links Among Engineering, Technology, Science, and Society	SCI.ETS2.A.h When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
	SCI.ETS2.B.h Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
Engineering, Technology, and the Application of Science - Nature of Science and Engineering	SCI.ETS3.A.h Individuals from diverse backgrounds bring unique perspectives that are valuable to the outcomes and processes of science and engineering. Scientists' and engineers' backgrounds, perspectives, and fields of endeavor influence the nature of questions they ask, the definition of problems, and the nature of their findings and solutions. Some cultures have historically been marginalized in science and engineering discourse. Scientists and engineers embrace skepticism and critique as a community. Deliberate deceit in science is rare and is likely exposed through the peer review process. When discovered, intellectual dishonesty is condemned by the scientific community.
	SCI.ETS3.B.h Science is both a body of knowledge that represents current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. These processes differentiate science from other ways of knowing. Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. Science and engineering innovations may raise ethical issues for which science and engineering, by themselves, do not provide answers and solutions.
	SCI.ETS3.C.h Scientists use a variety of methods, tools, and techniques to develop theories. A scientific theory is an explanation of some aspect of the natural word, based on evidence that has been repeatedly confirmed through observation, experimentation (hypothesis-testing), and peer review. The certainty and durability of science findings varies based on the strength of supporting evidence. Theories are usually modified if they are not able to accommodate new evidence. Engineers use a variety of approaches, tools, and techniques to define problems and develop solutions to those problems. Successful engineering solutions meet stakeholder needs and safety requirements, and are economically viable. Trade-offs in design aspects balance competing demands.