PROPOSED REGULATION OF THE

STATE BOARD OF EDUCATION

LCB File No. R084-13

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EXPLANATION – Matter in *italics* is new; matter in brackets [~~omitted material~~] is material to be omitted.

AUTHORITY: §§1-8 and 10, NRS 385.080, 385.110, 389.0185 and 389.520; §9, NRS 385.080, 385.110, 389.0185, 389.019 and 389.520; §11, NRS 385.080 and 385.110.

A REGULATION relating to curriculum; revising the performance standards for instruction in science for kindergarten through the 12th grade; and providing other matters properly relating thereto.

Section 1. Chapter 389 of NAC is hereby amended by adding thereto the provisions set forth as sections 2 to 5, inclusive, of this regulation.

Sec. 2. ***Instruction in kindergarten in science must be designed so that pupils meet the following performance standards by the completion of kindergarten:***

1. For the area of physical science, understand:

(a) The forces and interactions which affect motion and stability, as demonstrated by the ability of the pupil to:

(1) Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. Pushes or pulls may be demonstrated in various manners, including, without limitation, by 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. An assessment of pupils in this area must be limited to different relative strengths or different directions of pushes and pulls, but not both

at the same time and must not include noncontact pushes or pulls such as those produced by magnets.

(2) Analyze data to determine if a design solution works as intended to change the speed or direction of an object by pushing or pulling the object. A problem for which a design solution is prepared may include, without limitation, having a marble or other object move a certain distance, follow a particular path and knock down other objects. Design solutions may include, without limitation, the use of tools such as a ramp to increase the speed of the object and a structure that causes an object such as a marble or ball to turn. An assessment of pupils in this area must not include friction as a mechanism for change in speed.

(b) Energy, as demonstrated by the ability of the pupil to:

(1) Make observations to determine the effect of sunlight on the surface of the earth, which may include, without limitation, the effect on sand, soil, rocks and water. An assessment of pupils in this area is limited to recognizing relative measures of temperature which may include, without limitation, whether the surface is warmer or cooler.

(2) Use tools and materials to design and build a structure to reduce the warming effect of sunlight on an area. Such structures may include, without limitation, umbrellas, canopies and tents.

2. For the area of life science, understand the structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to use observations to describe patterns of the things plants and animals, including humans, need to survive. Such observations may include, without limitation, that animals need to consume food to survive while plants do not, the different kinds of food needed by different types of animals to survive, that plants need to have light to survive and that all living things need water to survive.

3. For the area of earth science, understand:

(a) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Use and share observations of local weather conditions to describe patterns over time. Qualitative observations may include, without limitation, descriptions of the weather as sunny, cloudy, rainy and warm. Quantitative observations may include, without limitation, the number of sunny, windy and rainy days in a month. Descriptions of patterns of weather conditions may include, without limitation, that it is usually cooler in the morning than in the afternoon and the number of sunny days compared to cloudy days in different months. An assessment of pupils in this area with respect to quantitative observations must be limited to whole numbers and relative measures such as whether the weather is warmer or cooler.

(2) Construct an argument supported by evidence for how plants and animals, including humans, are able to change the environment to meet their needs. Such evidence may include, without limitation, that a squirrel digs in the ground to hide its food and that tree roots can break concrete.

(b) The earth and human activity on earth, as demonstrated by the ability of the pupil to:

(1) Use a model to represent the relationship between the needs of different plants or animals, including humans, and the places they live. Such relationships may include, without limitation, that deer which eat buds and leaves usually live in forested areas, that grasses which need sunlight often grow in meadows and that plants, animals and their surroundings make up a system.

(2) Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. Emphasis in this area must be on local forms of severe weather.

(3) Communicate solutions that will reduce the impact of humans on land, water, air and other living things in the local environment. Human impact on land may include, without limitation, cutting trees to produce paper and using resources to produce bottles. Solutions may include, without limitation, reusing paper and recycling cans and bottles.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Ask questions, make observations and gather information about a situation for which a change is desired to define a simple problem that can be solved through the development of a new or improved object or tool.

(b) Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

(c) Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of the performance of each object.

Sec. 3. *By the beginning of the first grade, pupils must know and be able to do everything required in kindergarten for science offered in public schools. Instruction in the first grade in science must be designed so that pupils meet the following performance standards by the completion of the first grade:*

1. For the area of physical science, understand waves and their application in technology for the transfer of information, as demonstrated by the ability of the pupil to:

(a) Plan and conduct investigations to provide evidence that vibrating materials can make sound waves and that sound waves can make materials vibrate. Vibrating materials that make sound waves may include, without limitation, tuning forks and plucking a stretched string. Demonstrations of sound waves that make matter vibrate may include, without limitation,

holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.

(b) Make observations to construct an evidence-based account that objects can be seen only when illuminated by light waves. Observations may include, without limitation, those made in a completely dark room, a pinhole box and a video of a cave explorer with a flashlight. Illumination may be provided by an external light source or by an object giving off its own light.

(c) Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. Materials may include, without limitation, transparent materials such as clear plastic, translucent materials such as wax paper, opaque materials such as cardboard and reflective materials such as a mirror. An assessment of pupils in this area must not include the speed of light.

(d) Use tools and materials to design and build a device that uses light or sound waves to solve the problem of communicating over a distance. Devices may include, without limitation, a light source to send signals, paper cup and string "telephones" and a pattern of drum beats. An assessment of pupils in this area must not include technological details for how communication devices work.

2. For the area of life science, understand:

(a) The structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to:

(1) Use materials to design a solution to a human problem by mimicking how plants and animals use their external parts to help them survive, grow and meet their needs. A human problem that can be solved by mimicking plant or animal solutions may include, without

limitation, 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 detecting intruders by mimicking eyes and ears.

(2) Read texts and use media to determine patterns in the behavior of parents and their offspring that help the offspring survive. Such patterns of behaviors may include, without limitation, the signals that offspring make, including, without limitation, crying, cheeping and other vocalizations, and the responses of the parents to such signals, including, without limitation, feeding, comforting and protecting their offspring.

(b) The inheritance and variation of traits of heredity, as demonstrated by the ability of the pupil to make observations to construct an evidence-based account that young plants and animals, including humans, are similar to, but not exactly the same as, their parents. Patterns that may be used include, without limitation, the features that plants or animals share. Observations that may be used include, without limitation, that leaves from the same kind of plant are the same shape but may differ in size and that although dogs of a particular breed may look alike, the individual dogs are not exactly the same. An assessment of pupils in this area must not include inheritance or animals that are hybrids or undergo metamorphosis.

3. For the area of earth science, understand the earth's place in the universe, as demonstrated by the ability of the pupil to:

(a) Use observations of the sun, moon and stars to describe patterns that can be predicted. Patterns that may be used include, without limitation, that the sun and moon appear to rise in one part of the sky, move across the sky and set and that stars other than the sun are visible at

night but not during the day. An assessment of pupils in this area must be limited to star patterns that are visible at night and not during the day.

(b) Make observations at different times of the year to relate the amount of daylight to the time of year. Emphasis in this area must be on relative comparisons of the amount of daylight that exists in the winter to the amount of daylight that exists in the spring or fall. An assessment of pupils in this area must be limited to relative amounts of daylight, not quantifying the hours or time of daylight.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Ask questions, make observations and gather information about a situation which persons have a desire to change to define a simple problem that can be solved through the development of new or improved objects or tools.

(b) Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

(c) Analyze data from testing two objects designed to solve the same problem to compare the strengths and weaknesses displayed by each object.

Sec. 4. *By the beginning of the third grade, pupils must know and be able to do everything required in the previous grades for science offered in public schools. Instruction in the third grade in science must be designed so that pupils meet the following performance standards by the completion of the third grade:*

1. For the area of physical science, understand the forces and interactions which affect motion and stability, as demonstrated by the ability of the pupil to:

(a) Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Examples may include, without limitation, that an unbalanced force on one side of a ball can make the ball start moving and that balanced forces pushing on a box from both sides will not produce any motion. An assessment of pupils in this area must be limited to one variable at a time, including, without limitation, the number, size or direction of forces, and must be limited to gravity being addressed as a force that pulls objects down and must not include quantitative force size, only qualitative and relative force.

(b) Make observations or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. Examples of motion with a predictable pattern may include, without limitation, a child swinging back and forth on a swing, a ball rolling back and forth in a bowl and two children moving up and down on a see-saw. An assessment of pupils in this area must not include technical terms.

(c) Ask questions to determine the cause and effect of electrical or magnetic interactions between two objects that do not make contact. Examples of electrical force may include, without limitation, the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper. Examples of magnetic force may include, without limitation, the force between two permanent magnets, the force between an electromagnet and steel paperclips and the force exerted by one magnet compared to the force exerted by two magnets. Examples of cause and effect relationships may include, without limitation, the manner in which the distance between objects affects the strength of the force and how the orientation of magnets affects the direction of the magnetic force. An assessment

of pupils in this area must be limited to forces produced by objects that can be manipulated by pupils. Electrical interactions must be limited to static electricity.

(d) Define a simple design problem that can be solved by applying scientific concepts about magnets. Problems may include, without limitation, constructing a latch to keep a door shut and creating a device to prevent two moving objects from touching each other.

2. For the area of life science, understand:

(a) The structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to develop models to illustrate that organisms have unique and diverse life cycles but that each organism experiences birth, growth, reproduction and death and that there is a pattern to the changes organisms go through during their lives. An assessment of pupils in this area must be limited to plant life cycles of flowering plants and must not include details of human reproduction.

(b) The interactions, energy and dynamics of ecosystems, as demonstrated by the ability of the pupil to construct arguments that some animals form groups that help members of the same species survive.

(c) The inheritance and variation of traits of heredity, as demonstrated by the ability of the pupil to:

(1) Analyze and interpret data to provide evidence that plants and animals, including humans, have traits inherited from their parents and that variations of these traits exist in a group of similar organisms. Patterns of heredity may be demonstrated through the similarities and differences in traits shared between offspring and their parents or among siblings. An assessment of pupils in this area must include only examples of living things that are not human and must not include genetic mechanisms of inheritance or prediction of traits.

(2) Use evidence to support the explanation that traits can be influenced by the environment. Environmental factors affecting a trait that may be used include, without limitation, evidence that an insufficient water supply may cause tall plants to have stunted growth and that a pet that is given too much food and little exercise may become overweight.

(d) The unity and diversity of biological evolution, as demonstrated by the ability of the pupil to:

(1) Analyze and interpret data from fossils to provide evidence of the existence of organisms and the environments in which they lived. Data may include, without limitation, the type, size and distribution of fossil organisms. Fossils and environments that may be used for data include, without limitation, marine fossils found on dry land, tropical plant fossils found in Arctic areas and fossils of extinct organisms. An assessment of pupils in this area must be limited to major fossil types and relative ages and must not include identification of specific fossils or present plants and animals.

(2) Use evidence to explain how the variations in characteristics among members of the same species may provide advantages to their ability to survive, find mates and reproduce. Cause and effect relationships that may be used include, without limitation, that plants which have larger thorns than other plants may be less likely to be eaten by predators and that animals which have better camouflage coloration than other animals may be more likely to survive and reproduce.

(3) Construct an argument with evidence that in a particular habitat some organisms are able to survive better than others and some are not able to survive. Evidence may include, without limitation, the needs and characteristics of the organisms and habitats involved and

that the organisms and their habitat comprise a system in which the parts of each depend on the other.

(4) Make a claim about the merit of a solution to a problem that is caused by a change in the environment that may cause the types of plants and animals that live in that environment to change. Environmental changes may include, without limitation, changes in the land, water distribution, temperature, food and other organisms. An assessment of pupils in this area must be limited to a single environmental change and must not include the greenhouse effect or climate change.

3. For the area of earth science, understand:

(a) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. Data may include, without limitation, average temperatures, precipitation and wind direction. An assessment of pupils in this area must be limited to the use of pictographs and bar graphs as graphical displays and must not include climate change.

(2) Obtain and combine information to describe climates in different regions of the world.

(b) The earth and human activity on earth, as demonstrated by the ability of the pupil to make claims about the merits of design solutions that reduce the impact of weather-related hazards. Design solutions may include, without limitation, barriers to prevent flooding, roofs that are wind resistant and lightning rods.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Define a simple design problem which reflects a need or desire and includes specified criteria for success and constraints on materials, time or cost.

(b) Generate and compare multiple possible solutions to a problem based on the likelihood that each solution meets the criteria and constraints of the problem.

(c) Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that may be improved.

Sec. 5. *By the beginning of the fourth grade, pupils must know and be able to do everything required in the previous grades for science offered in public schools. Instruction in the fourth grade in science must be designed so that pupils meet the following performance standards by the completion of the fourth grade:*

1. For the area of physical science, understand:

(a) Energy, as demonstrated by the ability of the pupil to:

(1) Use evidence to explain the relationship between the speed of an object and the energy of that object. An assessment of pupils in this area must not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.

(2) Make observations to provide evidence that energy can be transferred from one place to another by sound, light, heat and electrical currents. An assessment of pupils in this area must not include quantitative measurements of energy.

(3) Ask questions and predict outcomes about the changes in energy that occur when objects collide. Emphasis in this area must be on the change in energy from a change in speed as objects interact and not on the forces. An assessment of pupils in this area must not include quantitative measurements of energy.

(4) Apply scientific concepts to design, test and refine a device that converts energy from one form to another. Devices may include, without limitation, electrical circuits that convert electrical energy into motion energy of a vehicle, light or sound or a passive solar heater that converts light into heat. Factors that constrain the viability of a device may include, without limitation, the materials, cost or time to design the device. An assessment of pupils in this area must be limited to devices that convert motion energy to electrical energy or use stored energy to cause motion or produce light or sound.

(b) Waves and their application in technology for the transfer of information, as demonstrated by the ability of the pupil to:

(1) Develop a model of waves to demonstrate patterns in terms of amplitude and wavelength and that waves can cause objects to move. Models may include, without limitation, diagrams, analogies and physical models using wire to illustrate wavelength and amplitude of waves. An assessment of pupils in this area must not include interference effects, electromagnetic waves, nonperiodic waves or quantitative models of amplitude and wavelength.

(2) Develop a model to demonstrate that light reflecting from objects and entering the eye allows objects to be seen. An assessment of pupils in this area must not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision or how the retina works.

(3) Generate and compare multiple solutions that use patterns to transfer information. Solutions may include, without limitation, drums that send coded information through sound waves, use of a grid of 1's and 0's representing black and white to send information about a picture and use of Morse code to send text.

2. For the area of life science, understand the structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to:

(a) Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction. Structures may include, without limitation, thorns, stems, roots and colored petals and the heart, stomach, lungs, brain and skin. An assessment of pupils in this area must be limited to macroscopic structures within plant and animal systems.

(b) Use a model to demonstrate that animals receive different types of information through their senses, process the information in their brain and respond to the information in different ways. Emphasis in this area must be on systems used to transfer information. An assessment of pupils in this area must not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.

3. For the area of earth science, understand:

(a) The earth's place in the universe, as demonstrated by the ability of the pupil to identify evidence of change in the earth from patterns in rock formations and fossils in layers of rock to support an explanation for changes that have occurred in a landscape over time. Evidence of change in the earth from patterns may include, without limitation, layers of rock with marine shell fossils above layers of rocks with plant fossils and no shells, which indicate a change from land to water over time, and a canyon with different layers of rock in the walls and a river in the bottom, which indicate that over time a river cut through the rock. An assessment of pupils in this area must be limited to relative time and must not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers.

(b) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Make observations or measurements to provide evidence of the effects of weathering on the earth or the rate of its erosion by water, ice, wind or vegetation. Variables that may be tested include, without limitation, the angle of the 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. An assessment of pupils in this area must be limited to a single form of weathering or erosion.

(2) Analyze and interpret data from maps to describe patterns of the earth's features. Maps may include topographic maps of the earth's land and ocean floor and maps of the locations of mountains, continental boundaries, volcanoes and earthquakes.

(c) The earth and human activity on earth, as demonstrated by the ability of the pupil to:

(1) Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. Renewable energy resources may include, without limitation, wind energy, water behind dams and sunlight. Nonrenewable energy resources may include, without limitation, fossil fuels and fissile materials. Environmental effects may include, without limitation, loss of habitat from dams, loss of habitat from surface mining and air pollution from burning fossil fuels.

(2) Generate and compare multiple solutions to reduce the impacts of natural earth processes on humans. Solutions may include, without limitation, designing a building which is earthquake-resistant and improving the manner in which volcanic activity is monitored. An assessment of pupils in this area must be limited to impacts from earthquakes, floods, tsunamis and volcanic eruptions.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Define a simple design problem which reflects a need or desire and includes specified criteria for success and constraints on materials, time or cost.

(b) Generate and compare multiple possible solutions to a problem based on how well each solution is likely to meet the criteria and constraints of the problem.

(c) Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that may be improved.

Sec. 6. NAC 389.244 is hereby amended to read as follows:

389.244 ***By the beginning of the second grade, pupils must know and be able to do everything required in the previous grades for science offered in public schools.*** Instruction in ~~[kindergarten through]~~ the second grade in science must be designed so that pupils meet the following ***performance*** standards by the completion of the second grade:

1. For the area of ***physical*** science ~~[inquiry:~~

~~(a) Understand that science is an active process of systematically examining the natural world;~~

~~(b) Know how to make observations and provide descriptions of such observations using words, numbers and drawings;~~

~~(c) Know that tools can be used safely to gather data and to extend the senses; and~~

~~(d) Know that observable patterns can be used to predict future events or sort items.]~~ ***, understand matter and its interactions, as demonstrated by the ability of the pupil to:***

(a) Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. Observable properties may include, without limitation, color,

texture, hardness and flexibility. Patterns may include, without limitation, the similar properties that different materials share.

(b) Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. Properties may include, without limitation, strength, flexibility, hardness, texture and absorbency. An assessment of pupils in this area that includes quantitative measurements must be limited to length.

(c) Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. Sets of pieces may include, without limitation, blocks, building bricks or other assorted small objects.

(d) Construct an argument with evidence that some changes caused by heating or cooling are able to be reversed and some are not. Examples of reversible changes may include, without limitation, materials such as water and butter at different temperatures. Examples of irreversible changes may include, without limitation, cooking an egg, freezing a plant leaf and heating paper.

2. For the ~~[areas]~~ ***area*** of ***life*** science, ~~[technology and society:~~

~~(a) Understand that many people contribute to the field of science, including, without limitation, men and women of all ages and backgrounds; and~~

~~(b) Know that teamwork is beneficial to the study of science, including, without limitation, working and sharing findings with others.~~

~~3. For the area of matter:~~

~~(a) Understand that matter has observable properties;~~

~~(b) Know that matter can exist in a solid form or liquid form;~~

(c) Know that certain properties of materials can be changed by heating, freezing, mixing, cutting or bending the material;

(d) Know that matter can be categorized by observable properties, including, without limitation, color, size, shape and weight; and

(e) Know that different objects can be made of many different types of materials.

4. For the areas of force and motion:

(a) Understand that the position and motion of an object can be described;

(b) Know that the position and motion of an object can be changed by pushing or pulling the object;

(c) Know that an object can move:

(1) In various manners and directions, including, without limitation, straight lines, zigzags, vibrations and circular motions; and

(2) At various speeds, including, without limitation, fast and slow;

(d) Know that magnets can be used to make certain objects move without being touched; and

(e) Know that an object will fall to the ground unless something holds the object off of the ground.

5. For the area of energy:

(a) Understand that heat, light and sound can be produced;

(b) Know that the sun is a source of heat and light;

(c) Know that sound is produced through the vibration of one or more objects; and

(d) Know that an object can be described as hot or cold in relation to another object.

6. For the area of heredity:

(a) Understand that living things, including, without limitation, plants and animals, pass certain characteristics to their offspring that make them resemble each other; and

(b) Know that differences exist among individuals of the same kind of plant or animal.

7. For the area of the structure of life:

(a) Understand that living things have identifiable characteristics; and

(b) Know that humans and other animals use their senses to understand and adapt to their environment.

8. For the area of organisms and their environment:

(a) Understand that living things live in different places and environments;

(b) Know that plants and animals need certain resources for energy and growth;

(c) Know that a habitat includes, without limitation, food, water, shelter and space; and

(d) Know that living things exist almost everywhere on the earth.

9. For the area of the diversity of life:

(a) Understand that there are many kinds of living things on the earth;

(b) Know that plants and animals can be distinguished by observable characteristics and behaviors; and

(c) Know that certain plants and animals are extinct.

10. For the areas of the atmospheric processes and the cycle of water:

(a) Understand that changes in the weather can transform the state of water from a liquid form to a solid form or a solid form to a liquid form;

(b) Know that the sun is a source of heat and light;

(c) Know that the water on the earth exists in a liquid form or solid form and can transform from one form to the other form;

~~(d) Know that the weather changes from day to day and from season to season; and~~

~~(e) Know that the weather can be described in terms of certain measurements, including, without limitation, the degree of the temperature, the direction and speed of the wind, and the amount of precipitation.~~

~~11. For the areas of the solar system and the universe:~~

~~(a) Understand that there are objects in the sky which display patterns, including, without limitation, how they look, where they are located and how they move;~~

~~(b) Know that the sun rises every day and the moon can rise during the day and night;~~

~~(c) Know that the sun and moon appear to move across the sky; and~~

~~(d) Know that the shape of the moon appears to change over the course of a month.~~

~~12. For the area of the structure and composition of the earth:~~

~~(a) Understand that the earth is composed of various materials, including, without limitation, rock, soil and water;~~

~~(b) Know that rocks exist in various sizes, shapes, textures and colors;~~

~~(c) Know that different objects are made of different types of materials; and~~

~~(d) Know that the color and texture of soil depends upon the composition of the soil.]~~ ***understand:***

(a) The interactions, energy and dynamics of ecosystems, as demonstrated by the ability of the pupil to:

(1) Plan and conduct an investigation to determine if plants need sunlight and water to grow. An assessment of pupils in this area must be limited to testing one variable at a time.

(2) Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

(b) The unity and diversity of biological evolution, as demonstrated by the ability of the pupil to make observations of plants and animals to compare the diversity of life in different habitats. Emphasis in this area must be on the diversity of living things in each of a variety of different habitats. An assessment of pupils in this area must not include specific animal and plant names in specific habitats.

3. For the area of earth science, understand:

(a) The earth's place in the universe, as demonstrated by the ability of the pupil to use information from several sources to provide evidence that events affecting the earth can occur quickly or slowly. Events and timescales may include, without limitation, sudden volcanic explosions and earthquakes and the gradual erosion of rocks. An assessment of pupils in this area must not include quantitative measurements of timescales.

(b) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Examples of solutions may include, without limitation, 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.

(2) Develop a model to illustrate the shapes and kinds of land and bodies of water in an area. An assessment of pupils in this area must not include quantitative scaling in models.

(3) Obtain information to demonstrate where water is found on earth and that water can be solid or liquid.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Ask questions, make observations and gather information about a situation which persons desire to change to define a simple problem that can be solved through the development of new or improved objects or tools.

(b) Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

(c) Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of the performance of each object.

Sec. 7. NAC 389.2939 is hereby amended to read as follows:

389.2939 By the ~~[end]~~ ***beginning*** of the fifth grade, pupils must ~~[understand,]~~ know and be able to do everything required in the previous grades for ~~[courses in]~~ science offered in public schools. Instruction in the ~~[third grade through the]~~ fifth grade in science must be designed so that pupils meet the following standards by the completion of the fifth grade:

1. For the area of ***physical*** science ~~[inquiry:~~

~~(a) Understand that the study of science involves asking and answering questions and comparing the answers to what scientists already know about the world;~~

~~(b) Know that scientific progress is made by conducting careful investigations, recording data and communicating the results of investigations and data in an accurate manner;~~

~~(c) Know how to compare the results of a scientific experiment to what scientists already know about the world;~~

~~(d) Know how to draw conclusions from scientific evidence;~~

~~(e) Know that graphic representations of recorded data can be used to make predictions;~~

~~(f) Know how to plan and conduct a safe and simple investigation; and~~

(g) Know that a model is a tool which can be used to learn about the object or properties the model is designed to resemble.

2. For the areas of science, technology and society:

(a) Understand that people from all cultures and levels of education, experience and ability contribute to the fields of science and technology;

(b) Know that people of diverse cultures have contributed to scientific knowledge and technology throughout history;

(c) Know that technology has positive and negative impacts on society; and

(d) Know that there are benefits to working with others in a team and sharing findings.

3. For the area of matter:

(a) Understand the properties of objects and materials;

(b) Know that matter exists in different states which have distinct physical properties, including, without limitation, solids, liquids and gases;

(c) Know that heating and cooling can change some common materials from one state to another, including, without limitation, water;

(d) Know that materials can be classified by their observable physical and chemical properties, including, without limitation, magnetism, conductivity, density and solubility;

(e) Know that a material can be created by combining two or more different materials and that the properties of the newly created material may be different from the properties of the original materials;

(f) Know that the mass of a material remains constant whether the material is together, separated into parts or changed to a different state or form; and

(g) Know that materials are composed of certain elements that are too small to be seen without magnification.

4. For the areas of force and motion:

(a) Understand that certain forces applied to an object can change the position or motion of the object, including, without limitation, gravitational, electrical and magnetic forces;

(b) Know that an object will speed up, slow down or move in a different direction if an unbalanced force is applied to the object;

(c) Know that the strength of a force which is applied to an object and the mass of the object will influence the amount of change in the motion of the object;

(d) Know that a magnetic force can cause certain objects to attract or repel each other;

(e) Know that an electrically charged particle can attract or repel another electrically charged particle or material; and

(f) Know that the gravity of the earth can pull any object toward the surface of the earth without touching the object.

5. For the area of energy:

(a) Understand that energy exists in different forms;

(b) Know that light can be described in terms of simple properties, including, without limitation, color, brightness and reflection;

(c) Know the wave characteristics of sound;

(d) Know that heat can be produced as a by-product when one form of energy converts to another form of energy, including, without limitation, the conversion of stored energy to motion through the use of a machine or a living organism;

(e) Know that heat can transfer from one object to another by conduction and that certain materials conduct heat better than other materials; and

(f) Know the organization of a simple electrical circuit, including, without limitation, a battery, generator or a wire through which an electrical current can pass.

6. For the area of heredity:

(a) Understand that certain characteristics in living things are inherited and certain characteristics are not inherited;

(b) Know certain physical characteristics and behaviors that are inherited in animals and plants;

(c) Know that reproduction is an essential characteristic for the continuation of every species;

(d) Know that the offspring of an animal or plant can:

(1) Resemble the animal or plant from which the offspring was generated;

(2) Resemble other offspring of the animal or plant from which the offspring was generated; and

(3) Exhibit differences in characteristics from the animal or plant from which the offspring was generated;

(e) Know how to observe and describe differences between different persons of the human population; and

(f) Know that certain behaviors of animals are learned behaviors.

7. For the area of the structure of life:

(a) Understand that living things have specialized structures that perform a variety of life functions;

(b) Know that plants and animals have structures that enable them to grow, reproduce and survive; and

(c) Know that living things have predictable life cycles.

8. For the area of organisms and their environment:

(a) Understand that there are a variety of ecosystems on the earth and that different organisms interact with one another within their ecosystems;

(b) Know the organization of simple food webs;

(c) Know that organisms interact with one another and with the nonliving elements of their ecosystem;

(d) Know that changes to an environment can be beneficial or detrimental to certain organisms;

(e) Know that all organisms, including, without limitation, human beings, can cause changes to their environment; and

(f) Know that plants and animals can adapt in certain ways to survive in certain ecosystems.

. For the area of the diversity of life:

(a) Understand that living things can be classified according to physical characteristics, behaviors and habitats;

(b) Know that animals and plants can be classified according to their observable characteristics;

(c) Know that fossils are evidence of past life on the earth; and

(d) Know that certain differences between each animal or plant within a species can provide the animal or plant with advantages or disadvantages for survival and reproduction.

10. For the areas of the atmospheric processes and the cycle of water:

(a) Understand the relationship between the weather and the cycle of water;

(b) Know that the sun is the main source of energy for the earth;

(c) Know the processes of the cycle of water and the role of the sun in the cycle of water;

(d) Know that most of the surface of the earth is covered with fresh water or salt water;

(e) Know the role of water in various phenomena involving the weather, including, without limitation, the role of water in thunderstorms, snowstorms, floods and droughts; and

(f) Know that air is a substance that surrounds the earth, takes up space and moves around the earth in the form of wind.

11. For the areas of the solar system and the universe:

(a) Understand that there are many components in the solar system, including, without limitation, the earth;

(b) Know that there are more stars than can easily be counted by the human eye;

(c) Know that stars are not the same color or brightness and are not scattered evenly throughout the solar system;

(d) Know that the solar system includes, without limitation, the sun, planets and moons;

(e) Know that the sun is a star;

(f) Know that stars other than the sun are so far away from the earth that they look like points of light;

(g) Know that there are cyclical patterns of observable objects in the solar system; and

(h) Know that the patterns of stars in the sky stay the same, except that the patterns of stars appear to move across the sky each night and that different stars can be seen in different seasons.

12. For the area of the composition and structure of the earth:

~~(a) Understand that features on the surface of the earth are constantly changed by a combination of slow and rapid processes;~~

~~(b) Know that fossils are evidence of past life;~~

~~(c) Know that water, wind and ice constantly change the surface of the land on the earth through erosion of rock and soil in some geographic locations and the deposit of rock and soil in other geographic locations;~~

~~(d) Know that landforms can be created from:~~

~~(1) Slow processes, including, without limitation, erosion and deposition of rock and soil; and~~

~~(2) Fast processes, including, without limitation, volcanoes, earthquakes, landslides, floods and human activity;~~

~~(e) Know that rock is composed of various combinations of minerals; and~~

~~(f) Know that soil varies from place to place and contains biological and mineral components.~~ ***, understand:***

(a) Matter and its interactions, as demonstrated by the ability of the pupil to:

(1) Develop a model to demonstrate that matter is made of particles too small to be seen. Evidence may include, without limitation, adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water and evaporating salt water. An assessment of pupils in this area must not include the atomic-scale mechanism of evaporation and condensation or defining unseen particles.

(2) 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. Reactions or changes may include, without limitation, phase changes, dissolving

and mixing that form new substances. An assessment of pupils in this area must not include distinguishing mass and weight.

(3) Make observations and measurements to identify materials based on their properties. Materials to be identified may include, without limitation, baking soda and other powders, metals, minerals and liquids. Properties may include, without limitation, color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces and solubility. An assessment of pupils in this area must not include density or distinguishing mass and weight.

(4) Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

(b) The forces and interactions which affect motion and stability, as demonstrated by the ability of the pupil to support an argument that the gravitational force exerted by earth on objects is directed down. An assessment of pupils in this area must not include a mathematical representation of gravitational force. For the purpose of this paragraph, "down" means the direction that points toward the center of the spherical earth.

(c) Energy, as demonstrated by the ability of the pupil to use models to demonstrate that energy in the food consumed by animals, which is used for body repair, growth and motion and to maintain body warmth, was once energy from the sun. Models may include, without limitation, diagrams and flow charts.

2. For the area of life science, understand:

(a) The structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to support an argument that plants primarily obtain the matter they need

for growth from air and water. Emphasis in this area must be placed on the concept that plant matter is derived mostly from air and water and not from the soil.

(b) The interactions, energy and dynamics of ecosystems, as demonstrated by the ability of the pupil to develop a model to demonstrate the movement of matter among plants, animals, decomposers and the environment. Emphasis in this area must be on the concept that matter that is not food, such as air, water and decomposed materials in soil, is changed by plants into matter that is food. Systems may include, without limitation, organisms, ecosystems and the earth. An assessment of pupils in this area must not include molecular explanations.

3. For the area of earth science, understand:

(a) The earth's place in the universe, as demonstrated by the ability of the pupil to:

(1) Support an argument that differences in the apparent brightness of the sun compared to other stars are because of their relative distances from earth. An assessment of pupils in this area must be limited to the relative distances of stars and not their sizes and must not include other factors that affect apparent brightness, such as stellar masses, age or stage.

(2) Represent data in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the sky at night. Patterns may include, without limitation, the position and motion of earth with respect to the sun and selected stars that are visible only during particular months. An assessment of pupils in this area must not include the causes of seasons.

(b) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Develop a model using an example to demonstrate the ways in which the geosphere, biosphere, hydrosphere and atmosphere interact. Examples may include, without limitation, the influence of the ocean on ecosystems, landform shape and climate, the influence of the

atmosphere on landforms and ecosystems through weather and climate and the influence of mountain ranges on winds and clouds in the atmosphere. For this area, the geosphere, hydrosphere, atmosphere and biosphere are each considered a system. An assessment of pupils in this area must be limited to the interactions of two systems at a time.

(2) Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on earth. An assessment of pupils in this area must be limited to oceans, lakes, rivers, glaciers, groundwater and polar ice caps and must not include the atmosphere.

(c) The earth and human activity on earth, as demonstrated by the ability of the pupil to obtain and combine information about ways individual communities use scientific concepts to protect the earth's resources and environment.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Define a simple design problem which reflects a need or desire and includes specified criteria for success and constraints on materials, time or cost.

(b) Generate and compare multiple possible solutions to a problem based on how well each solution is likely to meet the criteria and constraints of the problem.

(c) Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that may be improved.

Sec. 8. NAC 389.411 is hereby amended to read as follows:

389.411 By the ~~[end]~~ ***beginning*** of the ~~[eighth]~~ ***sixth*** grade, pupils must ~~[understand,]~~ know and be able to do everything required in the previous grades for ~~[courses in]~~ science offered in public schools. Instruction in the sixth ~~[grade through the]~~ ***, seventh and*** eighth ~~[grade]~~ ***grades*** in

science must be designed so that pupils meet the following standards by the completion of the eighth grade:

1. For the area of ***physical*** science ~~[inquiry:~~

~~(a) Understand that scientific knowledge requires critical consideration of verifiable evidence which is obtained from scientific inquiry and appropriate investigation;~~

~~(b) Know how to identify and critically evaluate information in data, tables and graphs;~~

~~(c) Know how to critically evaluate information to distinguish between scientific fact and opinion;~~

~~(d) Know that various explanations can be made for the same evidence;~~

~~(e) Know how to design and conduct a controlled experiment;~~

~~(f) Know how to use appropriate technology and laboratory procedures safely to observe, measure, record and analyze data; and~~

~~(g) Know that scientific inquiry includes, without limitation, evaluation of the results of scientific investigations, experiments, observations, theoretical and mathematical models and explanations proposed by other scientists.~~

~~2. For the areas of science, technology and society:~~

~~(a) Understand the interactions and relationships between science and society in a world which is constantly changing;~~

~~(b) Understand that technology can cause various consequences to the environment, including, without limitation:~~

~~(1) The depletion of environmental resources and degradation to the environment; and~~

~~(2) An increase in the availability of environmental resources, the mitigation of degradation to the environment and the use of new resources in a more economical manner; and~~

(c) Know that scientific knowledge is revised through a process of incorporating new evidence which is obtained through ongoing scientific research, investigation and collaborative discussion.

3. For the area of matter:

(a) Understand the properties of matter and the changes that can occur to the properties of matter;

(b) Know that matter is made up of tiny particles called atoms;

(c) Know that a substance which contains only one kind of atom is an element that cannot be broken into smaller pieces by normal laboratory processes;

(d) Know that atoms combine to form molecules;

(e) Know that a compound is formed when two or more different kinds of atoms are chemically bonded together;

(f) Know that the particles of the same matter are arranged differently based upon whether the matter is a solid, liquid or gas;

(g) Know that elements can be arranged in the periodic table in a manner which shows repeating patterns that group certain elements with similar properties;

(h) Know the characteristics of electrons, protons and neutrons;

(i) Know methods for separating mixtures based on the properties of the components; and

(j) Know that mass is conserved in physical and chemical changes.

4. For the areas of force and motion:

(a) Understand that the position and motion of an object depend on the forces acting on the object;

(b) Know the effect that balanced and unbalanced forces have on the motion of an object;

(c) Know that electric currents can produce magnetic forces and that magnets can cause electric currents; and

(d) Know that every object exerts a gravitational force on every other object and that the magnitude of the gravitational force depends on the mass of the objects and the distance between the objects.

5. For the area of energy:

(a) Understand how energy is transferred;

(b) Know that light which is visible is a narrow band within the electromagnetic spectrum;

(c) Know that vibrations, including, without limitation, sound and earthquakes:

(1) Move at various speeds in different materials;

(2) Have different wavelengths; and

(3) Create disturbances in a wavy pattern that spread away from the source of the vibration in a uniform manner;

(d) Know that physical, chemical and nuclear changes involve a transfer of energy;

(e) Know that energy can only be changed from one form to another and cannot be created or destroyed through a chemical or physical reaction;

(f) Know that energy which is produced from heat flows from warmer materials or regions to cooler materials or regions through the process of conduction, convection or radiation; and

(g) Know that heat, light, sound and other chemical changes can be produced by transferring electrical energy through electrical circuits.

6. For the area of heredity:

(a) Understand the role of genetic information in the continuation of a species;

(b) Know that heredity is the passage of genetic instructions from one generation to the next generation;

(c) Know that changes in the genes of an egg or sperm can cause changes in the characteristics which are inherited;

(d) Know that specific organisms can be bred to produce specific characteristics; and

(e) Know that certain characteristics of an organism are caused by interaction with the environment and genetic information.

7. For the area of the structure of life:

(a) Understand that all living things are composed of cells, which are the fundamental units of life;

(b) Understand that multicellular organisms have specialized cells which perform a variety of life functions;

(c) Know that a cell can grow, divide and take in nutrients which are used to provide energy for the cell to function;

(d) Know that certain organisms are composed of only one cell and that multicellular organisms can consist of millions of cells which work together to allow the organism to function;

(e) Know that tissues, organs and organ systems work together to perform the functions of life and that:

(1) Tissue can be formed when cells combine; and

(2) Organs and systems of organs can be formed when tissues combine; and

(f) Know that disease can result from defects in certain systems of the body or from damage caused by certain infections.

8. For the area of organisms and their environment:

(a) Understand various interactions between living and nonliving components of various ecosystems;

(b) Know how matter and energy are transferred through food webs in an ecosystem;

(c) Know how to characterize an organism in an ecosystem based on the functions of the organism;

(d) Know how to evaluate whether changes in the environment of an organism can be beneficial or harmful; and

(e) Know that interrelated factors affect the number and type of organisms an ecosystem can support.

9. For the area of the diversity of life:

(a) Understand that living things change over time and contribute to the variety of organisms existing on the earth;

(b) Know that a species can be identified and classified based upon its characteristics;

(c) Know that fossils provide evidence of how life and environmental conditions have changed throughout geological time; and

(d) Know that the behavior of an organism is based on experience and the evolutionary history of the species of the organism.

10. For the areas of the atmospheric processes and the cycle of water:

(a) Understand the relationship between the atmosphere, topography, weather and climate of the earth;

(b) Know that seasons are caused by variations in the amounts of the energy transferred from the sun to the surface of the earth based on the axial tilt of the earth;

(c) Know how the processes involved in the cycle of water affect patterns in the climate;

(d) Know the properties that make water an essential component of various systems of the earth;

(e) Understand the composition of the atmosphere of the earth, with an emphasis on the role of the atmosphere in the weather and climate of the earth;

(f) Know the difference between local weather and regional climates; and

(g) Know the topography of the earth and the patterns of global and local atmospheric movement which influence local weather and which occur primarily in the lower atmosphere.

11. For the area of the solar system and the universe:

(a) Understand the characteristics of the solar system which is part of the Milky Way Galaxy, including, without limitation, the characteristics of the planets in the solar system;

(b) Know that the universe contains many billions of galaxies and each galaxy contains many billions of stars;

(c) Know that the solar system includes, without limitation, a great variety of planetary moons, asteroids and comets;

(d) Know that the earth is part of the solar system located within the Milky Way Galaxy;

(e) Know that the sun is many thousands of times closer to the earth than any other star and billions of times closer to the earth than the farthest end of the Milky Way Galaxy;

(f) Know that the sun is a star in the Milky Way Galaxy which is medium in size in relation to other stars in the Milky Way Galaxy, part of which can be seen as a glowing band of light which spans across the sky; and

(g) Know that regular and predictable patterns of movement by the earth around the sun and by the moon around the earth explain certain phenomena, including, without limitation, the day, the year, phases of the moon and eclipses.

~~12. For the area of the composition and structure of the earth:~~

~~(a) Understand that landforms result from a combination of constructive and destructive processes;~~

~~(b) Know that sedimentary rocks and fossils provide evidence of changing environments and the constancy of geological processes;~~

~~(c) Know that rocks at the surface of the earth can weather and form sediments that are buried, compacted, heated and recrystallized into new rock;~~

~~(d) Know that the earth is composed of:~~

~~(1) A continental and oceanic crust;~~

~~(2) A mantle which contains hot convection currents; and~~

~~(3) A dense metallic core;~~

~~(e) Know that the very slow movement of large crustal plates results in geological events;~~

~~(f) Know that geological processes produce state and regional topography;~~

~~(g) Know that minerals have different properties and different distributions according to how they form;~~

~~(h) Know the characteristics, amounts and locations of renewable and nonrenewable resources found in Nevada; and~~

~~(i) Know that soil:~~

~~(1) Has various properties, including, without limitation, color, texture and the amount of water the soil can retain; and~~

~~(2) Provides nutrients for life in accordance with the manner in which the living thing is formed.~~] ***, understand:***

(a) Matter and its interactions, as demonstrated by the ability of the pupil to:

(1) Develop models to demonstrate the atomic composition of simple molecules and extended structures. Emphasis in this area must be on developing models of molecules that vary in complexity. Simple molecules may include, without limitation, ammonia and methanol. Extended structures may include, without limitation, sodium chloride or diamonds. Molecular-level models may include, without limitation, drawings, three-dimensional ball and stick structures or computer representations showing different molecules with different types of atoms. An assessment of pupils in this area must not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures or a complete depiction of all individual atoms in a complex molecule or extended structure.

(2) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Examples of reactions may include, without limitation, burning sugar or steel wool, fat reacting with sodium hydroxide and mixing zinc with hydrogen chloride. An assessment of pupils in this area must be limited to an analysis of density, melting point, boiling point, solubility, flammability and odor.

(3) Gather and analyze information to describe that synthetic materials are derived from natural resources and impact society. Emphasis in this area must be on natural resources that undergo a chemical process to form a synthetic material. New materials that are analyzed may include, without limitation, new medicine, foods and alternative fuels. An assessment of pupils in this area must be limited to qualitative information.

(4) Develop a model that demonstrates predictions and changes in the particle motion, temperature and state of a pure substance when thermal energy is added or removed. Emphasis in this area must be on qualitative molecular-level models of solids, liquids and

gases to demonstrate that adding or removing thermal energy increases or decreases the kinetic energy of the particles until a change of state occurs. Models may include, without limitation, drawings and diagrams. Particles may include, without limitation, molecules or inert atoms. Pure substances may include, without limitation, water, carbon dioxide and helium.

(5) Develop and use a model to demonstrate that the total number of atoms does not change in a chemical reaction and that mass is therefore conserved. Emphasis in this area must be on the law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. An assessment of pupils in this area must not include the use of atomic masses, balancing symbolic equations or intermolecular forces.

(6) Undertake a design project to construct, test and modify a device that either releases or absorbs thermal energy by chemical processes. Emphasis in this area must be on the design, control of the transfer of energy to the environment and modification of a device using factors such as type and concentration of a substance. Designs may include, without limitation, chemical reactions such as dissolving ammonium chloride or calcium chloride. An assessment of pupils in this area must be limited to the criteria of the amount, time and temperature of a substance in testing the device.

(b) The forces and interactions which affect motion and stability, as demonstrated by the ability of the pupil to:

(1) Apply Newton's third law of motion to design a solution to a problem involving the motion of two colliding objects. Practical problems may include, without limitation, the impact of collisions between two cars, between a car and a stationary object and between a meteor

and a space vehicle. An assessment of pupils in this area must be limited to vertical or horizontal interactions in one dimension.

(2) Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Emphasis in this area must be on balanced and unbalanced forces in a system and Newton's first law of motion, qualitative comparisons of forces, mass and changes in motion and Newton's second law of motion, frame of reference and specification of units. An assessment of pupils in this area must be limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time and must not include the use of trigonometry.

(3) Ask questions about data to determine the factors that affect the strength of electrical and magnetic forces. Devices that use electrical and magnetic forces may include, without limitation, electromagnets, electrical motors or generators. Data may include, without limitation, the effect of the number of turns of wire on the strength of an electromagnet or the effect of increasing the number or strength of magnets on the speed of an electrical motor. An assessment of pupils in this area that requires quantitative answers must be limited to proportional reasoning and algebraic concepts.

(4) Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Evidence for arguments may include, without limitation, data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the sun and orbital periods of objects within the solar system. An assessment of pupils in this area must not include Newton's law of universal gravitation or Kepler's laws.

(5) Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Examples of this phenomenon may include, without limitation, the interactions of magnets, electrically-charged strips of tape and electrically-charged pith balls. Investigations may include, without limitation, first-hand experiences or simulations. An assessment of pupils in this area must be limited to electrical and magnetic fields and qualitative evidence for the existence of fields.

(c) Energy, as demonstrated by the ability of the pupil to:

(1) Construct and interpret graphical displays of data to describe the relationship of kinetic energy to the mass of an object and to the speed of an object. Emphasis in this area must be on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples of objects in motion may include, without limitation, riding a bicycle at different speeds, rolling different sizes of rocks downhill and getting hit by a wiffle ball compared to a tennis ball.

(2) Develop a model to demonstrate that, when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. Emphasis in this area must be on relative amounts of potential energy and not on calculations of potential energy. Objects within systems interacting at varying distances may include, without limitation, the earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction or orientation of a magnet and a balloon with static electrical charge being brought closer to a classmate's hair. Models may include, without limitation, representations, diagrams, pictures and written descriptions of systems. An

assessment of pupils in this area must be limited to two objects and electrical, magnetic and gravitational interactions.

(3) Apply scientific principles to design, construct and test a device that either minimizes or maximizes the transfer of thermal energy. Devices may include, without limitation, an insulated box, a solar cooker and a Styrofoam cup. An assessment of pupils in this area must not include calculating the total amount of thermal energy transferred.

(4) Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass and the change in the average kinetic energy of particles as measured by the temperature of the sample. Investigations may include, without limitation, comparing final water temperatures after different masses of ice have melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment or the same material with different masses when a specific amount of energy is added. An assessment of pupils in this area must not include calculating the total amount of thermal energy transferred.

(5) Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Empirical evidence used in arguments may include, without limitation, an inventory or other representation of the energy before and after the transfer of energy in the form of temperature changes or motion of the object. An assessment of pupils in this area must not include calculations of energy.

(d) Waves and their application in technology for the transfer of information, as demonstrated by the ability of the pupil to:

(1) Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in the wave. Emphasis in this area must be on describing waves using qualitative and quantitative thinking skills. An assessment of pupils in this area must be limited to standard repeating waves and must not include electromagnetic waves.

(2) Develop and use a model to demonstrate that waves are reflected, absorbed or transmitted through various materials. Emphasis in this area must be on both light and mechanical waves. Models may include, without limitation, drawings, simulations and written descriptions. An assessment of pupils in this area must be limited to qualitative applications pertaining to light and mechanical waves.

(3) Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. Emphasis in this area must be on a basic understanding of the use of waves for purposes of communication. Methods of transmitting information may include, without limitation, using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices and conversion of stored binary patterns to make sound or text on a computer screen. An assessment of pupils in this area must not include binary counting or the specific mechanism of any given device.

2. For the area of life science, understand:

(a) The structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to:

(1) Conduct an investigation to provide evidence that living things are made of cells and that some living things consist of one cell while others consist of many different numbers and

types of cells. Emphasis in this area must be on developing evidence that living things are made of cells, distinguishing between living and nonliving cells and understanding that living things may be made of one cell or many and varied cells.

(2) Develop and use a model to demonstrate the function of a cell as a whole and the ways in which the parts of a cell contribute to that function. Emphasis in this area must be on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane and cell wall. An assessment of pupils in this area that concerns relationships between organelle structures and functions must be limited to the cell wall and cell membrane. Such assessments of the function of the other organelles must be limited to their relationship to the whole cell and must not include the biochemical function of cells or parts of cells.

(3) Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Emphasis in this area must be on the conceptual understanding that cells form tissues and tissues form organs specialized for particular functions of the body. Evidence may include, without limitation, the interaction of subsystems within a system and the normal functioning of those systems. An assessment of pupils in this area must not include the mechanism of one body system independent of others and must be limited to the circulatory, excretory, digestive, respiratory, muscular and nervous systems.

(4) Use arguments based on empirical evidence and scientific reasoning to explain how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. Behaviors that affect the probability of animal reproduction may include, without limitation, the building of nests to protect the young from cold, the herding of animals to protect the young from predators and

the vocalization of animals and colorful plumage to attract mates for breeding. Animal behaviors that affect the probability of plant reproduction may include, without limitation, transferring pollen or seeds and creating conditions for seed germination and growth. Plant structures may include, without limitation, bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen and hard shells on nuts that squirrels bury.

(5) Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Local environmental factors that may be considered include, without limitation, availability of food, light, space and water. Genetic factors that may be considered include, without limitation, large breed cattle and species of grass affecting the growth of organisms. Evidence may include, without limitation, drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions and fish growing larger in large ponds than in small ponds. An assessment of pupils in this area must not include genetic mechanisms, gene regulation or biochemical processes.

(6) Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and the flow of energy into and out of organisms. Emphasis in this area must be on tracing the movement of matter and the flow of energy. An assessment of pupils in this area must not include the biochemical mechanisms of photosynthesis.

(7) Develop a model to demonstrate how food is rearranged through chemical reactions by forming new molecules that support growth or release energy as this matter moves through an organism. Emphasis in this area must be on describing the manner in which molecules are

broken apart and put back together and release energy. An assessment of pupils in this area must not include details of the chemical reactions for photosynthesis or respiration.

(8) Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. An assessment of pupils in this area must not include mechanisms for the transmission of this information.

(b) The interactions, energy and dynamics of ecosystems, as demonstrated by the ability of the pupil to:

(1) Analyze and interpret data to provide evidence of the effects of resource availability on organisms and populations of organisms in an ecosystem. Emphasis in this area must be on cause and effect relationships between resources and the growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

(2) Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Emphasis in this area must be on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Types of interactions may include, without limitation, competitive, predatory and mutually beneficial interactions.

(3) Develop a model to demonstrate the manner in which matter cycles and energy flows among living and nonliving parts of an ecosystem. Emphasis in this area must be on describing the conservation of matter and the flow of energy into and out of various ecosystems and on defining the boundaries of the system. An assessment of pupils in this area must not include the use of chemical reactions to describe the processes.

(4) Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. Emphasis in this area must be on recognizing patterns in data and making warranted inferences about changes in populations and on evaluating empirical evidence supporting arguments about changes to ecosystems.

(5) Evaluate competing design solutions for maintaining biodiversity and ecosystem services. Ecosystem services may include, without limitation, water purification, nutrient recycling and prevention of soil erosion. Constraints on design solutions may include, without limitation, scientific, economic and social considerations.

(c) The inheritance and variation of traits of heredity, as demonstrated by the ability of the pupil to:

(1) Develop and use a model to demonstrate why structural changes to genes located on chromosomes, known as mutations, may affect proteins and may result in harmful, beneficial or neutral effects to the structure and function of the organism. Emphasis in this area must be on conceptual understanding that changes in genetic material may result in making different proteins. An assessment of pupils in this area must not include specific changes at the molecular level, mechanisms for protein synthesis or specific types of mutations.

(2) Develop and use a model to demonstrate why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Emphasis in this area must be on using models such as Punnett squares, diagrams and simulations to describe the cause and effect relationship of gene transmission from parents to offspring and the resulting genetic variation.

(d) The unity and diversity of biological evolution, as demonstrated by the ability of the pupil to:

(1) Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction and change of life forms throughout the history of life on earth, assuming that natural laws operate the same today as in the past. Emphasis in this area must be on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the layers of rock. An assessment of pupils in this area must not include the names of individual species or geological eras in the fossil record.

(2) Apply scientific concepts to construct explanations for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. Emphasis in this area must be on explanations of the evolutionary relationships among organisms in terms of similarities or differences of the gross appearance of anatomical structures.

(3) Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. Emphasis in this area must be on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. An assessment of pupils in this area that includes comparisons must be limited to the gross appearance of anatomical structures in embryological development.

(4) Construct an explanation based on evidence that describes how genetic variations of traits in a population increase the probability that some members of the population will survive and reproduce in a specific environment. Emphasis in this area must be on using simple probability statements and proportional reasoning to construct explanations.

(5) Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms. Emphasis in this area must be on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection, such as genetic modification, animal husbandry and gene therapy, and on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

(6) Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. Emphasis in this area must be on using mathematical models, probability statements and proportional reasoning to support explanations of trends in changes to populations over time. An assessment of pupils in this area must not include Hardy-Weinberg calculations.

3. For the area of earth science, understand:

(a) The earth's place in the universe, as demonstrated by the ability of the pupil to:

(1) Develop and use a model of the earth-sun-moon system to demonstrate the cyclical patterns of lunar phases, eclipses of the sun and moon and the seasons. Models may be physical, graphical or conceptual.

(2) Develop and use a model to demonstrate the role of gravity in the way in which things move within galaxies and the solar system. Emphasis for a model must be on gravity as the force that holds together the solar system and Milky Way galaxy and that controls the orbital motions within each of them. Models may be physical, such as the analogy of distance along a football field or computer visualizations of elliptical orbits, or conceptual, such as mathematical proportions relative to the size of familiar objects such as the pupil's school or

state of residence. An assessment of pupils in this area must not include Kepler's laws of orbital motion or the apparent retrograde motion of the planets as viewed from earth.

(3) Analyze and interpret data to determine scale properties of objects in the solar system. Emphasis in this area must be on the analysis of data from earth-based instruments, space-based telescopes and spacecraft to determine similarities and differences among solar system objects. Scale properties may include, without limitation, the sizes of the layers of an object, such as crust and atmosphere, surface features, such as volcanoes, and orbital radius. Data may include, without limitation, statistical information, drawings, photographs and models. An assessment of pupils in this area must not include recalling facts about the properties of the planets and other solar system bodies.

(4) Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize the 4.6-billion-year-old history of earth. Emphasis in this area must be on how analyses of rock formations and their fossils are used to establish the relative time of major events in earth's history. The timing of earth's major events may range from very recent, such as the last Ice Age or the earliest fossils of homo sapiens, to very old, such as the formation of earth or the earliest evidence of life. Events may include, without limitation, the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms or significant volcanic eruptions. An assessment of pupils in this area must not include recalling the names of specific periods or epochs and events within them.

(b) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Develop a model to demonstrate the cycling of the earth's materials and the flow of energy that drives this process. Emphasis in this area must be on the processes of melting,

crystallization, weathering, deformation and sedimentation which act together to form minerals and rocks through the cycling of the earth's materials. An assessment of pupils in this area must not include the identification and naming of minerals.

(2) Construct an explanation based on evidence for how geoscientific processes have changed the earth's surface at varying times and spatial scales. Emphasis in this area must be on how processes change the earth's surface at time and spatial scales that can be large, such as slow plate motions or the uplift of large mountain ranges, or small, such as rapid landslides or microscopic geochemical reactions, and how many geoscientific processes, such as earthquakes, volcanoes and meteor impacts, usually occur gradually but are punctuated by catastrophic events. Geoscientific processes may include, without limitation, surface weathering and deposition by the movements of water, ice and wind. Emphasis in this area must be on geoscientific processes that shape local geographic features, where appropriate.

(3) Analyze and interpret data regarding the distribution of fossils and rocks, continental shapes and seafloor structures to provide evidence of past plate motions. Data may include, without limitation, similarities of rock and fossil types on different continents, the shapes of the continents and continental shelves and the locations of ocean structures such as ridges, fracture zones and trenches. An assessment of pupils in this area must not include paleomagnetic anomalies in oceanic and continental crust.

(4) Develop a model to demonstrate the cycling of water through the earth's systems driven by energy from the sun and the force of gravity. Emphasis in this area must be on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Models may be conceptual or physical. An assessment of pupils in this area must not include a quantitative understanding of the latent heats of vaporization and fusion.

(5) Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. Emphasis in this area must be on how air masses flow from regions of high pressure to low pressure, causing weather, defined by temperature, pressure, humidity, precipitation and wind, at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis in this area must be on how to predict weather within probabilistic ranges. Data may be provided to pupils, including, without limitation, weather maps, diagrams and visualizations, or obtained through laboratory experiments such as with condensation. An assessment of pupils in this area must not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.

(6) Develop and use a model to demonstrate how unequal heating and rotation of the earth cause patterns of atmospheric and oceanic circulation that determine regional climates. Emphasis in this area must be on how patterns vary by latitude, altitude and geographic land distribution. Emphasis of atmospheric circulation must be on the sunlight-driven latitudinal banding, the Coriolis effect and resulting prevailing winds. Emphasis of ocean circulation must be on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Models may include, without limitation, diagrams, maps and globes or digital representations. An assessment of pupils in this area must not include the dynamics of the Coriolis effect.

(c) The earth and human activity on earth, as demonstrated by the ability of the pupil to:

(1) Construct a scientific explanation based on evidence for how the uneven distributions of the mineral, energy and groundwater resources of the earth are the result of past and current geoscientific processes. Emphasis in this area must be on how these

resources are limited and typically nonrenewable and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes may include, without limitation, petroleum as a result of the locations of the burial of organic marine sediments and subsequent geologic traps, metal ores as a result of the locations of past volcanic and hydrothermal activity associated with subduction zones, and soil as a result of the locations of active weathering or deposition of rock.

(2) Analyze and interpret data regarding natural hazards to forecast future catastrophic events for use in the development of technologies to mitigate the effects of such hazards and events. Emphasis in this area must be on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and without notice, and are not yet predictable. Natural hazards may be taken from interior processes, such as earthquakes and volcanic eruptions, surface processes, such as mass wasting and tsunamis, or severe weather events, such as hurricanes, tornadoes and floods. Data may include, without limitation, the locations, magnitudes and frequencies of the natural hazards. Mitigating technologies may be global, such as satellite systems to monitor hurricanes or forest fires, or local, such as building basements in tornado-prone regions or reservoirs.

(3) Apply scientific principles to design a method for monitoring and minimizing human impacts on the environment. The design process may include, without limitation, examining human environmental impacts, assessing the kinds of solutions that are feasible and designing and evaluating solutions that could reduce that impact. Human impacts examined may include, without limitation, water usage, such as the withdrawal of water from streams and

aquifers or the construction of dams and levees, land usage, such as urban development, agriculture or the removal of wetlands, and pollution, such as of the air, water or land.

(4) Construct an argument supported by evidence for how increases in the human population and per capita consumption of natural resources impact the earth's systems. Evidence may include, without limitation, grade-appropriate databases on human populations and the rates of consumption of food and natural resources, such as fresh water, minerals and energy. Impacts may include, without limitation, changes to the appearance, composition and structure of the earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources must be described by scientific means, but the pupil must demonstrate an understanding that science does not make the decisions for the actions taken by persons in a society.

(5) Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. These factors may include, without limitation, human activities, such as fossil fuel combustion, cement production and agricultural activity, and natural processes, such as changes in incoming solar radiation or volcanic activity. Evidence may include, without limitation, tables, graphs and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane and the rates of human activities. Emphasis in this area must be on the major role that human activities play in causing the rise in global temperatures.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and the potential impacts on humans and the natural environment that may limit possible solutions.

(b) Evaluate competing design solutions using a systematic process to determine how well the solutions meet the criteria and constraints of the problem.

(c) Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each solution that can be combined into a new solution to better meet the criteria for success.

(d) Develop a model to generate data for iterative testing and modification of a proposed object, tool or process, such that an optimal design can be achieved.

Sec. 9. NAC 389.491 is hereby amended to read as follows:

389.491 ~~[1.]~~ A local school district shall ensure that pupils, by the completion of the 12th grade, are able to comply with the standards required for science which are adopted by the State Board of Education pursuant to NAC 389.244, 389.2939, 389.411 and 389.4915 ~~[.]~~ ***and sections 2 to 5, inclusive, of this regulation.*** In carrying out this requirement, the district shall:

~~[(a)]~~ ***1.*** Develop courses which must encompass all of the standards required for science by the completion of the 12th grade; and

~~[(b)]~~ ***2.*** Provide to each pupil, upon enrollment in high school, a listing of the courses that encompass all of the standards required for science by the completion of the 12th grade.

~~[2. If a pupil enrolls in a science course listed under NAC 389.492 to 389.498, inclusive, the school district shall notify the pupil in writing at the time of enrollment in the course that:~~

~~(a) The objectives of the science course may include standards for science in addition to the standards that are required to be completed by the end of the 12th grade; and~~

~~(b) The science courses listed under NAC 389.492 to 389.498, inclusive, are not designed to ensure that the standards for science that are required to be completed by the end of 12th grade will be met by completion of a course listed under NAC 389.492 to 389.498, inclusive, unless that course is included in the listing provided pursuant to paragraph (b) of subsection 1.]~~

Sec. 10. NAC 389.4915 is hereby amended to read as follows:

389.4915 By the ~~[end of the 12th grade,]~~ ***beginning of high school,*** pupils must know ~~[, understand]~~ and be able to do everything required in the previous grades for ~~[courses in]~~ science offered in public schools. Instruction in ~~[the 9th grade through the 12th grade]~~ ***high school in science*** must be designed so that pupils meet the following ***performance*** standards by the completion of ~~[the 12th grade:]~~ ***high school:***

1. For the area of ***physical*** science ~~[inquiry:~~

~~(a) Understand that various methods of communication can be used to share scientific information;~~

~~(b) Know that tables, charts, illustrations and graphs can be used to make scientific arguments or claims and can be used as visual aids for oral and written presentations regarding such scientific arguments or claims;~~

~~(c) Know that scientists maintain a permanent record of procedures, data, analyses, decisions and understandings of scientific investigations;~~

~~(d) Know that experiments which are repeated allow scientists to prepare statistical analyses and make unbiased conclusions;~~

~~(e) Know how safely to conduct an original scientific investigation using the appropriate tools and technology; and~~

(f) Know that models and modeling can be used to identify and predict certain cause-and-effect relationships.

2. For the areas of science, technology and society:

(a) Understand the impact of science and technology as it relates to the costs and benefits to society;

(b) Know that science, technology and society have positive and negative influences on one another;

(c) Know that patterns of consumption, efforts at conservation, and cultural and social practices in various countries have different impacts on the environment;

(d) Know the influence of ethics on scientific enterprise; and

(e) Know that scientific knowledge is built on previous scientific information.

3. For the area of matter:

(a) Understand that atomic structure explains the properties and behavior of matter;

(b) Know that different molecular arrangements and motions account for the different physical properties of solids, liquids and gases;

(c) Know that elements in the periodic table are arranged into groups and periods by repeating patterns and relationships;

(d) Know that identifiable properties can be used to separate mixtures;

(e) Know that atoms bond with one another by transferring or sharing electrons;

(f) Know that chemical reactions can take place at different rates depending on a variety of factors which include, without limitation, temperature, concentration, surface area and agitation;

(g) Know that chemical reactions release energy or absorb energy;

(h) Know that during a chemical reaction, elements combine in predictable ratios and the numbers of atoms of each element do not change;

(i) Know that most elements have two or more isotopes, some of which have certain practical applications; and

(j) Know that the number of electrons in an atom determines whether the atom is:

(1) An electrically neutral atom; or

(2) An ion.

4. For the areas of force and motion:

(a) Understand the interactions between force and motion;

(b) Know that the laws of motion can be used to determine the effects of certain forces on the motion of an object;

(c) Know that an electromagnetic force can be established by magnetic forces and electric forces;

(d) Know that the strength of the electric force between two objects:

(1) Increases with an increase in the charge of the force; and

(2) Decreases with an increase in the distance between the objects; and

(e) Know that the strength of the gravitational force between two objects:

(1) Increases with an increase in the mass of the objects; and

(2) Decreases rapidly with an increase in the distance between the objects.

5. For the area of energy:

(a) Understand that there are interactions between matter and energy;

(b) Know that certain waves, including, without limitation, sound waves, seismic waves and electromagnetic waves, have energy that can be transferred when the waves interact with matter;

(c) Know that forms of energy can be converted;

(d) Know that nuclear reactions can convert a relatively small amount of material into a large amount of energy;

(e) Know the characteristics, applications and impacts of radioactivity;

(f) Know the relationship between heat and temperature; and

(g) Know that electricity is transferred from sources which generate electricity for consumption and practical uses.

6. For the area of heredity:

(a) Understand how genetic information is passed from one generation to the next generation;

(b) Know that genetic information which is passed from a parent to an offspring is coded in the DNA molecule;

(c) Know that DNA molecules provide instructions for assembling protein molecules;

(d) Know that all cells in the body of an organism develop from a single cell and contain essentially identical genetic instructions;

(e) Know several causes and effects of somatic mutations versus sex-cell mutations; and

(f) Know how to predict patterns of inherited characteristics.

7. For the area of the structure of life:

(a) Understand that all life forms at every level of organization have specialized structures and use similar processes to satisfy the needs of life;

(b) Know the structure and function of cells;

(c) Know that the human body has a specialized anatomy and physiology composed of a hierarchical arrangement of differentiated cells; and

(d) Know that disease disrupts the equilibrium that exists in a healthy organism.

8. For the area of organisms and their environment:

(a) Understand that ecosystems display patterns of organization, stability and change which result from the interactions and interdependencies between the living and nonliving components of the earth;

(b) Know the relationship between various organisms and their physical environments;

(c) Know how changes in an ecosystem can affect the biodiversity in the ecosystem and the contribution of the biodiversity to the stability of an ecosystem;

(d) Know that the amount of living matter that an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle certain materials; and

(e) Know the unique geological, hydrological, climatic and biological characteristics of the bioregions of the State of Nevada.

9. For the area of the diversity of life:

(a) Understand biological evolution and the diversity of life;

(b) Know that organisms can be classified based on evolutionary relationships;

(c) Know that the similarity of sequences of DNA provide evidence of relationships between certain organisms;

(d) Know that records of fossils provide evidence of natural selection and the evolutionary consequences of natural selection;

(e) Know that the extinction of a species can be a natural process;

(f) Know that biological evolution explains the diversity of life; and

(g) Know the concepts of natural and artificial selection.

10. For the areas of the atmospheric processes and the cycle of water:

(a) Understand that heat and energy transfer in and out of the atmosphere and influence the weather and the climate of the earth;

(b) Know that the sun is a major source of the energy for the earth and provides the energy that establishes the weather and the climate of the earth;

(c) Know that the composition of the atmosphere of the earth has changed in the past and continues to change;

(d) Understand the role of the atmosphere in the greenhouse effect of the earth;

(e) Know that convection and radiation play important roles in moving heat energy throughout the earth; and

(f) Know that the rotation of the earth affects wind currents and ocean currents.

11. For the area of the solar system and the universe:

(a) Know the scientific theories of the origins and evolution of the universe;

(b) Know the common characteristics of stars;

(c) Know that stars are powered by the nuclear fusion of lighter elements into heavier elements, which results in the release of large amounts of energy;

(d) Know the ways in which technology has increased the understanding of the universe;

(e) Know the continuing processes involved in the formation and destruction of stars; and

(f) Know that scientific evidence suggests that the universe is expanding.

12. For the area of the structure and composition of the earth:

(a) Understand scientific evidence concerning processes that take place on a geological time scale;

~~(b) Know how successive rock strata and fossils can be used to confirm the age, history and changing life forms of the earth, including, without limitation, the manner in which this evidence is affected by the folding, breaking and uplifting of layers of the earth;~~

~~(c) Understand the concept of and evidence supporting plate tectonics, including, without limitation, structural, geophysical and paleontological evidence;~~

~~(d) Know that elements exist in fixed amounts and move through solid earth, oceans, the atmosphere and living things as part of biogeochemical cycles;~~

~~(e) Know the processes of obtaining, using and recycling renewable and nonrenewable resources; and~~

~~(f) Know that soil, which is derived from weathered rocks and decomposed organic material, is found in layers of the earth.]~~ ***, understand:***

(a) Matter and its interactions, as demonstrated by the ability of the pupil to:

(1) Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. Properties that may be predicted from patterns include, without limitation, reactivity of metals, the types of bonds formed, the numbers of bonds formed and reactions with oxygen. An assessment of pupils in this area must be limited to main group elements and must not include quantitative understanding of ionization energy beyond relative trends.

(2) Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table and knowledge of the patterns of chemical properties. Chemical reactions may include, without limitation, the reaction of sodium and chlorine, of carbon and oxygen or of carbon and hydrogen. An

assessment of pupils in this area must be limited to chemical reactions involving main group elements and combustion reactions.

(3) Plan and conduct an investigation by gathering evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Emphasis in this area must be on understanding the strengths of forces between particles, not on naming specific intermolecular forces, such as dipole-dipole. Particles may include, without limitation, ions, atoms, molecules and networked materials such as graphite. Bulk properties of substances may include, without limitation, the melting point and boiling point, vapor pressure and surface tension. An assessment of pupils in this area must not include calculations of vapor pressure using Raoult's law.

(4) Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. Emphasis in this area must be on understanding that a chemical reaction is a system that affects the energy change. Models may include, without limitation, molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products and representations showing energy is conserved. An assessment of pupils in this area must not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.

(5) Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. Emphasis in this area must be on reasoning that focuses on the number and energy of collisions between molecules. An assessment of pupils in this area must be limited to

simple reactions in which there are only two reactants, evidence from temperature, concentration and rate data and qualitative relationships between rate and temperature.

(6) Refine the design of a chemical system by specifying a change in conditions that produce increased amounts of products at equilibrium. Emphasis in this area must be on the application of Le Chatlier's principle and on refining designs of chemical reaction systems, including, without limitation, descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Designs may include, without limitation, different ways to increase product formation, including adding reactants or removing products. An assessment of pupils in this area must be limited to specifying the change in one variable at a time and must not include calculating equilibrium constants and concentrations.

(7) Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Emphasis in this area must be on using mathematical concepts to communicate the proportional relationships between masses of atoms in the reactants and the products and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis in this area must be on assessing pupils' use of mathematics to solve a problem and not on memorization or rote problem-solving techniques. An assessment of pupils in this area must not include complex chemical reactions.

(8) Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion and radioactive decay. Emphasis in this area must be on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.

Assessments of pupils in this area must be limited to alpha, beta and gamma radioactive decays and must not include quantitative calculations of the energy released.

(b) The forces and interactions which affect motion and stability, as demonstrated by the ability of the pupil to:

(1) Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, including its mass and acceleration. Data may include, without limitation, tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp or a moving object being pulled by a constant force. An assessment of pupils in this area must be limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.

(2) Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. Emphasis in this area must be on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. An assessment of pupils in this area must be limited to systems of two macroscopic bodies moving in one dimension.

(3) Apply scientific and engineering concepts to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision. Evaluation and refinement may include, without limitation, determining the success of the device at protecting an object from damage and modifying the design of the device to improve its success. Devices may include, without limitation, a football helmet or parachute. An assessment of pupils in this area must be limited to qualitative evaluations or algebraic manipulations.

(4) Use mathematical representations of Newton's law of universal gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. Emphasis in this area must be on both quantitative and conceptual descriptions of gravitational and electrical fields. An assessment of pupils in this area must be limited to systems with two objects.

(5) Plan and conduct an investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electrical current. An assessment of pupils in this area must be limited to designing and conducting investigations with the materials and tools provided to pupils.

(6) Communicate scientific and technical information about the importance of molecular-level structure in the functioning of designed materials. Emphasis in this area must be on the attractive and repulsive forces that determine the functioning of the materials. Such information may include, without limitation, why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules and pharmaceuticals are designed to interact with specific receptors. An assessment of pupils in this area must be limited to molecular structures of specific designed materials provided to pupils.

(c) Energy, as demonstrated by the ability of the pupil to:

(1) Create a computational model to calculate the change in the energy of one component in a system when the change in energy of all other components and energy flows in and out of the system are known. Emphasis in this area must be on explaining the meaning of mathematical expressions used in the model. An assessment of pupils in this area must be limited to basic algebraic expressions or computations, to systems of two or three components

and to thermal energy, kinetic energy and the energies in gravitational, magnetic or electrical fields.

(2) Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles that comprise objects and energy associated with the relative position of particles that comprise objects. Phenomena at the macroscopic scale may include, without limitation, the conversion of kinetic energy to thermal energy, the energy stored because of the position of an object above the earth and the energy stored between two electrically-charged plates. Models may include, without limitation, diagrams, drawings, descriptions and computer simulations.

(3) Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy. Emphasis in this area must be on both qualitative and quantitative evaluations of devices. Devices may include, without limitation, Rube Goldberg devices, wind turbines, solar cells, solar ovens and generators. Constraints may include, without limitation, use of renewable energy forms and efficiency. An assessment of pupils in this area that involves quantitative evaluations must be limited to total output for a given input and must be limited to devices constructed with the materials provided to pupils.

(4) Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system as described by the second law of thermodynamics. Emphasis in this area must be on analyzing data from investigations by pupils and using mathematics to describe the energy changes both quantitatively and conceptually. Investigations may include, without limitation, mixing liquids at different initial temperatures or adding objects at different temperatures to water. An

assessment of pupils in this area must be limited to investigations based on the materials and tools provided to pupils.

(5) Develop and use a model of two objects interacting through electrical or magnetic fields to illustrate the forces between objects and the changes in energy of the objects because of the interaction. Models may include, without limitation, diagrams, texts and drawings, such as drawings of the result of two charges of opposite polarity when placed near each other. An assessment of pupils in this area must be limited to systems containing two objects.

(d) Waves and their application in technology for the transfer of information, as demonstrated by the ability of the pupil to:

(1) Use mathematical representations to support a claim regarding relationships among the frequency, wavelength and speed of waves traveling through various media. Data may include, without limitation, electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through the air and water, and seismic waves traveling through the earth. An assessment of pupils in this area must be limited to algebraic relationships and describing those relationships qualitatively.

(2) Evaluate questions about the advantages of using digital transmission and storage of information. Advantages may include, without limitation, the stability of digital information because it can be stored reliably in computer memory, transferred easily and copied and shared rapidly. Disadvantages may include, without limitation, issues of easy deletion, security and theft.

(3) Evaluate the claims, evidence and reasoning for describing electromagnetic radiation by a wave model or a particle model and that for some situations one model is more useful than the other. Emphasis in this area must be on the manner in which experimental

evidence supports the claim and the manner in which a theory is generally modified in light of new evidence. Phenomena may include, without limitation, resonance, interference, diffraction and the photoelectric effect. An assessment of pupils in this area must not include using quantum theory.

(4) Evaluate the validity and reliability of claims in published materials of the effects of different frequencies of electromagnetic radiation when absorbed by matter. Emphasis in this area must be on the concept that photons associated with different frequencies of light have different energies and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Published materials may include, without limitation, trade books, magazines, web resources, videos and other passages that may reflect bias. An assessment of pupils in this area must be limited to qualitative descriptions.

(5) Communicate technical information about the use by some technological devices of the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. Devices may include, without limitation, solar cells capturing light and converting it to electricity, medical imaging and communications technology. An assessment of pupils in this area must be limited to qualitative information and must not include band theory.

2. For the area of life science, understand:

(a) The structures and processes from molecules to organisms, as demonstrated by the ability of the pupil to:

(1) Construct an explanation based on evidence for the manner in which the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. An assessment of pupils in this area must not include

identification of specific cell or tissue types, whole body systems, specific protein structures and functions or the biochemistry of protein synthesis.

(2) Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. Emphasis in this area must be on functions at the organism system level such as nutrient uptake, water delivery and organism movement in response to neural stimuli. Examples of interacting systems may include, without limitation, an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system. An assessment of pupils in this area must not include interactions and functions at the molecular or chemical reaction level.

(3) Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. Examples of investigations may include, without limitation, heart rate response to exercise, stomate response to moisture and temperature and root development in response to water levels. An assessment of pupils in this area must not include the cellular processes involved in the feedback mechanism.

(4) Use a model to illustrate the role of cellular division, known as mitosis, and to differentiate the production and maintenance of complex organisms. An assessment of pupils in this area must not include specific gene control mechanisms or rote memorization of the steps of mitosis.

(5) Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Emphasis in this area must be on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Models may include, without limitation, diagrams, chemical

equations and conceptual models. An assessment of pupils in this area must not include specific biochemical steps.

(6) Construct and revise an explanation based on evidence concerning the manner in which carbon, hydrogen and oxygen from sugar molecules may combine with other elements to form amino acids or other large carbon-based molecules. Emphasis in this area must be on using evidence from models and simulations to support explanations. An assessment of pupils in this area must not include the details of the specific chemical reactions or identification of macromolecules.

(7) Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. Emphasis in this area must be on the conceptual understanding of the inputs and outputs of the process of cellular respiration. An assessment of pupils in this area must not include identification of the steps or specific processes involved in cellular respiration.

(b) The interactions, energy and dynamics of ecosystems, as demonstrated by the ability of the pupil to:

(1) Use mathematical or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales. Emphasis in this area must be on quantitative analysis and comparison of the relationships among interdependent factors, including, without limitation, boundaries, resources, climate and competition. Mathematical comparisons may include, without limitation, graphs, charts, histograms and population changes gathered from simulations or historical data sets. An

assessment of pupils in this area must not include deriving mathematical equations to make comparisons.

(2) Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Mathematical representations may include, without limitation, finding the average, determining trends and using graphical comparisons of multiple sets of data. An assessment of pupils in this area must be limited to data provided to the pupils.

(3) Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. Emphasis in this area must be on a conceptual understanding of the role of aerobic and anaerobic respiration in different environments. An assessment of pupils in this area must not include the specific chemical processes of either aerobic or anaerobic respiration.

(4) Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. Emphasis in this area must be on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis in this area must be on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem. An assessment of pupils in this area must be limited to proportional reasoning to describe the cycling of matter and flow of energy.

(5) Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere. Models may include, without limitation, simulations and mathematical models. An assessment of

pupils in this area must not include the specific chemical steps of photosynthesis and respiration.

(6) Evaluate the claims, evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, while changing conditions may result in a new ecosystem. Changes in ecosystem conditions may include, without limitation, modest biological or physical changes, such as moderate hunting or a seasonal flood, and extreme changes, such as volcanic eruption or sea level rise.

(7) Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity. Human activities may include, without limitation, urbanization, building dams and dissemination of invasive species.

(8) Evaluate the evidence for the role of group behavior on the chances of individuals and species to survive and reproduce. Emphasis in this area must be on distinguishing between group and individual behavior, identifying evidence to support the outcomes of group behavior and developing logical and reasonable arguments based on evidence. Group behaviors may include, without limitation, flocking, schooling and herding and cooperative behaviors such as hunting, migrating and swarming.

(c) The inheritance and variation of traits of heredity, as demonstrated by the ability of the pupil to:

(1) Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to their offspring. An assessment of pupils in this area must not include the phases of meiosis or the biochemical mechanism of specific steps in the process.

(2) Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication or mutations caused by environmental factors. Emphasis in this area must be on using data to support arguments for the way variations occur. An assessment of pupils in this area must not include the phases of meiosis or the biochemical mechanism of specific steps in the process.

(3) Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. Emphasis in this area must be on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. An assessment of pupils in this area must not include Hardy-Weinberg calculations.

(d) The unity and diversity of biological evolution, as demonstrated by the ability of the pupil to:

(1) Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. Emphasis in this area must be on a conceptual understanding of the role of each line of evidence relating to common ancestry and biological evolution. Evidence may include, without limitation, similarities in DNA sequences, anatomical structures and order of appearance of structures in embryological development.

(2) Construct an explanation based on evidence that the process of evolution primarily results from four factors:

(I) The potential for a species to increase in number;

(II) The heritable genetic variation of individuals of a species from mutation and sexual reproduction;

(III) Competition for limited resources; and

(IV) The proliferation of those organisms that are better able to survive and reproduce in the environment.

➥ Emphasis in this area must be on using evidence to explain the influence of each of the four factors on the number of organisms, behaviors, morphology or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Evidence may include, without limitation, mathematical models such as simple distribution graphs and proportional reasoning. An assessment of pupils in this area must not include other mechanisms of evolution such as genetic drift, gene flow through migration and co-evolution.

(3) Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Emphasis in this area must be on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. An assessment of pupils in this area must be limited to basic statistical and graphical analysis and must not include allele frequency calculations.

(4) Construct an explanation based on evidence for how natural selection leads to the adaptation of populations. Emphasis in this area must be on using data to provide evidence for how specific biotic and abiotic differences in ecosystems, such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers or evolution of other organisms, contribute to a change in gene frequency over time,which leads to the adaptation of populations.

(5) Evaluate the evidence supporting claims that changes in environmental conditions may result in increases in the number of members of some species, the emergence of new species over time and the extinction of other species. Emphasis in this area must be on determining cause and effect relationships for the manner in which changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood and the rate of change of the environment affect distribution or disappearance of traits in species.

(6) Create or revise a simulation to test a solution to mitigate the adverse impacts of human activity on biodiversity. Emphasis in this area must be on designing solutions for a proposed problem related to threatened or endangered species or to genetic variation of organisms for multiple species.

3. For the area of earth science, understand:

(a) The earth's place in the universe, as demonstrated by the ability of the pupil to:

(1) Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches earth in the form of radiation. Emphasis in this area must be on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach earth. Evidence for the model may include, without limitation, observations of the masses and lifetimes of other stars and the ways that the sun's radiation varies because of sudden solar flares and other space weather, the 11-year sunspot cycle and non-cyclic variations over centuries. An assessment of pupils in this area must not include details of the atomic and subatomic processes involved with the sun's nuclear fusion.

(2) Construct an explanation of the big bang theory based on astronomical evidence of light spectra, motion of distant galaxies and composition of matter in the universe. Emphasis

in this area must be on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the big bang and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases, from the spectra of electromagnetic radiation from stars, which matches the composition of three-fourths hydrogen and one-fourth helium predicted by the big bang theory.

(3) Communicate scientific concepts about the way stars, over their life cycle, produce elements. Emphasis in this area must be on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime. An assessment of pupils in this area must not include details of the many different nucleosynthesis pathways for stars of differing masses.

(4) Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. Emphasis in this area must be on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons. Mathematical representations for the gravitational attraction of bodies and Kepler's laws of orbital motions must not deal with more than two bodies or involve the use of calculus.

(5) Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. Emphasis in this area must be on the ability of plate tectonics to explain the ages of crustal rocks. Explanations may include, without limitation, evidence of the ages of oceanic crust increasing with distance from mid-ocean ridges as a result of plate spreading and the ages of North American continental crust increasing with distance away from a central ancient core as a result of past plate interactions.

(6) Apply scientific reasoning and evidence from ancient materials from the earth, meteorites and other planetary surfaces to construct an account of the formation and early history of the earth. Emphasis in this area must be on using available evidence within the solar system to reconstruct the early history of earth. Evidence may include, without limitation, the absolute ages of ancient materials obtained by radiometric dating of meteorites, moon rocks and earth's oldest minerals, the sizes and compositions of solar system objects and the impact cratering record of planetary surfaces.

(b) The earth's systems, as demonstrated by the ability of the pupil to:

(1) Develop a model to illustrate how the internal and surface processes of earth operate at different spatial and temporal scales to form continental and ocean-floor features. Emphasis in this area must be on how the appearance of land features, such as mountains, valleys and plateaus, and sea-floor features, such as trenches, ridges and seamounts, are a result of both constructive forces, such as volcanism, tectonic uplift and orogeny, and destructive mechanisms, such as weathering, mass wasting and coastal erosion. An assessment of pupils in this area must not include memorization of the details of the formation of specific geographic features of the earth's surface.

(2) Analyze geoscientific data to make the claim that one change to the surface of the earth can create feedback that causes changes to the other systems of the earth. Feedbacks may include, without limitation, climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice which reduces the amount of sunlight reflected from earth's surface, increasing surface temperatures and further reducing the amount of ice. Feedbacks may include, without limitation, other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion, how

dammed rivers increase groundwater recharge, decrease sediment transport and increase coastal erosion or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.

(3) Develop a model based on evidence of the interior of the earth to demonstrate the cycling of matter by thermal convection. Emphasis in this area must be on both a one-dimensional model of earth with radial layers determined by density and a three-dimensional model which is controlled by mantle convection and the resulting plate tectonics. Evidence may include, without limitation, maps of earth's three-dimensional structure obtained from seismic waves, records of the rate of change of earth's magnetic field as constraints on convection in the outer core and identification of the composition of the earth's layers from high-pressure laboratory experiments.

(4) Use a model to demonstrate how variations in the flow of energy into and out of the earth's systems result in changes in climate. An assessment of pupils in this area that involves the results of changes in climate must be limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels and biosphere distribution. The causes of climate change must differ by timescale and may include, without limitation, for a timescale of:

(I) Less than 10 years, large volcanic eruption or ocean circulation;

(II) Ten or more but less than 10,000 years, changes in human activity, ocean circulation or solar output;

(III) Ten thousand or more but less than 10,000,000 years, changes to the earth's orbit and the orientation of its axis; and

(IV) Ten million or more years, long-term changes in atmospheric composition.

(5) Plan and conduct an investigation of the properties of water and its effects on the materials and surface processes of the earth. Emphasis in this area must be on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Mechanical investigations may include, without limitation, stream transportation and deposition using a stream table, erosion using variations in soil moisture content or frost wedging by the expansion of water as it freezes. Chemical investigations may include, without limitation, chemical weathering and recrystallization by testing the solubility of different materials or melt generation by examining how water lowers the melting temperature of most solids.

(6) Develop a quantitative model to demonstrate the cycling of carbon among the hydrosphere, atmosphere, geosphere and biosphere. Emphasis in this area must be on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil and biosphere, including humans, thereby providing the foundation for living organisms.

(7) Construct an argument based on evidence about the simultaneous co-evolution of the earth's systems and life on earth. Emphasis in this area must be on the dynamic causes, effects and feedbacks between the biosphere and the earth's other systems whereby geoscientific factors control the evolution of life, which in turn continuously alters earth's surface. Evidence may include, without limitation, how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life, how microbial life on land increased the formation of soil, which in turn allowed for the evolution of plants on land or how the evolution of corals

created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for new life forms to evolve. An assessment of pupils in this area must not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of the earth's other systems.

(c) The earth and human activity on earth, as demonstrated by the ability of the pupil to:

(1) Construct an explanation based on evidence regarding the availability of natural resources, the occurrence of natural hazards and the changes in climate and their influence on human activity. Key natural resources may include, without limitation, access to fresh water, such as rivers, lakes and groundwater, regions of fertile soils, such as river deltas, and high concentrations of minerals and fossil fuels. Natural hazards may include, without limitation, interior processes, such as volcanic eruptions and earthquakes, surface processes, such as tsunamis, mass wasting and soil erosion, and severe weather, such as hurricanes, floods and droughts. The results of changes in climate that may affect populations or drive mass migrations include, without limitation, changes to sea level, regional patterns of temperature and precipitation and the types of crops and livestock that can be raised.

(2) Evaluate competing design solutions for developing, managing and utilizing energy and mineral resources based on cost-benefit ratios. Emphasis in this area must be on the conservation, recycling and reuse of resources, such as minerals and metals, where possible, and on minimizing impacts where it is not possible. Design solutions may include, without limitation, developing best practices for agricultural soil use, mining, such as for coal, tar sands and oil shales, and pumping, such as for petroleum and natural gas. Emphasis in this area must be on science as an indicator of what can happen in natural systems and not what should happen in natural systems.

(3) Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations and biodiversity. Factors that affect the management of natural resources may include, without limitation, the costs of resource extraction and waste management, per capita consumption and the development of new technologies. Factors that affect human sustainability may include, without limitation, agricultural efficiency, levels of conservation and urban planning. An assessment of pupils in this area that involves computational simulations must be limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.

(4) Evaluate or refine a technological solution that reduces the impact of human activities on natural systems. Data on the impacts of human activities may include, without limitation, the quantities and types of pollutants released, changes to biomass and species diversity or areal changes in land surface use such as for urban development, agriculture and livestock or surface mining. Solutions that limit future impacts may include, without limitation, local efforts, such as reducing, reusing and recycling resources, and large-scale geoengineering design solutions, such as altering global temperatures by making large changes to the atmosphere or ocean.

(5) Analyze geoscientific data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate changes and associated future impacts to the earth's systems. Evidence, for both data and climate model outputs, may include, without limitation, climate changes, such as precipitation and temperature, and their associated impacts, such as on the sea level, glacial ice volumes or atmosphere and ocean composition. An assessment of pupils in this area must be limited to one example of a climate change and its associated impacts.

(6) Use a computational representation to illustrate the relationships among the earth's systems and how those relationships are being modified by human activity. Examples of the earth's systems to be considered may include, without limitation, the hydrosphere, atmosphere, cryosphere, geosphere and biosphere. Impacts from human activities may include, without limitation, how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations. An assessment of pupils in this area must be limited to using the published results of scientific computational models and must not include running computational representations.

4. For the area of engineering technology, understand design, as demonstrated by the ability of the pupil to:

(a) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

(b) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

(c) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including, without limitaiton, cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts.

(d) Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Sec. 11. NAC 389.492, 389.494, 389.496 and 389.498 are hereby repealed.

TEXT OF REPEALED SECTIONS

389.492 Life science. (NRS 385.080, 385.110) In addition to the course of study in science required for all grades of high school, a course of study in life science must include instruction designed to teach the pupil to do the following, as appropriate to the specific course in life science:

1. Demonstrate the active use of critical thinking and logical reasoning.
2. Identify relationships between matter and energy.
3. Analyze the characteristics and organization of the processes that cause diversity and change in the universe.
4. Recognize the interdependence of organisms and their environment.
5. Understand that mathematics is used to communicate scientific principles.
6. Use mathematics in collecting and interpreting scientific data.
7. Explain the relationship among scientific disciplines and their relationship to choosing a career, industry and daily living.
8. Understand environmental concepts as they relate to life science.
9. Demonstrate an understanding of the continuity and development of life forms.
10. Demonstrate an understanding of the structure and interdependence of living systems.
11. Demonstrate an understanding of metabolic processes.

389.494 Earth science. (NRS 385.080, 385.110) In addition to the course of study in science required for all grades of high school, a course of study in earth science must include instruction designed to teach the pupil to do the following, as appropriate to the specific course in earth science:

1. Demonstrate the active use of critical thinking and logical reasoning.

2. Identify relationships between matter and energy.

3. Analyze the characteristics and organization of the processes that cause diversity and change in the universe.

4. Recognize the interdependence of organisms and their environment.

5. Understand that mathematics is used to communicate scientific principles.

6. Use mathematics in collecting and interpreting scientific data.

7. Explain the relationship among scientific disciplines and their relationship to choosing a career, industry and daily living.

8. Understand environmental concepts as they relate to earth science.

9. Demonstrate an understanding of geology, oceanography, meteorology and other phenomena related to earth science.

10. Demonstrate an understanding of the solar system and the universe.

389.496 Physical science. (NRS 385.080, 385.110) In addition to the course of study in science required for all grades of high school, a course of study in physical science must include instruction designed to teach the pupil to do the following, as appropriate to the specific course in physical science:

1. Demonstrate the active use of critical thinking and logical reasoning.

2. Identify relationships between matter and energy.

3. Analyze the characteristics and organization of the processes that cause diversity and change in the universe.

4. Recognize the interdependence of organisms and their environment.

5. Understand that mathematics is used to communicate scientific principles.

6. Use mathematics to quantify science and in collecting and interpreting scientific data.

7. Explain the relationship among scientific disciplines and their relationship to choosing a career, industry and daily living.

8. Understand environmental concepts as they relate to physical science.

9. Explain the relationship between the structure and properties of matter.

10. Demonstrate an understanding of the transformation of energy, the forces of nature, motion and the relationship of cause and effect in those contexts.

389.498 Environmental science. (NRS 385.080, 385.110) In addition to the course of study in science required for all grades of high school, a course of study in environmental science must include instruction designed to teach the pupil to do the following:

1. Demonstrate the active use of critical thinking and logical reasoning.

2. Identify relationships between matter and energy.

3. Analyze the characteristics and organization of the processes that cause diversity and change in the universe.

4. Recognize the interdependence of organisms and their environment.

5. Understand that mathematics is used to communicate scientific principles.

6. Use mathematics to quantify science in collecting and interpreting scientific data.

7. Explain the relationship among scientific disciplines and their relationship to choosing a career, industry and daily living.

8. Understand environmental concepts as they relate to human activities.

9. Demonstrate an understanding of the interrelationship among components of the biosphere.

10. Demonstrate an understanding of succession.

11. Demonstrate an understanding of the effect of technology on the environment.

12. Demonstrate an understanding of the environmental effects of change in the biosphere.