

Minnesota Academic Standards in Science
Changes for Rulemaking
July 15, 2009

The following changes were made to the April 27th version of the science standards to prepare them for the rulemaking process. The changes were made to provide clarity to the statements. No standards or benchmarks were added or deleted. An x at the end of the code indicates a standard, and a number at the end indicates a benchmark.

Code	Current Text	Revised Text	Rationale
4.2..* in grades K-5,	Interdepend-ence in Living Systems	2. Interdepend-ence Among Living Systems	It is currently inconsistent with 7 & 9 and should be "Among"
7.4.2.x.x 9.4.2.x.x	2. Interdepend-ence among Living Systems	2. Interdepend-ence Among Living Systems	Among should be capitalized
0.4.1.1.3	<i>For example:</i> Sort live organisms (or pictures of organisms) into groups of those that grow and reproduce and need air, food and water, and those that don't.	Sort organisms and objects (or pictures of these) into groups of those that grow, and reproduce, and need air, food, and water; and those that don't.	Clarity: The original language did not include non-living objects in the materials to be sorted; punctuation
0.4.2.1.x	1. Natural systems have many components that interact to maintain the living system.	1. Natural systems have many components that interact to maintain the living system.	Eliminates confusion of natural and living
0.4.2.1.1	Observe a natural system or its model and identify living and nonliving components in that system.	Observe a natural system or its model ¹ , and identify living and nonliving components in that system.	Comma for clarity
1.1.1.1.x	1. Scientists work as individuals and groups to investigate the natural world, emphasizing evidence and communicating with others.	1. Scientists work as individuals and in groups to investigate the natural world, emphasizing evidence and communicating with others.	Mistake – makes it consistent with 3.1.1.1.x
2.1.2.2.x	2. Engineering design is the process of identifying problems and devising a product or solution.	2. Engineering design is the process of identifying a problem and devising a product or process to solve the problem.	Clarification and grammar
2.2.1.2.1	Observe, record and recognize that water can be a solid or a liquid and can change from one state to another and that the amount of water stays the same when it melts and freezes.	Observe, record and recognize that water can be a solid or a liquid and can change from one state to another. and that the amount of water stays the same when it melts and freezes.	Inaccurate and confusing
2.4.2.1.x	1. Natural systems have many components that interact to maintain the living system	1. Natural systems have many components that interact to maintain the living system.	Eliminates confusion of natural and living
2.4.2.1.1	Recognize that plants need space, water, food and air and they fulfill these needs in different ways.	Recognize that plants need space, water, nutrients and air, and that they fulfill these needs in different ways.	It is a misconception that plants take in food.
3.2.3.1.1	<i>Another example:</i> Compare materials according to their ability to conduct or produce sound.	[Delete the second example]	Conduction of sound is not part of the benchmark
3.2.3.1.2	Explain how shadows can form in various ways	Explain how shadows form and can change in various ways.	Clarity – they don't form in various ways
3.3.3.2.x	2. Objects in the solar system are seen from Earth as points of light with distinctive patterns of motion.	2. Objects in the solar system as seen from Earth have various sizes and distinctive patterns of motion.	"Points" implies very small. That doesn't apply to the sun and moon
4.1.2.2.3	Test and evaluate solutions, including advantages and disadvantages of the engineering solution, and communicate the results effectively.	Test and evaluate solutions, considering advantages and disadvantages of the engineering solution, and communicate the results effectively.	Clarity –

5.1.1.1.1	Explain why evidence, clear communication, accurate record keeping, replication by others, and openness to scrutiny are an essential part of doing science.	Explain why evidence, clear communication, accurate record keeping, replication by others, and openness to scrutiny are an essential parts of doing science.	plural
6.1.3.1.2	Distinguish between open and closed systems. <i>For example:</i> Kinetic and potential energy are conserved in a closed system, but are not conserved when frictional heating is considered.	[Delete the example]	Not a clear example
6.1.3.4.2	Demonstrate the conversion of units within the Systeme Internationale (SI, or metric) and estimate the magnitude of common objects and quantities using metric units.	Demonstrate the conversion of units within the International System of Units (SI, or metric) and estimate the magnitude of common objects and quantities using metric units.	English name rather than French
6.2.1.1.x	1. Pure substances can be identified by properties which are independent of the sample of the substance and can be explained by a model of matter that is composed of small particles.	1. Pure substances can be identified by properties which are independent of the sample of the substance and the properties can be explained by a model of matter that is composed of small particles.	clarity
6.2.1.2.3	Use the relationship between heat and the motion and arrangement of particles in solids, liquids and gases to explain melting, freezing, boiling and evaporation.	Use the relationship between heat and the motion and arrangement of particles in solids, liquids and gases to explain melting, freezing, condensation and evaporation.	Includes all the processes and at an parallel level
6.2.2.1.x	1. The motion of an object can be described in terms of position, direction and speed.	1. The motion of an object can be described in terms of speed, direction and change of position.	Clarity
6.2.2.1.2	Graph an object's position as a function of time and an object's speed as a function of time for an object traveling in a straight line and use the graphs to describe the object's motion.	For an object traveling in a straight line, graph the object's position as a function of time, and its speed as a function of time. Explain how these graphs describe the object's motion.	Clarity
6.2.3.2.3	Describe how energy is transferred in conduction, convection and radiation	Describe how heat energy is transferred in conduction, convection and radiation	Specificity
7.1.1.1.x	1. Science is a way of knowing about the natural world that is characterized by empirical criteria, logical argument and skeptical review.	1. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	clarity
7.1.1.1.1	Understand that prior expectations create bias when conducting scientific investigations. <i>For example:</i> Students continue to think that air is not matter, even though they have evidence from investigations.	Understand that prior expectations can create bias when conducting scientific investigations. <i>For example:</i> Students often continue to think that air is not matter, even though they have contrary evidence from investigations.	Clarification
7.2.1.1.3	Recognize that a chemical equation describes a reaction where pure substances change to produce one or more different substances whose properties are different from the original substance(s).	Recognize that a chemical equation describes a reaction where pure substances change to produce one or more pure substances whose properties are different from the original substance(s).	Clarity

7.4.1.2.x	2. All organisms are composed of one or more cells which carry on the many functions needed to sustain life.	2. All living organisms are composed of one or more cells which carry on the many functions needed to sustain life.	Adds clarity for other uses of the word organisms (Viruses are sometimes considered nonliving organisms and they do not have cells.)
7.4.3.1.2	Recognize that in asexually reproducing organisms all the genes come from a single parent, and that in sexually reproducing organisms half of the genes come from each parent.	Recognize that in asexually reproducing organisms all the genes come from a single parent, and that in sexually reproducing organisms about half of the genes come from each parent.	More accurate
7.4.3.2.4	Recognize that extinction is a common event and it can occur when the environment changes and an organism's ability to adapt is insufficient to allow its survival.	Recognize that extinction is a common event and it can occur when the environment changes and a population's ability to adapt is insufficient to allow its survival.	The original language might imply that an individual adapts, which is false.
8.1.1.1.x	. Science is a way of knowing about the natural world that is characterized by empirical criteria, logical argument and skeptical review.	. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	clarity
8.1.3.3.1	Explain how constraints like scientific laws and engineering principles, as well as economic, political, social, and ethical expectations, must be taken into account in designing engineering solutions or conducting scientific investigations.	Explain how constraints like scientific laws and engineering principles, as well as economic, political, social, and ethical expectations, must be taken into account in designing engineering solutions or conducting scientific investigations.	Laws and principles don't have the connotation of constraints.
8.2.1.1.x	1. Pure substances can be identified by properties which are independent of the sample of the substance and can be explained by a model of matter that is composed of small particles.	1. Pure substances can be identified by properties which are independent of the sample of the substance and the properties can be explained by a model of matter that is composed of small particles.	clarity
8.2.3.1.1	Explain how seismic waves transfer energy through the Earth and across its surfaces.	Explain how seismic waves transfer energy through the layers of the Earth and across its surface .	Clarity, surface is singular
8.3.2.2.1	Describe how the composition and structure of the Earth's atmosphere affects energy absorption, climate and distribution of particulates and gases.	Describe how the composition and structure of the Earth's atmosphere affects energy absorption, climate, and the distribution of particulates and gases.	Clarity and grammar
8.3.2.3.x	3. The water cycle is an open system with many inputs.	Water, which covers the majority of the Earth's surface, circulates through the crust, oceans and atmosphere in what is known as the water cycle.	Clearer statement, uses language of NAEP
8.3.3.1.3	Recognize that gravity exists between any two objects and describe how the mass and distance between objects affects the force of gravity.	Recognize that gravitational force exists between any two objects and describe how the masses of the objects and distance between them affect the force.	Clarity/grammar
8.3.3.1.4	Compare and contrast the planets and the moons of our solar system in terms of their size, location and composition.	Compare and contrast the sizes, locations, and compositions of the planets and moons in our solar system.	Clarity
8.3.3.1.5	Use the predictability of the motions of the Earth, sun and moon to explain day length, the phases of the moon, and eclipses.	Use the predictable motions of the Earth around its own axis and around the sun, and of the moon around the Earth, to explain day length, the phases of the moon, and eclipses.	Clarity

8.3.4.1.2	Recognize that land and water use practices in specific areas affect natural processes and that natural processes interfere and interact with human systems. <i>For example:</i> Levees change the natural flooding process of a river. <i>Another example:</i> Agricultural runoff joins the water cycle and influences natural systems far from the source.	Recognize that land and water use practices in specific areas can affect natural processes and that natural processes interfere and interact with human systems. <i>For example:</i> Levees change the natural flooding process of a river. <i>Another example:</i> Agricultural runoff joins the water cycle and influences natural systems far from the source.	Eliminates some confusion
9.1.1.1.x	1. Science is a way of knowing about the natural world that is characterized by empirical criteria, logical argument and skeptical review.	1. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	Match 7 th grade standard 7.1.1.1.x
9.1.1.1.2	Understand that scientists conduct investigations for a variety of reasons: to discover new aspects of the natural world, to explain recently observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain recently observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	Clarity
9.1.1.1.5	Identify sources of bias and how bias might influence the direction of research and the interpretation of data.	Identify sources of bias and explain how bias might influence the direction of research and the interpretation of data.	clarity
9.1.2.1.1	Understand that engineering designs and products must be continually checked and critiqued for alternatives, risks, costs and benefits, so that subsequent designs are refined and improved.	Understand that engineering designs and products are often continually checked and critiqued for alternatives, risks, costs and benefits, so that subsequent designs are refined and improved.	clarity
9.1.2.1.3	Explain and give examples of how, in the design of a device or process, engineers consider how it is to be manufactured, operated, maintained, replaced and disposed of.	Explain and give examples of how, in the design of a device, or process , engineers consider how it is to be manufactured, operated, maintained, replaced and disposed of.	Clarity: processes are not manufactured.
9.1.2.2.x	2. Engineering design is an analytical and creative process of devising a product or solution to meet a need or solve a specific problem.	2. Engineering design is an analytical and creative process of devising a product or solution to meet a need or solve a specific problem.	Clarity: "solution" can include a product
9.2.2.2.x	Forces and object mass determine the motion of an object.	An object's mass and the forces on it affect the motion of an object.	clarity
9.2.2.2.1	Recognize that the inertia of an object causes it to resist changes in motion.	Recognize that inertia is the property of an object that causes it to resist changes in motion.	clarity
9.2.2.2.4	Use the law of gravitation to describe and calculate the attraction between massive objects based on the distance between them.	Use Newton's universal law of gravitation to describe and calculate the attraction between massive objects based on the distance between them.	Clarity on which law of gravity
9.2.3.2.3	Describe how energy is transferred through sound waves and how pitch and loudness are related to wave properties of amplitude and wavelength.	Describe how energy is transferred through sound waves and how pitch and loudness are related to wave properties of frequency and amplitude.	Parallel terms and order

9.2.3.2.6	Use the idea that small amounts of matter are transformed into large amounts of energy in nuclear reactions to compare fission and fusion in terms of beginning and end products and the amount of energy released.	Compare fission and fusion in terms of the reactants, the products and the conversion from matter into energy.	Clarity and consolidation
9.2.4.1.2	<i>For example:</i> Fluorescent light bulbs use less energy, but contain toxic mercury	<i>For example:</i> Fluorescent light bulbs use less energy than incandescent lights, but contain toxic mercury.	Clarity and missing period
9.3.1.3.1	Use relative dating techniques to explain how the structure of the Earth and life on Earth has changed over short and long periods of time. <i>For example:</i> Use radiometric dating and fossils to correlate rock sequences from separate locations.	Use relative dating techniques to explain how the structures of the Earth and life on Earth have changed over short and long periods of time. [Delete the example]	Grammar and mismatch of the example with the benchmark
9.3.2.3.x	3. Material in the Earth system cycles through different reservoirs, and is powered by the Earth's sources of energy.	The cycling of materials through different reservoirs of the Earth's system is powered by the Earth's sources of energy.	clarity
9.3.3.3.x	3. The big bang theory states that the universe expanded from a hot, dense chaotic mass, after which elements formed and clumped together to eventually form stars and galaxies.	3. The big bang theory states that the universe expanded from a hot, dense chaotic mass, after which chemical elements formed and clumped together to eventually form stars and galaxies.	clarity
9.3.3.3.1	Explain how evidence is used to understand the composition, early history and expansion of the universe. <i>For example:</i> Doppler shift of light or cosmic background radiation.	Explain how evidence, including the Doppler shift of light from distant stars and cosmic background radiation, is used to understand the composition, early history and expansion of the universe. [Delete example]	Clarity and recognition of the necessity to specify the evidence.
9.4.1.2.1	Recognize that cells are composed primarily of a few elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur), and describe the basic molecular structures of cells and the primary functions of carbohydrates, lipids, proteins and nucleic acids.	Recognize that cells are composed primarily of a few elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur), and describe the basic molecular structures of cells and the primary functions of carbohydrates, lipids, proteins and nucleic acids.	"of cells" was supposed to be deleted. Cells do not have molecular structures,
9.4.2.2.2	Explain how matter and energy in an ecosystem is transformed and transferred among organisms, and how energy is dissipated as heat into the environment.	Explain how matter and energy in an ecosystem is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment.	clarity
9.4.4.2.4	Explain how environmental factors and personal decisions, such as water pollution, air quality and smoking affect personal and community health.	Explain how environmental factors and personal decisions, such as water quality, air quality and smoking affect personal and community health.	Clarity, parallel language
9.4.4.2.5	Recognize that a gene mutation in a cell can result in uncontrolled cell division called cancer and how exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Recognize that a gene mutation in a cell can result in uncontrolled cell division called cancer, and how exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Clarity – addition of a comma

9C.2.1.2.6	Describe the dynamic process by which solutes dissolve in solvents and calculate concentrations, including percent concentration, molarity and parts per million.	Describe the dynamic process by which solutes dissolve in solvents, and calculate concentrations, including percent concentration, molarity and parts per million.	Clarity – addition of a comma
9C.2.1.4.x	4. States of matter can be described in terms of motion of molecules. The properties and behavior of gases can be explained using the Kinetic Molecular Theory.	4. States of matter can be described in terms of motion of molecules. The properties and behavior of gases can be explained using the kinetic molecular theory.	Consistency - don't capitalize Kinetic Molecular Theory
9C.2.1.4.2	Explain changes in temperature, pressure, volume and number of particles of a gas in terms of the random motion of molecules	Use the kinetic molecular theory to explain the behavior of gases and the relationship among temperature, pressure, volume and the number of particles.	Clarity
9P.2.2.2.2	<i>For example:</i> Objects in orbit	<i>For example:</i> Objects in orbit.	Missing period
9P.2.2.2.3	Use conservation of momentum and energy to analyze the elastic collision of two solid objects in one-dimensional motion.	Use conservation of momentum and conservation of energy to analyze an elastic collision of two solid objects in one-dimensional motion.	Clarity
9P.2.3.1.2	Describe how vibration of physical objects sets up transverse and longitudinal waves in gases, liquids and solid materials.	Describe how vibration of physical objects sets up transverse and/or longitudinal waves in gases, liquids and solid materials.	Clarity – gases don't have transverse waves
9P.2.3.1.3	Explain how wave properties, such as interference, resonance, refraction and reflection, affect sound waves.	Explain how interference, resonance, refraction and reflection affect sound waves.	Clarity – these are not wave properties.
9P.2.3.2.1	Explain why currents flow when free charges are placed in an electrical field, and how that forms the basis for electrical circuits.	Explain why currents flow when free charges are placed in an electric field, and how that forms the basis for electric circuits.	Grammar and consistency
9P.2.3.3.1	Describe the nature of the magnetic and electrical fields in a propagating electromagnetic wave.	Describe the nature of the magnetic and electric fields in a propagating electromagnetic wave.	Consistency
9P.2.3.3.2	Quantitatively relate the speed of light in a medium to its frequency and wavelength in that medium, and in free space.	Explain and calculate how the speed of light and its wavelength change when the medium changes.	Clarity
9P.2.3.3.3	Use Snell's Law to explain the refraction and total internal reflection of light in transparent media, such as lenses and fiber optics.	Use Snell's Law to Explain the refraction and/or total internal reflection of light in transparent media, such as lenses and optical fibers.	Clarity - (Snell's law is a formula)
9P.2.3.3.6	Compare the wavelength, frequency and energy of different kinds of waves in the electromagnetic spectrum and describe their applications.	Compare the wavelength, frequency and energy of waves in different regions of the electromagnetic spectrum and describe their applications.	clarity
9P.2.3.4.x	4. Heat is energy transferred between objects or regions that are at different temperatures by the processes of convection, conduction and radiation.	4. Heat is energy is transferred between objects or regions that are at different temperatures by the processes of convection, conduction and radiation.	clarity
9P.2.3.4.1	Describe and calculate the quantity of heat transferred between solids and/or liquids, using specific heat, density and temperatures.	Describe and calculate the quantity of heat transferred between solids and/or liquids, using specific heat, mass and change in temperatures.	Clarity and accuracy