3501.0945 GRADES 9 THROUGH 12 STANDARDS.

Subpart 1. **The nature of science and engineering.**

A. The practice of science. The student will understand that science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument, and skeptical review.

B. The practice of science. The student will understand that scientific inquiry uses multiple interrelated processes to investigate and explain the natural world.

C. The practice of engineering. The student will understand that engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes, and systems.

D. The practice of engineering. The student will understand that engineering design is an analytical and creative process of devising a solution to meet a need or solve a specific problem.

E. Interactions among science, technology, engineering, mathematics, and society. The student will understand that natural and designed systems are made up of components that act within a system and interact with other systems.

F. Interactions among science, technology, engineering, mathematics, and society. The student will understand that men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry.

G. Interactions among science, technology, engineering, mathematics, and society. The student will understand that science and engineering operate in the context of society and both influence and are influenced by this context.

H. Interactions among science, technology, engineering, mathematics, and society. The student will understand that science, technology, engineering, and mathematics rely on each other to enhance knowledge and understanding.

Subp. 2. **Physical science.**

A. Matter. The student will understand that the structure of the atom determines chemical properties of elements.

B. Matter. The student will understand that chemical reactions involve the rearrangement of atoms as chemical bonds are broken and formed through transferring or sharing of electrons and the absorption or release of energy.

C. Motion. The student will understand that an object's mass and the forces on it affect the motion of an object.

D. Energy. The student will understand that energy can be transformed within a system or transferred to other systems or the environment, but is always conserved.

E. Human interactions with physical systems. The student will understand that there are benefits, costs, and risks to different means of generating and using energy.

Subp. 3. **Earth and space science.**

A. Earth structure and processes. The student will understand that the relationships among earthquakes, mountains, volcanoes, fossil deposits, rock layers, and ocean features provide evidence for the theory of plate tectonics.

B. Earth structure and processes. The student will understand that by observing rock sequences and using fossils to correlate the sequences at various locations, geologic events can be inferred and geologic time can be estimated.

C. Interdependence within the Earth system. The student will understand that the Earth system has internal and external sources of energy, which produce heat and drive the motion of material in the oceans, atmosphere, and solid earth.

D. Interdependence within the Earth system. The student will understand that global climate is determined by distribution of energy from the sun at the Earth's surface.

E. Interdependence within the Earth system. The student will understand that the cycling of materials through different reservoirs of the Earth's system is powered by the Earth's sources of energy.

F. The universe. The student will understand that the solar system, sun, and Earth formed over billions of years.

G. The universe. The student will understand that 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.

H. Human interactions with Earth systems. The student will understand that people consider potential benefits, costs, and risks to make decisions on how they interact with natural systems.

Subp. 4. **Life science.**

A. Structure and function in living systems. The student will understand that organisms use the interaction of cellular processes as well as tissues and organ systems to maintain homeostasis.

B. Structure and function in living systems. The student will understand that cells and cell structures have specific functions that allow an organism to grow, survive, and reproduce.

C. Interdependence among living systems. The student will understand that the interrelationship and interdependence of organisms generate dynamic biological communities in ecosystems.

D. Interdependence among living systems. The student will understand that matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways.

E. Evolution in living systems. The student will understand that genetic information found in the cell provides information for assembling proteins, which dictate the expression of traits in an individual.

F. Evolution in living systems. The student will understand that variation within a species is the natural result of new inheritable characteristics occurring from new combinations of existing genes or from mutations of genes in reproductive cells.

G. Evolution in living systems. The student will understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.

H. Human interactions with living systems. The student will understand that human activity has consequences on living organisms and ecosystems.

I. Human interactions with living systems. The student will understand that personal and community health can be affected by the environment, body functions, and human behavior.

Statutory Authority: *MS s 120B.02*

History: *34 SR 1609*

Published Electronically: *January 4, 2018*