



**NEBRASKA**

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*DEPARTMENT OF*

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**EDUCATION**

**301 Centennial Mall South  
Lincoln, Nebraska 68509-4987**

**NEBRASKA  
SCIENCE STANDARDS**

**Grades K-12**

Adopted by the Nebraska State Board of Education  
October 6, 2010

# NEBRASKA SCIENCE STANDARDS

## Grades K-2

### SC 1: INQUIRY, THE NATURE OF SCIENCE, AND TECHNOLOGY

Students will combine scientific processes and knowledge with scientific reasoning and critical thinking to ask questions about phenomena and propose explanations based on gathered evidence.

#### 1.1. Abilities to do Scientific Inquiry

- 2.1.1 Students will ask questions and conduct investigations that lead to observations and communication of findings.

##### *Scientific Questioning*

- 2.1.1.a Ask questions that relate to a science topic

##### *Scientific Investigations*

- 2.1.1.b Conduct simple investigations

##### *Scientific Tools*

- 2.1.1.c Select and use simple tools appropriately

##### *Scientific Observations*

- 2.1.1.d Describe objects, organisms, or events using pictures, words, and numbers

##### *Scientific Data Collection*

- 2.1.1.e Collect and record observations

##### *Scientific Communication*

- 2.1.1.f Use drawings and words to describe and share observations with others

##### *Mathematics*

- 2.1.1.g Use appropriate mathematics in all aspects of scientific inquiry

### SC 2: PHYSICAL SCIENCE

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.

#### 2.1. Matter

- 2.2.1 Students will observe and describe properties of objects and their behavior.

##### *Properties and Structure of Matter*

- 2.2.1.a Observe physical properties of objects (freezing and melting, sinking and floating, color, size, texture, shape, weight)  
2.2.1.b Separate and sort objects by physical attributes  
2.2.1.c Measure objects using standard and non-standard units

##### *States of Matter*

- 2.2.1.d Identify solids and liquids and recognize that liquids take the shape of their container

#### 2.2. Force and Motion

- 2.2.2 Students will compare relative position and motion of objects.

##### *Motion*

- 2.2.2.a State location and/or motion relative to another object or its surroundings (in front of, behind, between, over, under, faster, slower, forward and backward, up and down)  
2.2.2.b Describe how objects move in many different ways (straight, zigzag, round and round, back and forth, and fast and slow)

### **SC 3: LIFE SCIENCE**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Life Sciences to make connections with the natural and engineered world.

#### **3.1. Structure and Function of Living Systems**

2.3.1 Students will investigate the characteristics of living things.

##### *Characteristics of Life*

2.3.1.a Differentiate between living and nonliving things

##### *Characteristics of Living Organisms*

2.3.1.b Identify the basic needs of living things (food, water, air, space, shelter)

2.3.1.c Identify external parts of plants and animals

2.3.1.d Observe and match plants and animals to their distinct habitats

#### **3.2. Heredity**

2.3.2 Students will recognize changes in living things.

##### *Inherited Traits*

2.3.2.a Describe how offspring resemble their parents

##### *Reproduction*

2.3.2.b Describe how living things change as they grow

#### **3.4. Biodiversity**

2.3.4 Students will recognize changes in organisms

##### *Biological Adaptations*

2.3.4.a Recognize seasonal changes in animals and plants

### **SC 4: EARTH AND SPACE SCIENCES**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of Earth and Space Sciences to make connections with the natural and engineered world.

#### **4.1. Earth in Space**

2.4.1 Students will observe and identify objects of the sky.

##### *Objects in the Sky and Universe*

2.4.1.a Identify objects in the sky (the Sun, the Moon, the stars) and when they are observable

##### *Motion of Objects in the Solar System*

2.4.1.b Identify objects that appear to move in the sky (the Sun, the Moon, stars)

#### **4.2. Earth Structures and Processes**

2.4.2 Students will observe, identify, and describe characteristics of Earth's materials.

##### *Properties of Earth Materials*

2.4.2.a Describe Earth materials (sand, soil, rocks, water)

##### *Use of Earth Materials*

2.4.2.b Recognize ways in which individuals and families can conserve Earth's resources by reducing, reusing, and recycling

**4.3. Energy in Earth's Systems**

2.4.3 Students will observe simple patterns of change on Earth.

*Energy Sources*

2.4.3.a Observe that the Sun provides heat and light

*Weather and Climate*

2.4.3.b Observe and describe simple daily changes in weather

2.4.3.c Describe simple seasonal weather indicators and how they impact student choices (activities, clothing)

# NEBRASKA SCIENCE STANDARDS

## GRADES 3-5

### SC 1: INQUIRY, THE NATURE OF SCIENCE, AND TECHNOLOGY

Students will combine scientific processes and knowledge with scientific reasoning and critical thinking to ask questions about phenomena and propose explanations based on gathered evidence.

#### 1.1. Abilities to do Scientific Inquiry

5.1.1 Students will plan and conduct investigations that lead to the development of explanations.

##### *Scientific Questioning*

5.1.1.a Ask testable scientific questions

##### *Scientific Investigations*

5.1.1.b Plan and conduct investigations and identify factors that have the potential to impact an investigation

##### *Scientific Tools*

5.1.1.c Select and use equipment correctly and accurately

##### *Scientific Observations*

5.1.1.d Make relevant observations and measurements

##### *Scientific Data Collection*

5.1.1.e Collect and organize data

##### *Scientific Interpretations, Reflections, and Applications*

5.1.1.f Develop a reasonable explanation based on collected data

##### *Scientific Communication*

5.1.1.g Share information, procedures, and results with peers and/or adults

5.1.1.h Provide feedback on scientific investigations

##### *Mathematics*

5.1.1.i Use appropriate mathematics in all aspects of scientific inquiry

#### 1.2. Nature of Science

5.1.2 Students will describe how scientists go about their work.

##### *Scientific Knowledge*

5.1.2.a Recognize that scientific explanations are based on evidence and scientific knowledge

##### *Science and Society*

5.1.2.b Recognize that new discoveries are always being made which impact scientific knowledge

##### *Science as a Human Endeavor*

5.1.2.c Recognize many different people study science

#### 1.3. Technology

5.1.3 Students will solve a simple design problem.

##### *Abilities to do Technical Design*

5.1.3.a Identify a simple problem

5.1.3.b Propose a solution to a simple problem

5.1.3.c Implement the proposed solution

5.1.3.d Evaluate the implementation

5.1.3.e Communicate the problem, design, and solution

## SC 2: PHYSICAL SCIENCE

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.

### 2.1. Matter

5.2.1 Students will explore and describe the physical properties of matter and its changes

#### *Properties and Structure of Matter*

- 5.2.1.a Identify mixtures and pure substances
- 5.2.1.b Identify physical properties of matter (color, odor, elasticity, weight, volume)
- 5.2.1.c Use appropriate metric measurements to describe physical properties

#### *States of Matter*

- 5.2.1.d Identify state changes caused by heating and cooling solids, liquids, and gasses

### 2.2. Force and Motion

5.2.2 Students will identify the influence of forces on motion.

#### *Motion*

- 5.2.2.a Describe motion by tracing and measuring an object's position over a period of time (speed)

#### *Forces/Newton's 2<sup>nd</sup> law*

- 5.2.2.b Describe changes in motion due to outside forces (push, pull, gravity)

#### *Universal Forces*

- 5.2.2.c Describe magnetic behavior in terms of attraction and repulsion

### 2.3. Energy

5.2.3 Students will observe and identify signs of energy transfer.

#### *Sound/Mechanical Waves*

- 5.2.3.a Recognize that sound is produced from vibrating objects; the sound can be changed by changing the vibration

#### *Light*

- 5.2.3.b Recognize that light travels in a straight line and can be reflected by an object (mirror)
- 5.2.3.c Recognize that light can travel through certain materials and not others (transparent, translucent, opaque)

#### *Heat*

- 5.2.3.d Identify ways to generate heat (friction, burning, incandescent light bulb)
- 5.2.3.e Identify materials that act as thermal conductors or insulators

#### *Electricity/Magnetism*

- 5.2.3.f Recognize that the transfer of electricity in an electrical circuit requires a closed loop

### **SC 3: LIFE SCIENCE**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Life Sciences to make connections with the natural and engineered world.

#### **3.1. Structure and Function of Living Systems**

5.3.1 Students will investigate and compare the characteristics of living things.

##### *Characteristics of Life*

5.3.1.a Compare and contrast characteristics of living and nonliving things

##### *Characteristics of Living Organisms*

5.3.1.b Identify how parts of plants and animals function to meet basic needs (e.g., leg of an insect helps an insect move, root of a plant helps the plant obtain water)

#### **3.2. Heredity**

5.3.2 Students will identify variations of inherited characteristics and life cycles.

##### *Inherited Traits*

5.3.2.a Identify inherited characteristics of plants and animals

##### *Reproduction*

5.3.2.b Identify the life cycle of an organism

#### **3.3. Flow of Matter and Energy in Ecosystems**

5.3.3 Students will describe relationships within an ecosystem.

##### *Flow of Energy*

5.3.3.a Diagram and explain a simple food chain beginning with the Sun

5.3.3.b Identify the role of producers, consumers, and decomposers in an ecosystem

##### *Ecosystems*

5.3.3.c Recognize the living and nonliving factors that impact the survival of organisms in an ecosystem

##### *Impact on Ecosystems*

5.3.3.d Recognize all organisms cause changes, some beneficial and some detrimental, in the environment where they live

#### **3.4. Biodiversity**

5.3.4 Students will describe changes in organisms over time.

##### *Biological Adaptations*

5.3.4.a Describe adaptations made by plants or animals to survive environmental changes

## **SC 4: EARTH AND SPACE SCIENCES**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of Earth and Space Sciences to make connections with the natural and engineered world.

### **4.1. Earth in Space**

5.4.1 Students will observe and describe characteristics, patterns, and changes in the sky.

#### *Objects in the Sky and Universe*

5.4.1.a Recognize that the observed shape of the Moon changes from day to day during a one month period

#### *Motion of Objects in the Solar System*

5.4.1.b Recognize the motion of objects in the sky (the Sun, the Moon, stars) change over time in recognizable patterns

### **4.2. Earth Structures and Processes**

5.4.2 Students will observe and describe Earth's materials, structure, and processes.

#### *Properties of Earth Materials*

5.4.2.a Describe the characteristics of rocks, minerals, soil, water, and the atmosphere

#### *Earth's Processes*

5.4.2.b Identify weathering, erosion, and deposition as processes that build up or break down Earth's surface

#### *Use of Earth Materials*

5.4.2.c Identify how Earth materials are used (fuels, building materials, sustaining plant life)

### **4.3. Energy in Earth's Systems**

5.4.3 Students will observe and describe the effects of energy changes on Earth.

#### *Energy Sources*

5.4.3.a Describe the Sun's warming effect on the land and water

#### *Weather and Climate*

5.4.3.b Observe, measure, and record changes in weather (temperature, wind direction and speed, precipitation)

5.4.3.c Recognize the difference between weather, climate, and seasons

### **4.4. Earth's History**

5.4.4 Students will describe changes in Earth.

#### *Past/Present Earth*

5.4.4.a Describe how slow processes (erosion, weathering, deposition) and rapid processes (landslides, volcanic eruptions, earthquakes) change Earth's surface



# NEBRASKA SCIENCE STANDARDS

## Grades 6-8

### SC 1: INQUIRY, THE NATURE OF SCIENCE, AND TECHNOLOGY

Students will combine scientific processes and knowledge with scientific reasoning and critical thinking to ask questions about phenomena and propose explanations based on gathered evidence.

#### 1.1. Abilities to do Scientific Inquiry

8.1.1 Students will design and conduct investigations that will lead to descriptions of relationships between evidence and explanations.

##### *Scientific Questioning*

8.1.1.a Formulate testable questions that lead to predictions and scientific investigations

##### *Scientific Investigations*

8.1.1.b Design and conduct logical and sequential investigations including repeated trials

##### *Scientific Controls and Variables*

8.1.1.c Determine controls and use dependent (responding) and independent (manipulated) variables

##### *Scientific Tools*

8.1.1.d Select and use equipment appropriate to the investigation, demonstrate correct techniques

##### *Scientific Observations*

8.1.1.e Make qualitative and quantitative observations

##### *Scientific Data Collection*

8.1.1.f Record and represent data appropriately and review for quality, accuracy, and relevancy

##### *Scientific Interpretations, Reflections, and Applications*

8.1.1.g Evaluate predictions, draw logical inferences based on observed patterns/relationships, and account for non-relevant information

##### *Scientific Communication*

8.1.1.h Share information, procedures, results, and conclusions with appropriate audiences

8.1.1.i Analyze and provide appropriate critique of scientific investigations

##### *Mathematics*

8.1.1.j Use appropriate mathematics in all aspects of scientific inquiry

#### 1.2. Nature of Science

8.1.2 Students will apply the nature of science to their own investigations.

##### *Scientific Knowledge*

8.1.2.a Recognize science is an ongoing process and the scientific community accepts and uses explanations until they encounter new experimental evidence not matching existing explanations

##### *Science and Society*

8.1.2.b Describe how scientific discoveries influence and change society

##### *Science as a Human Endeavor*

8.1.2.c Recognize scientists from various cultures have made many contributions to explain the natural world

### 1.3. Technology

8.1.3 Students will solve a design problem which involves one or two science concepts.

#### *Abilities to do Technical Design*

- 8.1.3.a Identify problems for technical design
- 8.1.3.b Design a solution or product
- 8.1.3.c Implement the proposed design
- 8.1.3.d Evaluate completed technological designs or products
- 8.1.3.e Communicate the process of technical design

#### *Understanding of Technical Design*

- 8.1.3.f Distinguish between scientific inquiry (asking questions about the natural world) and technological design (using science to solve practical problems)
- 8.1.3.g Describe how science and technology are reciprocal
- 8.1.3.h Recognize that solutions have intended and unintended consequences
- 8.1.3.i Compare and contrast the reporting of scientific knowledge and the reporting of technological knowledge

## SC 2: PHYSICAL SCIENCE

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.

### 2.1. Matter

8.2.1 Students will identify and describe the particulate nature of matter including physical and chemical interactions.

#### *Properties and Structure of Matter*

- 8.2.1.a Compare and contrast elements, compounds, and mixtures
- 8.2.1.b Describe physical and chemical properties of matter

#### *States of Matter*

- 8.2.1.c Recognize most substances can exist as a solid, liquid, or gas depending on temperature
- 8.2.1.d Compare and contrast solids, liquids, and gasses based on properties of these states of matter

#### *Physical and Chemical Changes*

- 8.2.1.e Distinguish between physical and chemical changes (phase changes, dissolving, burning, rusting)
- 8.2.1.f Recognize conservation of matter in physical and chemical changes

#### *Classification of Matter*

- 8.2.1.g Classify substances into similar groups based on physical properties

### 2.2. Force and Motion

8.2.2 Students will investigate and describe forces and motion.

#### *Motion*

- 8.2.2.a Describe motion of an object by its position and velocity

#### *Inertia/Newton's 1<sup>st</sup> law*

- 8.2.2.b Recognize an object that is not being subjected to a force will continue to move at a constant speed in a straight line or stay at rest (Newton's 1<sup>st</sup> law)

#### *Forces/Newton's 2<sup>nd</sup> law*

- 8.2.2.c Compare the motion of objects related to the effects of balanced and unbalanced forces

#### *Universal Forces*

- 8.2.2.d Recognize that everything on or around Earth is pulled towards Earth's center by gravitational force

### 2.3. Energy

8.2.3 Students will identify and describe how energy systems and matter interact.

#### *Sound/Mechanical Waves*

- 8.2.3.a Recognize that vibrations set up wave-like disturbances that spread away from the source (sound, seismic, water waves)
- 8.2.3.b Identify that waves move at different speeds in different materials

#### *Light*

- 8.2.3.c Recognize that light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection)
- 8.2.3.d Recognize that to see an object, light from the surface of the object must enter the eye; the color seen depends on the properties of the surface and the color of the available light sources

#### *Heat*

- 8.2.3.e Recognize that heat moves from warmer objects to cooler objects until both reach the same temperature

#### *Conservation*

- 8.2.3.f *Describe transfer of energy from electrical and magnetic sources to different energy forms (heat, light, sound, chemical)*
- 8.2.3.g *Recognize all energy is neither created nor destroyed*

### SC 3: LIFE SCIENCE

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Life Sciences to make connections with the natural and engineered world.

### 3.1. Structure and Function of Living Systems

8.3.1 Students will investigate and describe the structure and function of living organisms.

#### *Characteristics of Life*

- 8.3.1.a Recognize the levels of organization in living organisms (cells, tissues, organs, organ systems, organisms)

#### *Cellular Composition of Organisms*

- 8.3.1.b Recognize that all organisms are composed of one or many cells; that these cells must grow, divide, and use energy; and that all cells function similarly
- 8.3.1.c Recognize specialized cells perform specialized functions in multicellular organisms
- 8.3.1.d Identify the organs and functions of the major systems of the human body and describe ways that these systems interact with each other

#### *Behavior*

- 8.3.1.e Describe how plants and animals respond to environmental stimuli

### 3.2. Heredity

8.3.2 Students will investigate and describe the relationship between reproduction and heredity.

#### *Inherited Traits*

- 8.3.2.a Recognize that hereditary information is contained in genes within the chromosomes of each cell

#### *Reproduction*

- 8.3.2.b Compare and contrast sexual and asexual reproduction

### 3.3. Flow of Matter and Energy in Ecosystems

8.3.3 Students will describe populations and ecosystems.

#### *Flow of Energy*

8.3.3.a Diagram and explain the flow of energy through a simple food web

8.3.3.b Compare the roles of producers, consumers, and decomposers in an ecosystem

#### *Ecosystems*

8.3.3.c Recognize that producers transform sunlight into chemical energy through photosynthesis

8.3.3.d Determine the biotic and abiotic factors that impact the number of organisms an ecosystem can support

8.3.3.e Recognize a population is all the individuals of a species at a given place and time

8.3.3.f Identify symbiotic relationships among organisms

#### *Impact on Ecosystems*

8.3.3.g Identify positive and negative effects of natural and human activity on an ecosystem

### 3.4. Biodiversity

8.3.4 Students will identify characteristics of organisms that help them survive.

#### *Biological Adaptations*

8.3.4.a Describe how an inherited characteristic enables an organism to improve its survival rate

#### *Biological Evolution*

8.3.4.b Recognize the extinction of a species is caused by the inability to adapt to an environmental change

8.3.4.c Use anatomical features of an organism to infer similarities among other organisms

## SC 4: EARTH AND SPACE SCIENCES

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of Earth and Space Sciences to make connections with the natural and engineered world.

### 4.1. Earth in Space

8.4.1 Students will investigate and describe Earth and the solar system.

#### *Objects in the Sky and Universe*

8.4.1.a Describe the components of the solar system (the Sun, planets, moons, asteroids, comets)

#### *Motion of Objects in the Solar System*

8.4.1.b Describe the relationship between motion of objects in the solar system and the phenomena of day, year, eclipses, phases of the Moon and seasons

#### *Gravitational Effects*

8.4.1.c Describe the effects of gravity on Earth (tides) and the effect of gravity on objects in the solar system

## **4.2. Earth Structures and Processes**

8.4.2 Students will investigate and describe Earth's structure, systems, and processes.

### *Properties of Earth Materials*

- 8.4.2.a Describe the layers of Earth (core, mantle, crust, atmosphere)
- 8.4.2.b Describe the physical composition of soil
- 8.4.2.c Describe the mixture of gasses in Earth's atmosphere and how the atmosphere's properties change at different elevations
- 8.4.2.d Describe evidence of Earth's magnetic field

### *Earth's Processes*

- 8.4.2.e Compare and contrast constructive and destructive forces (deposition, erosion, weathering, plate motion causing uplift, volcanoes, earthquakes) that impact Earth's surface
- 8.4.2.f Describe the rock cycle
- 8.4.2.g Describe the water cycle (evaporation, condensation, precipitation)

### *Use of Earth Materials*

- 8.4.2.h Classify Earth materials as renewable or nonrenewable

## **4.3. Energy in Earth's Systems**

8.4.3 Students will investigate and describe energy in Earth's systems.

### *Energy Sources*

- 8.4.3.a Describe how energy from the Sun influences the atmosphere and provides energy for plant growth

### *Weather and Climate*

- 8.4.3.b Identify factors that influence daily and seasonal changes on Earth (tilt of the Earth, humidity, air pressure, air masses)
- 8.4.3.c Describe atmospheric movements that influence weather and climate (air masses, jet stream)

## **4.4. Earth's History**

8.4.4 Students will use evidence to draw conclusions about changes in Earth.

### *Past/Present Earth*

- 8.4.4.a Recognize that Earth processes we see today are similar to those that occurred in the past (uniformity of processes)
- 8.4.4.b Describe how environmental conditions have changed through use of the fossil record

# NEBRASKA SCIENCE STANDARDS

## Grades 9-12

### SC 1: INQUIRY, THE NATURE OF SCIENCE, AND TECHNOLOGY

Students will combine scientific processes and knowledge with scientific reasoning and critical thinking to ask questions about phenomena and propose explanations based on gathered evidence.

#### 1.1. Abilities to do Scientific Inquiry

12.1.1 Students will design and conduct investigations that lead to the use of logic and evidence in the formulation of scientific explanations and models.

##### *Scientific Questioning*

12.1.1.a Formulate a testable hypothesis supported by prior knowledge to guide an investigation

##### *Scientific Investigations*

12.1.1.b Design and conduct logical and sequential scientific investigations with repeated trials and apply findings to new investigations

##### *Scientific Controls and Variables*

12.1.1.c Identify and manage variables and constraints

##### *Scientific Tools*

12.1.1.d Select and use lab equipment and technology appropriately and accurately

##### *Scientific Observations*

12.1.1.e Use tools and technology to make detailed qualitative and quantitative observations

##### *Scientific Data Collection*

12.1.1.f Represent and review collected data in a systematic, accurate, and objective manner

##### *Scientific Interpretations, Reflections, and Applications*

12.1.1.g Analyze and interpret data, synthesize ideas, formulate and evaluate models, and clarify concepts and explanations

12.1.1.h Use results to verify or refute a hypothesis

12.1.1.i Propose and/or evaluate possible revisions and alternate explanations

##### *Scientific Communication*

12.1.1.j Share information, procedures, results, conclusions, and defend findings to a scientific community (peers, science fair audience, policy makers)

12.1.1.k Evaluate scientific investigations and offer revisions and new ideas as appropriate

##### *Mathematics*

12.1.1.l Use appropriate mathematics in all aspects of scientific inquiry

#### 1.2. Nature of Science

12.1.2 Students will apply the nature of scientific knowledge to their own investigations and in the evaluation of scientific explanations.

##### *Scientific Knowledge*

12.1.2.a Recognize that scientific explanations must be open to questions, possible modifications, and must be based upon historical and current scientific knowledge

##### *Science and Society*

12.1.2.b Describe how society influences the work of scientists and how science, technology, and current scientific discoveries influence and change society

*Science as a Human Endeavor*

- 12.1.2.c Recognize that the work of science results in incremental advances, almost always building on prior knowledge, in our understanding of the world
- 12.1.2.d Research and describe the difficulties experienced by scientific innovators who had to overcome commonly held beliefs of their times to reach conclusions that we now take for granted

**1.3. Technology**

12.1.3 Students will solve a complex design problem.

*Abilities to do Technical Design*

- 12.1.3.a Propose designs and choose between alternative solutions of a problem
- 12.1.3.b Assess the limits of a technical design
- 12.1.3.c Implement the selected solution
- 12.1.3.d Evaluate the solution and its consequences
- 12.1.3.e Communicate the problem, process, and solution

*Understanding of Technical Design*

- 12.1.3.f Compare and contrast the reasons for the pursuit of science and the pursuit of technology
- 12.1.3.g Explain how science advances with the introduction of new technology
- 12.1.3.h Recognize creativity, imagination, and a good knowledge base are all needed to advance the work of science and engineering

**SC 2: PHYSICAL SCIENCE**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.

**2.1. Matter**

12.2.1 Students will investigate and describe matter in terms of its structure, composition and conservation.

*Properties and Structure of Matter*

- 12.2.1.a Recognize bonding occurs when outer electrons are transferred (ionic) or shared (covalent)

*States of Matter*

- 12.2.1.b Describe the energy transfer associated with phase changes between solids, liquids, and gasses
- 12.2.1.c Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle arrangement, particle motion, and strength of bond between molecules

*Physical and Chemical Changes*

- 12.2.1.d Recognize a large number of chemical reactions involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base) between reacting ions, molecules, or atoms
- 12.2.1.e Identify factors affecting rates of chemical reactions (temperature, particle size, surface area)

*Atomic Structure*

- 12.2.1.f Recognize the charges and relative locations of subatomic particles (neutrons, protons, electrons)
- 12.2.1.g Describe properties of atoms, ions, and isotopes

*Classification of Matter*

- 12.2.1.h Describe the organization of the periodic table of elements with respect to patterns of physical and chemical properties

## 2.2. Force and Motion

12.2.2 Students will investigate and describe the nature of field forces and their interactions with matter.

### *Motion*

12.2.2.a Describe motion with respect to displacement and acceleration

### *Inertia/Newton's 1<sup>st</sup> law*

12.2.2.b Describe how the law of inertia (Newton's 1<sup>st</sup> law) is evident in a real-world event

### *Forces/Newton's 2<sup>nd</sup> law*

12.2.2.c Make predictions based on relationships among net force, mass, and acceleration (Newton's 2<sup>nd</sup> law)

### *Newton's 3<sup>rd</sup> law*

12.2.2.d Recognize that all forces occur in equal and opposite pairs (Newton's 3<sup>rd</sup> law)

12.2.2.e Describe how Newton's 3rd law of motion is evident in a real-world event

### *Universal Forces*

12.2.2.f Describe gravity as a force that each mass exerts on another mass, which is proportional to the masses and the distance between them

12.2.2.g Recognize that an attractive or repulsive electric force exists between two charged particles and that this force is proportional to the magnitude of the charges and the distance between them

## 2.3. Energy

12.2.3 Students will describe and investigate energy systems relating to the conservation and interaction of energy and matter.

### *Sound/Mechanical Waves*

12.2.3.a Describe mechanical wave properties (speed, wavelength, frequency, amplitude) and how waves travel through a medium

12.2.3.b Recognize that the energy in waves can be changed into other forms of energy

### *Light*

12.2.3.c Recognize that light can behave as a wave (diffraction and interference)

### *Heat*

12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)

12.2.3.e Compare and contrast methods of heat transfer and the interaction of heat with matter via conduction, convection, and radiation

### *Electricity/Magnetism*

12.2.3.f Recognize that the production of electromagnetic waves is a result of changes in the motion of charges or by a changing magnetic field

12.2.3.g Compare and contrast segments of the electromagnetic spectrum (radio, micro, infrared, visible, ultraviolet, x-rays, gamma) based on frequency and wavelength

### *Nuclear*

12.2.3.h Recognize that nuclear reactions (fission, fusion, radioactive decay) convert a fraction of the mass of interacting particles into energy, and this amount of energy is much greater than the energy in chemical interactions

### *Conservation*

12.2.3.i Interpret the law of conservation of energy to make predictions for the outcome of an event



*Mechanical Energy*

- 12.2.3.j Identify that all energy can be considered to be either kinetic, potential, or energy contained by a field (e.g. electromagnetic waves)

*Chemical Energy*

- 12.2.3.k Identify endothermic and exothermic reactions

**SC 3: LIFE SCIENCE**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Life Sciences to make connections with the natural and engineered world.

**3.1. Structure and Function of Living Systems**

- 12.3.1 Students will investigate and describe the chemical basis of the growth, development, and maintenance of cells.

*Characteristics of Life*

- 12.3.1.a Identify the complex molecules (carbohydrates, lipids, proteins, nucleic acids) that make up living organisms

*Cellular Composition of Organisms*

- 12.3.1.b Identify the form and function of sub-cellular structures that regulate cellular activities  
12.3.1.c Describe the cellular functions of photosynthesis, respiration, cell division, protein synthesis, transport of materials, and energy capture/release

*Behavior*

- 12.3.1.d Describe how an organism senses changes in its internal or external environment and responds to ensure survival

**3.2. Heredity**

- 12.3.2 Students will describe the molecular basis of reproduction and heredity.

*Inherited Traits*

- 12.3.2.a Identify that information passed from parents to offspring is coded in DNA molecules  
12.3.2.b Describe the basic structure of DNA and its function in genetic inheritance  
12.3.2.c Recognize how mutations could help, harm, or have no effect on individual organisms

*Reproduction*

- 12.3.2.d Describe that sexual reproduction results in a largely predictable, variety of possible gene combinations in the offspring of any two parents

**3.3. Flow of Matter and Energy in Ecosystems**

- 12.3.3 Students will describe, on a molecular level, the cycling of matter and the flow of energy between organisms and their environment.

*Flow of Energy*

- 12.3.3.a Explain how the stability of an ecosystem is increased by biological diversity

*Ecosystems*

- 12.3.3.b Recognize that atoms and molecules cycle among living and nonliving components of the biosphere  
12.3.3.c Explain how distribution and abundance of different organisms in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

*Impact on Ecosystems*

- 12.3.3.d Analyze factors which may influence environmental quality

### **3.4. Biodiversity**

12.3.4 Students will describe the theory of biological evolution.

#### *Biological Adaptations*

12.3.4.a Identify different types of adaptations necessary for survival (morphological, physiological, behavioral)

#### *Biological Evolution*

12.3.4.b Recognize that the concept of biological evolution is a theory which explains the consequence of the interactions of: (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring

12.3.4.c Explain how natural selection provides a scientific explanation of the fossil record and the molecular similarities among the diverse species of living organisms

12.3.4.d Apply the theory of biological evolution to explain diversity of life over time

## **SC 4: EARTH AND SPACE SCIENCES**

Students will integrate and communicate the information, concepts, principles, processes, theories, and models of Earth and Space Sciences to make connections with the natural and engineered world.

### **4.1. Earth in Space**

12.4.1 Students will investigate and describe the known universe.

#### *Objects in the Sky and Universe*

12.4.1.a Describe the formation of the universe using the Big Bang Theory

12.4.1.b Recognize that stars, like the Sun, transform matter into energy by nuclear reactions which leads to the formation of other elements

12.4.1.c Describe stellar evolution

### **4.2. Earth Structures and Processes**

12.4.2 Students will investigate the relationships among Earth's structure, systems, and processes.

#### *Properties of Earth Materials*

12.4.2.a Recognize how Earth materials move through geochemical cycles (carbon, nitrogen, oxygen) resulting in chemical and physical changes in matter

#### *Earth's Processes*

12.4.2.b Describe how heat convection in the mantle propels the plates comprising Earth's surface across the face of the globe (plate tectonics)

#### *Use of Earth Materials*

12.4.2.c Evaluate the impact of human activity and natural causes on Earth's resources (groundwater, rivers, land, fossil fuels)

### **4.3. Energy in Earth's Systems**

12.4.3 Students will investigate and describe the relationships among the sources of energy and their effects on Earth's systems.

#### *Energy Sources*

12.4.3.a Describe how radiation, conduction, and convection transfer heat in Earth's systems

12.4.3.b Identify internal and external sources of heat energy in Earth's systems

12.4.3.c Compare and contrast benefits of renewable and nonrenewable energy sources

#### *Weather and Climate*

12.4.3.d Describe natural influences (Earth's rotation, mountain ranges, oceans, differential heating) on global climate

#### **4.4. Earth's History**

12.4.4 Students will explain the history and evolution of Earth.

##### *Past/Present Earth*

- 12.4.4.a Recognize that in any sequence of sediments or rocks that has not been overturned, the youngest sediments or rocks are at the top of the sequence and the oldest are at the bottom (law of superposition)
- 12.4.4.b Interpret Earth's history by observing rock sequences, using fossils to correlate the sequences at various locations, and using data from radioactive dating methods
- 12.4.4.c Compare and contrast the physical and biological differences of the early Earth with the planet we live on today