Amplify Science

Grades K–5

Reverse Alignment to Minnesota Academic Standards in Science

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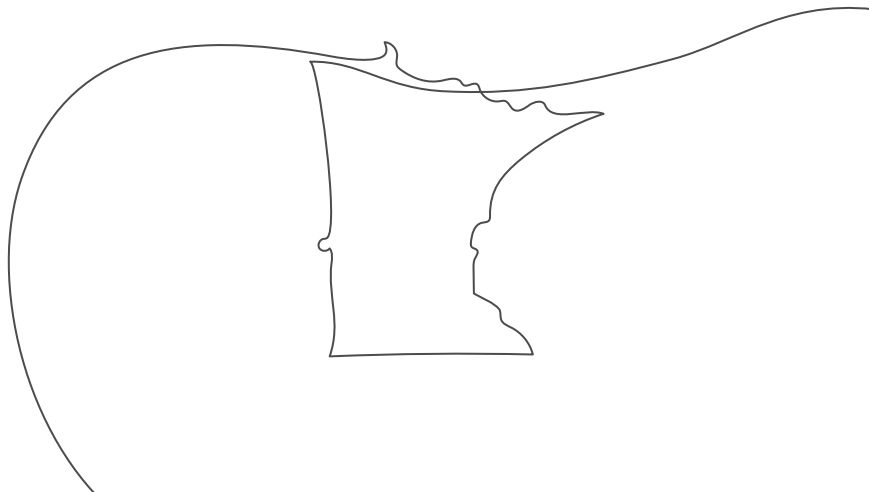

Grade K

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Needs of Plants and Animals **Milkweed and Monarchs** Students take on the role of scientists in order to figure out why there are no monarch caterpillars in a community garden since the vegetables were planted. In doing so, they investigate how plants and animals get what they need to live and grow. They then make a new plan for the garden that provides for the needs of the monarch caterpillars, in addition to vegetables for humans.	****0E.1.1.1.2** Ask questions about how a person may reduce the amount of natural resources the individual uses.* (P: 1, CC: 2, CI: ESS3) *Examples of questions may include reusing paper to reduce the number of trees cut down and recycling cans and bottles to reduce the amount of plastic, glass, or metal used.* **0L.1.2.1.2** Make observations of plants and animals to compare the diversity of life in different habitats. (P: 3, CC: 1, CI: LS4) *Emphasis is on the diversity of living things in a variety of different habitats and patterns across those habitats.* **0P.2.1.1.1** Sort objects in terms of natural/human-made, color, size, shape, and texture, then communicate the reasoning for the sorting system. (P: 4, CC: 2, CI: PS1) *Emphasis is on using observations to describe patterns and/or relationships in the natural and designed world in order to answer scientific questions and solve problems.* **0L.2.1.1.3** Record and use observations to describe patterns of what plants and animals (including humans) need to survive.** (P: 4, CC: 1, CI: LS1) *Examples of patterns may include that animals need to take in food, but plants do not; different animals need different kinds of food; plants require light; and that all living things need water.* **0L.3.1.1.1** Develop a simple model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. (P: 2, CC: 4, CI: LS2) *Examples of relationships may include that deer eat buds and leaves, therefore, they usually live in forested areas; and grasses need sunlight, so they often grow in meadows. Examples of models may include food chains, collages, and/or sorting activities.* **1E.4.1.1.1** Construct an argument based on observational evidence for how plants and animals (including humans) can change the non-living aspects of the environment to meet their needs. (P: 7, CC: 4, CI: ESS2) *Examples of plants and animals changing their environment may include a squirrel digging in the ground to hide its food and tree roots breaking concrete.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Needs of Plants and Animals **(continued)** **Milkweed and Monarchs**	**1E.4.2.1.1** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* (P: 8, CC: 4, CI: ESS3) *Examples of human actions that impact the land may include cutting trees to produce paper, using resources to produce bottles, and using water for bathing and brushing teeth. Examples of solutions may include reusing paper and recycling cans and bottles.* **2L.4.1.1.1** Construct an argument with evidence that evaluates how in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (P: 7, CC: 2, CI: LS4, ETS2) *Emphasis is on the interdependence of parts of a system (organisms and their habitat). Examples of habitats should include those found in Minnesota, such as a wetland, prairie, or garden. Examples of evidence may include needs and characteristics of the organisms and habitats involved.* ****3L.1.2.1.2** Plan and conduct an investigation to determine how amounts of sunlight and water impact the growth of a plant. (P: 3, CC:2, CI: LS2) *Emphasis of the practice is on conducting fair tests and using data to support explanations. Examples of investigations may include simple experiments with fast-growing plants.* **4E.4.2.2.1** Obtain and combine multiple sources of information about ways individual communities, including Minnesota American Indian tribes and communities and other cultures, use evidence and scientific principles to make decisions about the uses of Earth's resources.* (P: 8, CC: 4, CI: ESS3, ETS1) *Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Examples may include balancing the water, soil, wildlife, plant, and human needs to support sustainable use of resources.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Pushes and Pulls **Designing a Pinball Machine** Students take on the role of pinball machine engineers as they explore the effects of pushes and pulls on the motion of an object. They conduct tests in their own prototypes (models) of a pinball machine contributing to the design of a class pinball machine.	**0P.2.2.1.1** Identify and describe patterns that emerge from the effects of different strengths or different directions of pushes and pulls on the motion of an object.** (P: 5, CC: 2, CI: PS2) *Emphasis is on different relative strengths or different directions, but not both at the same time. Examples of pushes or pulls may include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.* ****0P.3.2.2.1** Design and build a structure to reduce the warming effect of sunlight on Earth's surface.* (P: 6, CC: 2, CI: PS3, ETS1) *Emphasis of the practice is on choosing appropriate materials and tools to solve a problem. Emphasis of the core idea is on understanding the heating effects of sunlight. Examples of structures may include umbrellas, canopies, and tents.* **0P.4.1.1.1** Construct an argument supported by evidence for whether a design solution works as intended to change the speed or direction of an object with a push or a pull.* (P: 7, CC: 2, CI: PS2, ETS1) *Examples of problems requiring a solution may include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions may include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.* **2P.1.1.1.1** Ask questions about an object's motion based on observation, that can be answered by an investigation. (P: 1, CC: 1, CI: PS2) *Examples of questions may include what is causing the motion, what type of motion (circular, bouncing, etc.), and what changes are happening in the motion.* **2P.2.2.1.1** Identify and predict quantitative patterns of the effects of balanced and unbalanced forces on the motion of an object.** (P: 5, CC: F412, CI: PS2) *Examples may include illustrating how an unbalanced force on one side of a ball can make it start moving; and balanced forces pushing on a box from both sides will not produce any motion at all. Data displays may include pictographs and bar graphs.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Sunlight and Weather **Solving Playground Problems** Students figure out why one fictional schoolyard is too cold in the morning, while another, which is nearby, is too hot in the afternoon. They use physical models and firsthand investigation to figure out the impact of sunlight on Earth's surface.	**0E.1.1.1.1** Ask questions to obtain information from weather forecasts to prepare for and respond to severe weather.* (P: 1, CC: 7, CI: ESS3, ETS2) *Emphasis is on local forms of severe weather that may arise quickly and should include examples of engineered solutions to severe weather (such as clothing to wear or places to safely shelter).* **0E.1.1.1.2** Ask questions about how a person may reduce the amount of natural resources the individual uses.* (P: 1, CC: 2, CI: ESS3) *Examples of questions may include reusing paper to reduce the number of trees cut down and recycling cans and bottles to reduce the amount of plastic, glass, or metal used.* **0P.1.2.1.1** Collect and organize observational data to determine the effect of sunlight on Earth's surface. (P: 3, CC: 2, CI: PS3, ETS2) *Examples of Earth's surface may include sand, soil, rocks, and water. Data may be organized in pictographs or bar graphs. Examples of observations may include heating, growth of plants, melting of snow, and shadows.* **0E.2.1.1.2** Make daily and seasonal observations of local weather conditions to describe patterns over time.** (P: 4, CC: 1, CI: ESS2) *Examples of qualitative observations may include descriptions of the weather (such as sunny, cloudy, rainy, and warm). Examples of quantitative observations may include numbers of sunny, windy, and rainy days in a month. Examples of patterns may include that it is usually cooler in the morning than in the afternoon and that different months have different numbers of sunny days versus cloudy days in different months.* **0P.3.2.2.1** Design and build a structure to reduce the warming effect of sunlight on Earth's surface.* (P: 6, CC: 2, CI: PS3, ETS1) *Emphasis of the practice is on choosing appropriate materials and tools to solve a problem. Emphasis of the core idea is on understanding the heating effects of sunlight. Examples of structures may include umbrellas, canopies, and tents.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Sunlight and Weather **(continued)** **Solving Playground Problems**	**0P.4.2.2.1** Communicate design ideas for a structure that reduces the warming effect of sunlight on Earth's surface.* (P: 8, CC: 2, CI: PS3, ETS1) *Examples of written designs include models, drawings, writing, or numbers.* ****1E.2.2.1.1** Use quantitative data to identify and describe patterns in the amount of time it takes for Earth processes to occur and determine whether they occur quickly or slowly. (P: 5, CC: 7, CI: ESS1) *Emphasis of the core idea is that some Earth processes happen quickly (like tornadoes and thunderstorms) and some slowly (like the erosion of soil). Examples of data may include firsthand observations from books, videos, pictures, or historical photos.* **2E.2.1.1.1** Represent data to describe typical weather conditions expected during a particular season. (P: 4, CC: 1, CI: ESS2) *Examples of data may include temperature, precipitation, and wind direction. Data displays can include pictographs and bar graphs.* **2E.2.1.1.2** Analyze data from tests of objects designed to reduce the impacts of weather-related hazards and compare the strengths and weaknesses of how each performs.* (P: 4, CC: 2, CI: ESS3, ETS1) *Emphasis is on data from tests of student-designed objects. Examples of design solutions to weather-related hazards may include barriers to prevent flooding or snow drifting, structures for sun shading, materials for clothing, and orientation of bus shelters.*

Grade 1

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Animal and Plant Defenses **Spikes, Shells, and Camouflage** Students take on the role of marine scientists. In their role, students apply their understanding about plant and animal defense structures to explain to concerned aquarium visitors how a sea turtle and her offspring can defend themselves from ocean predators when they are released into the wild.	**1L.1.1.1.1** Ask questions based on observations about the similarities and differences between young plants and animals and their parents. (P: 1, CC: 2, CI: LS3) *Examples of observations may include how leaves from the same kind of plant are the same shape but can differ in size; and a particular breed of dog looks like its parents but is not exactly the same.* **1L.3.1.1.1** Develop a simple model based on evidence to represent how plants or animals use their external parts to help them survive, grow, and meet their needs. (P: 2, CC: 6, CI: LS1) *Examples of external parts may include acorn shells, plant roots, thorns on branches, turtle shells, animal scales, animal tails, and animal quills.* **1L.3.2.2.2** Plan and design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* (P: 6, CC: 6, CI: LS1, ETS2) *Examples of human problems that can be solved by mimicking plant or animal solutions may include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills, and deterring intruders by mimicking eyes and ears.* **1L.4.2.1.2** Obtain information using various features of texts and other media to determine patterns in the behavior of parents and offspring that help offspring survive. (P: 8, CC: 1, CI: LS1) *Examples of text features include headings, glossaries, electronic menus, pictures, illustrations, icons, etc. Examples of behavior patterns may include the signals that offspring make (such as crying, chirping, and other vocalizations) and the responses of the parents (such as feeding,comforting, and protecting the offspring).* ****3L.3.1.1.2** Develop multiple models to describe how organisms have unique and diverse life cycles but all have birth, growth, reproduction, and death in common. (P: 2, CC: 4, CI: LS1) *Emphasis is on the pattern of changes organisms go through during their life. Examples of models may include diagrams, drawings, physical models, or computer programs.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Light and Sound **Puppet Theater Engineers** In their role as light and sound engineers, students investigate cause and effect relationships to learn about the nature of light and sound. They apply what they learn to design shadow scenery and sound effects for a puppet show.	**1P.1.2.1.1** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. (P: 3, CC: 2, CI: PS4) *Examples of vibrating materials that make sound may include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate may include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.* **1P.2.1.1.1** Identify and describe patterns obtained from testing different materials and determine which materials have the properties that are best suited for producing and/or transmitting sound.* (P: 4, CC: 1, CI: PS1, ETS1) *Examples of materials may be wood, paper, string, plastics, cloth, etc.* **1P.3.2.2.1** Design and build a device that uses light or sound to solve the problem of communicating over a distance.* (P: 6, CC: 6, CI: PS4, ETS1, ETS2) *Examples of devices may include paper cup and string "telephones" and a pattern of drum beats.* **3P.1.1.1.1** Ask questions based on observations about why objects in darkness can be seen only when illuminated. (P: 1, CC: 2, CI: PS4) *Emphasis should be on addressing the misconception that people can see in the dark if they wait long enough and on the way eyes receive light. Examples of observations may include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight.* **3P.1.2.1 1** Plan and conduct a controlled investigation to determine the effect of placing objects made with different materials in the path of a beam of light. (P: 3, CC: 2, CI: PS4) *Emphasis is on conducting fair tests by controlling variables. Examples of materials may include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).* ****3P.3.1.1.1** Develop a model to describe that light reflecting from objects that enter the eye allows objects to be seen. (P: 2, CC: 2, CI: PS4) *Examples of models may include diagrams, drawings, physical models, or computer programs.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Spinning Earth **Investigating Patterns in the Sky** As sky scientists, students figure out how to explain why it is never the same time of day for a grandmother who lives in Asia as it is for her grandson in the United States when she calls him. Students record, organize, and analyze observations of the sun and other sky objects as they look for patterns and make sense of the cycle of daytime and nighttime.	**1E.2.2.1.1** Use quantitative data to identify and describe patterns for the amount of time it takes for Earth processes to occur and determine whether they occur quickly or slowly. (P: 5, CC: 7, CI: ESS1) *Emphasis of the core idea is that some Earth processes happen quickly (like tornadoes and thunderstorms) and some slowly (like the erosion of soil). Examples of data may include firsthand observations from books, videos, pictures, or historical photos.* **3E.2.1.1.1** Record observations of the sun, moon, and stars and use them to describe patterns that can be predicted.** (P: 4, CC: 1, CI: ESS1) *Examples of patterns may include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.* **3E.2.2.1.1** Organize and electronically present collected data to identify and describe patterns in the amount of daylight in the different times of the year.** (P: 5, CC: 1, CI: ESS1) *Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.*

Grade 2

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Plant and Animal Relationships **Investigating Systems in a Bengali Forest** In their role as plant scientists, students work to figure out why there are no new Chalta trees growing in the Bengal Tiger Reserve, which is part of a broadleaf forest. Students investigate what the Chalta tree needs to survive, and collect and analyze qualitative and quantitative data to solve the mystery.	**2L.3.2.2.1** Engineer a device that mimics the structures and functions of plants or animals in seed dispersal.* (P: 6, CC: 6, CI: LS2, ETS1) *Emphasis is on how specific structures have particular functions. Examples of seed dispersal by animals may include feeding and subsequent elimination of seeds, or attachment of seeds/pollen to animal structures. Examples of seed dispersal by plants may include various wind-catching designs (as in dandelions or maple trees) or colors and smells that attract pollinators.* **3L.1.2.1.2** Plan and conduct an investigation to determine how amounts of sunlight and water impact the growth of a plant. (P: 3, CC:2, CI: LS2) *Emphasis of the practice is on conducting fair tests and using data to support explanations. Examples of investigations may include simple experiments with fast-growing plants.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Properties of Materials **Designing Glue** As glue engineers, students use engineering design practices to create a glue for use at their school. They conduct tests that yield quantifiable results, graph their data, analyze and interpret results, and then use that evidence to iteratively design a series of glue mixtures, each one better than the one before.	**2P.1.2.1.1** Plan and conduct an investigation to describe how heating and cooling affects different kinds of materials based upon their observable properties. (P: 3, CC: 1, CI: PS1) *Examples of materials may include metals, cloth, plastics, Styrofoam, wood, and glass.* **2P.3.1.1.1** Develop a simple diagram or physical model to illustrate how some changes caused by heating or cooling can be reversed and some cannot.** (P: 2, CC: 2, CI: PS3) *Examples of reversible changes may include materials such as water and butter at different temperatures. Examples of irreversible changes may include cooking an egg, freezing a plant leaf, and heating paper. Examples of diagrams may include a flow chart.* **2P.4.2.2.1** Obtain information and communicate how Minnesota American Indian tribes and communities and other cultures apply knowledge of the natural world in determining which materials have the properties that are best suited for an intended purpose.* (P: 8, CC: 2, CI: PS1, ETS1) *Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Emphasis of the practice is on obtaining, interpreting, and communicating information related to how various cultures have built materials suited for intended purposes according to their properties. Examples of materials may include instruments (cedar for knockers and black spruce for poles) for ricing, birch bark for baskets or other containers for carrying water, and sinew for connecting parts of tools.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Changing Landforms **The Disappearing Cliff** Students take on the role of geologists as they attempt to figure out what caused a certain rock cliff to change shape over time. They use models to investigate the erosion of rock and the formation of sand. Based on what they learn about erosion, students advise the director of the fictional Oceanside Recreation Center whether it is safe to keep the center open even though the cliff is changing.	**1E.2.2.1.1** Use quantitative data to identify and describe patterns in the amount of time it takes for Earth processes to occur and determine whether they occur quickly or slowly. (P: 5, CC: 7, CI: ESS1) *Emphasis of the core idea is that some Earth processes happen quickly (like tornadoes and thunderstorms) and some slowly (like the erosion of soil). Examples of data may include firsthand observations data from books, videos, pictures, or historical photos.* **1E.4.1.2.1** Construct an argument with evidence to evaluate multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* (P: 7, CC: 7, CI: ESS2, ETS2) *Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water; and different designs for using shrubs, grass, and trees to hold back the land.* **2E.4.2.1.1** Obtain and use information from multiple sources to identify where water is found on Earth. (P: 8, CC: 1, CI: ESS2) *Emphasis of the practice is on learning how to use texts and maps to integrate and evaluate content. Examples may include liquid water in oceans, lakes, rivers, and ponds; and solid water in glaciers and polar ice caps.*

Grade 3

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Balancing Forces **Investigating Floating Trains** In their role as consulting scientists, students are challenged to figure out how a floating train works in order to explain it to the citizens of the fictional city of Faraday. They apply ideas about non-touching forces as well as balanced and unbalanced forces to assuage citizens' fears.	****2P.1.1.1.1** Ask questions about an object's motion based on observation, that can be answered by an investigation. (P: 1, CC: 1, CI: PS2) *Examples of questions may include, what is causing the motion, what type of motion (circular, bouncing, etc.), and what changes are happening in the motion.* ****2P.2.2.1.1** Identify and predict quantitative patterns of the effects of balanced and unbalanced forces on the motion of an object.** (P: 5, CC: F412, CI: PS2) *Examples may include illustrating how an unbalanced force on one side of a ball can make it start moving; and balanced forces pushing on a box from both sides will not produce any motion at all. Data displays may include pictographs and bar graphs.* **4P.1.1.1.1** Ask questions to determine cause and effect relationships of electric and magnetic interactions between two objects not in contact with each other. (P: 1, CC: 2, CI: PS2) *Examples of an electric force may include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force may include the force between two permanent magnets, the force between an electromagnet and steel paper clips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships may include how the distance between objects affects the strength of the force and how the orientation of magnets affects the direction of the magnetic force.* **4P.1.1.2.1** Define a simple design problem that can be solved by applying scientific ideas about magnets.* (P: 1, CC: 2, CI: PS2, ETS2) *Examples of problems may include constructing a latch to keep the door shut and creating a device to keep two moving objects from touching each other.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Inheritance and Traits **Variation in Wolves** Students play the role of wildlife biologists working in Greystone National Park. They study two wolf packs and are challenged to figure out why an adoptive wolf in one of the packs has the traits it does. Students observe variation between and within different species, investigate inherited and acquired traits, and conclude the unit by writing an explanation of the origin of the adoptive wolf's traits for the visitors in Greystone National Park.	**3L.3.1.1.2** Develop multiple models to describe how organisms have unique and diverse life cycles but all have birth, growth, reproduction, and death in common. (P: 2, CC: 4, CI: LS1) *Emphasis is on the pattern of changes organisms go through during their life. Examples of models may include diagrams, drawings, physical models, or computer programs.* ****3L.3.2.1.1** Construct an explanation using evidence from various sources for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (P: 6, CC: 2. CI: LS4) *Examples of cause and effect relationships may include how individual plants of the same species with different length thorns may be more or less likely to be eaten by predators; or animals that have better camouflage coloration than others of their species may be more likely to survive and therefore more likely to leave offspring.* **3L.4.1.1.1** Construct an argument about strategies animals use to survive. (P: 7, CC: 2, CI: LS2) *Emphasis is on group behavior and how being part of a group helps animals obtain food, defend themselves, and cope with changes. Examples of animals should include wolves or other animals that live in Minnesota.* ****4E.1.1.1.2** Ask questions about how water moves through the Earth system and identify the type of question. (P: 1, CC: 5, CI: ESS2) *Emphasis is on the processes of evaporation, condensation, and precipitation. Examples of types of questions may include those that can be tested by an experiment, and questions that may be answered from a text.* **4L.4.1.1.1** Construct or support an argument that traits can be influenced by different environments. (P: 7, CC: 2, CI: LS3) *Emphasis of the practice is on using evidence, data, and/or a model to support an argument. Examples of the environment affecting a trait may include the stunted growth of a typically tall plant grown with insufficient water or an animal's weight being influenced by the availability of food.* **4L.4.2.1.2** Obtain information from various media sources to determine that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** (P: 8, CC: 1, CI: LS3) *Emphasis of the practice is to compare and/or combine information across texts and other reliable media. Emphasis is on organisms other than humans and the patterns in traits between offspring and their parents or among siblings.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Environments and Survival **Snail Trait Biomimicry** As engineers that specialize in biomimicry, designing structures that are modeled on organisms in the natural world, students investigate the adaptive traits of the Grove snail population, and use what they learn to design a protective shell to transport endangered sea turtle eggs.	**2L.3.2.2.1** Engineer a device that mimics the structures and functions of plants or animals in seed dispersal.* (P: 6, CC: 6, CI: LS2, ETS1) *Emphasis is on how specific structures have particular functions. Examples of seed dispersal by animals may include feeding and subsequent elimination of seeds, or attachment of seeds/pollen to animal structures. Examples of seed dispersal by plants may include various wind-catching designs (as in dandelions or maple trees) or colors and smells that attract pollinators.* **3L.3.2.1.1** Construct an explanation using evidence from various sources for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. (P: 6, CC: 2. CI: LS4) *Examples of cause and effect relationships may include how individual plants of the same species with different length thorns may be more or less likely to be eaten by predators; or animals that have better camouflage coloration than others of their species may be more likely to survive and therefore more likely to leave offspring.* **3L.4.2.1.1** Obtain information from various types of media to support an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** (P: 8, CC: 4, CI: LS1) *Examples of structures may include thorns, stems, roots, colored petals, heart, stomach, lungs, brain, and skin. Examples of media may include electronic sources.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Weather and Climate **Establishing an Orangutan Colony** As meteorologists for a nature conservation group, students determine which of four fictional islands will be the best location for an orangutan reserve. They analyze and interpret weather data in order to compare and construct arguments about the weather patterns for a particular location in the world over a given span of time.	**2E.2.1.1.1 Represent data to describe typical weather conditions expected during a particular season. (P: 4, CC: 1, CI: ESS2) *Examples of data may include temperature, precipitation, and wind direction. Data displays can include pictographs and bar graphs.* **2E.2.1.1.2 Analyze data from tests of objects designed to reduce the impacts of weather-related hazards and compare the strengths and weaknesses of how each performs.* (P: 4, CC: 2, CI: ESS3, ETS1) *Emphasis is on data from tests of student-designed objects. Examples of design solutions to weather-related hazards may include barriers to prevent flooding or snow drifting, structures for sun shading, materials for clothing, and orientation of bus shelters.* **2E.4.2.1.2 Obtain and use information from multiple sources, including electronic sources, to describe climates in different regions of the world.** (P: 8, CC: 1, CI: ESS2) *Emphasis of the practice is on learning how to use electronic sources to integrate and evaluate content. Examples of information may include data on an area's typical weather conditions and how these patterns are considered climate.*

Grade 4

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Energy Conversions **Blackout in Ergstown** Students play the role of systems engineers for Ergstown, a fictional town that experiences frequent blackouts. They explore reasons why an electrical system can fail, choose new energy sources and energy converters for the town, and use evidence to explain why their choices will make the town's electrical system more reliable.	****4E.3.2.2.1** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* (P: 6, CC: 2, CI: ESS3, ETS1) *Emphasis is on cause and effect relationships to explain change. Examples of solutions may include designing an earthquake-resistant building and improving monitoring of volcanic activity.* **4E.4.2.1.1** Read and comprehend grade appropriate complex texts and/or other reliable media to describe that energy and fuels are derived from natural resources and their uses affect the environment. (P: 8, CC: 2, CI: ESS3, ETS2) *Examples of information about natural resources should include details about those found in Minnesota. Examples of renewable energy resources may include wind, water behind dams, and sunlight; non-renewable energy resources include fossil fuels and fissile materials. Examples of environmental effects may include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution and global warming from burning fossil fuels.* ****4E.4.2.2.1** Obtain and combine multiple sources of information about ways individual communities, including Minnesota American Indian tribes and communities and other cultures, use evidence and scientific principles to make decisions about the uses of Earth's resources.* (P: 8, CC: 4, CI: ESS3, ETS1) *Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Examples may include balancing the water, soil, wildlife, plant, and human needs to support sustainable use of resources.* **5P.2.1.1.1** Analyze and interpret data to show that energy can be transferred from place to place by sound, light, heat, and electric currents. (P: 4, CC: 5, CI: PS3) *Emphasis of the practice is on analyzing student observations and data to serve as evidence to support a claim.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Energy Conversions **(continued)** **Blackout in Ergstown**	**5P.3.2.1.1** Construct an explanation based on evidence relating the speed of an object to the energy of that object. (P: 6, CC: 5, CI: PS3). *The emphasis of the practice is on students identifying the evidence that supports particular points in the explanation. Examples of evidence may include the damage and the height attained when going up a ramp.* **5P.3.2.2 1** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* (P: 6, CC: 5, CI: PS3, ETS1, ETS2) *Examples of devices may include electric circuits that convert electrical energy into motion, light, or sound; and a passive solar heater that converts light into heat. Examples of constraints may include the materials, cost, or time to design the device.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Vision and Light **Investigating Animal Eyes** As conservation biologists, students work to figure out why a local population of geckos has decreased since the construction of a new stadium. Students consider the bright lights of the stadium and use a computer simulation to investigate the relationship of light and vision, specifically the sensitivity of different animals' eyes to light, and make a recommendation for mitigating the situation.	**3P.1.1.1.1 Ask questions based on observations about why objects in darkness can be seen only when illuminated. (P: 1, CC: 2, CI: PS4) *Emphasis should be on addressing the misconception that people can see in the dark if they wait long enough and on the way eyes receive light. Examples of observations may include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight.*** **3P.3.1.1.1 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (P: 2, CC: 2, CI: PS4) *Examples of models may include diagrams, drawings, physical models, or computer programs.*** **3L.4.2.1.1 Obtain information from various types of media to support an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** (P: 8, CC: 4, CI: LS1) *Examples of structures may include thorns, stems, roots, colored petals, heart, stomach, lungs, brain, and skin. Examples of media may include electronic sources.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Earth's Features **Mystery in Desert Rocks Canyon** Playing the role of geologists, students help the National Park Service explain what a particular boney-looking rock is, how it formed, and how it came to be in its current location at the bottom of Desert Rocks National Park. Then they explain how the canyon where they are doing their research formed to park visitors.	**4E.1.2.1.1** Make observations and measurements to provide evidence of the effects of weathering or the rate of erosion by the forces of water, ice, wind, or vegetation.* (P: 3, CC: 2, CI: ESS2) *Emphasis is on predicting the rate of change when variables are changed. Examples of variables to test may include the angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.* **4E.1.2.1.2** Plan and carry out fair tests in which variables are controlled and failure points are considered to improve a model or prototype to prevent erosion.* (P: 3, CC: 2, CI: ESS2, ETS1; ETS2) *Examples of prototypes to prevent erosion include retaining walls, wind breaks, use of shrubs or other vegetation, and drainage systems.* **4E.3.1.1.1** Develop a model based in part on student observations or data to describe ways the geosphere, biosphere, hydrosphere, and atmosphere interact. (P: 2, CC: 4, CI: ESS2) *Emphasis is on how rock, living things, water, and/or air are individual systems that make up the larger Earth system and interact with each other.* **4E.3.2.1 1** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (P: 6, CC: 1, CI: ESS1) *Examples of evidence from patterns may include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.* ****4E.3.2.2.1** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* (P: 6, CC: 2, CI: ESS3, ETS1) *Emphasis is on cause and effect relationships to explain change. Examples of solutions may include designing an earthquake-resistant building and improving monitoring of volcanic activity.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Waves, Energy, and Information **Investigating How Dolphins Communicate** In their role as marine scientists, students work to figure out how mother dolphins communicate with their calves. They investigate how sound travels and learn about how to look for and create patterns of communication.	**4E.3.2.2.1** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* (P: 6, CC: 2, CI: ESS3, ETS1) *Emphasis is on cause and effect relationships to explain change. Examples of solutions may include designing an earthquake-resistant building and improving monitoring of volcanic activity.* **5P.1.1.1.1** Ask investigatable questions and predict reasonable outcomes about the changes in energy, related to speed, that occur when objects interact. (P: 1, CC: 5, CI: PS3) *Emphasis is on the change in energy due to a change in speed, not on the forces, as objects interact. Example of a question: Where and how do marbles move after a collision?* ****5P.2.1.1.1** Analyze and interpret data to show that energy can be transferred from place to place by sound, light, heat, and electric currents. (P: 4, CC: 5, CI: PS3) *Emphasis of the practice is on analyzing student observations and data to serve as evidence to support a claim.* ****5P.3.2.1.1** Construct an explanation based on evidence relating the speed of an object to the energy of that object. (P: 6, CC: 5, CI: PS3). *The emphasis of the practice is on students identifying the evidence that supports particular points in the explanation. Examples of evidence may include the damage and the height attained when going up a ramp.*

Grade 5

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Patterns of Earth and Sky **Analyzing Stars on Ancient Artifacts** In their role as astronomers, students investigate an artifact found on an archeological dig that seems to show patterns in the daytime and nighttime sky. Using a computer simulation of stars, physical models, and a reference text, students figure out how the position of stars around the Earth, and the spin and orbit of the Earth, cause us to see daily and yearly patterns of stars.	****3E.2.1.1.1** Record observations of the sun, moon, and stars and use them to describe patterns that can be predicted.** (P: 4, CC: 1, CI: ESS1) *Examples of patterns may include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.* ****3E.2.2.1.1** Organize and electronically present collected data to identify and describe patterns in the amount of daylight in the different times of the year.** (P: 5, CC: 1, CI: ESS1) *Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.* ****3E.4.2.2.1** Gather information and communicate how Minnesota American Indian tribes and communities and other cultures use patterns in stars to make predictions and plans. (P: 8, CC: 1, CI: ESS1) *Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Examples may include using star maps to predict seasons, star patterns to inform navigation, and using star stories to identify numeric patterns that guide behavior.* **5E.2.2.1.2** Use data to describe patterns in the daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** (P: 5, CC: 1, CI: ESS1) *Examples of patterns may include the number of daylight hours over the course of a year, selected stars that are visible only in particular months, and the length and direction of shadows over a year.* **5E.4.1.1.1** Use evidence to support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth. (P: 7, CC: 3, CI: ESS1) *Evidence may include analogies of light bulbs and distances.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Modeling Matter **The Chemistry of Food** As food scientists working in a fictional lab of a large food production company, students take on two work assignments: one related to food safety and one related to creation of a new food product. In doing so, they figure out that the properties of materials are related to the properties of the nanoparticles that make up those materials.	**5P.1.2.1.2** Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (P: 3, CC: 2, CI: PS1) *Emphasis is on conducting fair tests by controlling variables.* **5P.1.2.1.3** Evaluate appropriate methods and tools to identify materials based on their properties prior to investigation. (P: 3, CC: 3, CI: PS1) *Examples of materials to be identified may include baking soda and other powders, metals, minerals, and liquids. Examples of properties may include color, hardness, reflectivity, electrical conductivity, ability to conduct heat, response to magnetic forces, and solubility; density is not intended as an identifiable property.* ****5P.2.2.1.1** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (P: 5, CC: 3, CI: PS1) *Examples of reactions or changes may include phase changes, dissolving, and mixing to form new substances. Mass and weight are not distinguished.* **5P.3.1.1 1** Develop and refine a model to describe that matter is made of particles too small to be seen. (P: 2, CC: 3, CI: PS1) *Examples of evidence supporting a model may include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.* ****5L.3.1.1.3** Create an electronic visualization of the movement of matter among plants, animals, decomposers, and the environment.** (P: 2, CC: 4, CI: LS2) *Emphasis is on the idea that matter that is not food is changed by plants into matter that is food. Examples of systems through which matter cycles may include organisms, ecosystems, and the Earth. Examples of an electronic visualization may include a computer program, simulation, or animation.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
The Earth System **Investigating Water Shortages** As water resource engineers, students figure out what caused a water shortage on the east side of a fictional island, East Ferris, and work to design a solution to the problem. Applying their knowledge of water distribution and analyzing the flow of water between the hydrosphere, atmosphere, and geosphere, students communicate the nature of the problem and possible solutions to the people of East Ferris.	****4E.1.1.1.2** Ask questions about how water moves through the Earth system and identify the type of question. (P: 1, CC: 5, CI: ESS2) *Emphasis is on the processes of evaporation, condensation, and precipitation. Examples of types of questions may include those that can be tested by an experiment, and questions that may be answered from a text.* ****4E.2.2.1.1** Interpret charts, maps, and/or graphs of the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** (P: 5, CC: 4, CI: ESS2) *Emphasis is on oceans, lakes, rivers, glaciers, ground water, and polar ice caps.* ****4E.3.1.1.1** Develop a model based in part on student observations or data to describe ways the geosphere, biosphere, hydrosphere, and atmosphere interact. (P: 2, CC: 4, CI: ESS2) *Emphasis is on how rock, living things, water, and/or air are individual systems that make up the larger Earth system and interact with each other.* ****4E.3.2.2.1** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* (P: 6, CC: 2, CI: ESS3, ETS1) *Emphasis is on cause and effect relationships to explain change. Examples of solutions may include designing an earthquake-resistant building and improving monitoring of volcanic activity.* ****5P.1.2.1.2** Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (P: 3, CC: 2, CI: PS1) *Emphasis is on conducting fair tests by controlling variables.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
The Earth System **(continued)** **Investigating Water Shortages**	****5P.1.2.1.3** Evaluate appropriate methods and tools to identify materials based on their properties prior to investigation. (P: 3, CC: 3, CI: PS1) *Examples of materials to be identified may include baking soda and other powders, metals, minerals, and liquids. Examples of properties may include color, hardness, reflectivity, electrical conductivity, ability to conduct heat, response to magnetic forces, and solubility; density is not intended as an identifiable property.* **5P.2.2.1.1** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. (P: 5, CC: 3, CI: PS1) *Examples of reactions or changes may include phase changes, dissolving, and mixing to form new substances. Mass and weight are not distinguished.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Ecosystem Restoration **Matter and Energy in a Rainforest** Students engage as ecologists as they figure out why the plants and animals in a failing Costa Rican rainforest ecosystem aren't growing and thriving. Growing a terrarium, using physical models, and investigating how matter and energy flow with a computer model, students solve the mystery and create a plan for rainforest restoration.	**4E.2.2.1.1 Interpret charts, maps, and/or graphs of the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** (P: 5, CC: 4, CI: ESS2) *Emphasis is on oceans, lakes, rivers, glaciers, ground water, and polar ice caps.* **4E.4.2.2.1 Obtain and combine multiple sources of information about ways individual communities, including Minnesota American Indian tribes and communities and other cultures, use evidence and scientific principles to make decisions about the uses of Earth's resources.* (P: 8, CC: 4, CI: ESS3, ETS1) *Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Examples may include balancing the water, soil, wildlife, plant, and human needs to support sustainable use of resources.* **5L.1.2.1.4** Plan and conduct an investigation to obtain evidence that plants get the materials they need for growth chiefly from air and water. (P: 3, CC: 5, CI: LS1) *Examples of plants may include aquatic plants that grow without soil. Examples of observational evidence may include growth patterns for plants grown in different environments.* **5P.3.1.1 1** Develop and refine a model to describe that matter is made of particles too small to be seen. (P: 2, CC: 3, CI: PS1) *Examples of evidence supporting a model may include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.* **5P.3.1.1.2** Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun. (P: 2, CC: 5, CI: PS3) *Examples of models may include diagrams, and flow charts.*

Name and Summary	Minnesota Academic Standards in Science Performance Expectations addressed
Ecosystem Restoration **(continued)** **Matter and Energy in a Rainforest**	**5L.3.1.1.3** Create an electronic visualization of the movement of matter among plants, animals, decomposers, and the environment.** (P: 2, CC: 4, CI: LS2) *Emphasis is on the idea that matter that is not food is changed by plants into matter that is food. Examples of systems through which matter cycles may include organisms, ecosystems, and the Earth. Examples of an electronic visualization may include a computer program, simulation, or animation.* **5L.4.1.2.1** Evaluate the merit of a solution to a problem caused by changes in plant and animal populations as a result of environmental changes.* (P: 7, CC: 4, CI: LS4, ETS1) *Emphasis is on evaluating solutions (based on evidence and design criteria and constraints), not developing new solutions. Examples of environmental changes may include land characteristics, water distribution, temperature, food availability, or the presence of other organisms.*

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