SCIENCE

A

Science as Inquiry and Process

A student should understand and be able to apply the processes and applications of scientific inquiry.

A student who meets the content standard should:

1) develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments;
2) develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review; and
3) develop an understanding that culture, local knowledge, history, and interaction with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.

B

Concepts of Physical Science

A student should understand and be able to apply the concepts, models, theories, universal principles, and facts that explain the physical world.

A student who meets the content standard should:

1) develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior;
2) develop an understanding that energy appears in different forms, can be transformed from one form to another, can be transferred or moved from one place or system to another, may be unavailable for use, and is ultimately conserved;
3) develop an understanding of the interactions between matter and energy, including physical, chemical, and nuclear changes, and the effects of these interactions on physical systems; and
4) develop an understanding of motions, forces, their characteristics and relationships, and natural forces and their effects.

C

Concepts of Life Science

A student should understand and be able to apply the concepts, models, theories, facts, evidence, systems, and processes of life science.

A student who meets the content standard should:

1) develop an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution;
2) develop an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms; and
3) develop an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy.

D

Concepts of Earth Science

A student should understand and be able to apply the concepts, processes, theories, models, evidence, and systems of earth and space sciences.

A student who meets the content standard should:

1) develop an understanding of Earth's geochemical cycles;
2) develop an understanding of the origins, ongoing processes, and forces that shape the structure, composition, and physical history of the Earth;
3) develop an understanding of the cyclical changes controlled by energy from the sun and by Earth's position and motion in our solar system; and
4) develop an understanding of the theories regarding the origin and evolution of the universe.

E

Science and Technology

A student should understand the relationships among science, technology, and society.

A student who meets the content standard should:

1) develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events;
2) develop an understanding that solving problems involves different ways of thinking, perspectives, and curiosity that lead to the exploration of multiple paths that are analyzed using scientific, technological, and social merits; and
3) develop an understanding of how scientific discoveries and technological innovations affect and are affected by our lives and cultures

F

Cultural, Social, Personal Perspectives and Science

A student should understand the dynamic relationships among scientific, cultural, social, and personal perspectives.

A student who meets the content standard should:

1) develop an understanding of the interrelationships among individuals, cultures, societies, science, and technology;
2) develop an understanding that some individuals, cultures, and societies use other beliefs and methods in addition to scientific methods to describe and understand the world; and
3) develop an understanding of the importance of recording and validating cultural knowledge.

G

History and Nature of Science

A student should understand the history and nature of science.

A student who meets the content standard should:

1) develop an understanding that historical perspectives of scientific explanations demonstrate that scientific knowledge changes over time, building on prior knowledge;
2) develop an understanding that the advancement of scientific knowledge embraces innovation and requires empirical evidence, repeatable investigations, logical arguments, and critical review in striving for the best possible explanations of the natural world;
3) develop an understanding that scientific knowledge is ongoing and subject to change as new evidence becomes available through experimental and/or observational confirmation(s); and
4) develop an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base.

A1—Science as Inquiry and Process

SA Students develop an understanding of the processes and applications of scientific inquiry.

SA1 Students develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments.

SA2 Students develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.

SA3 Students develop an understanding that culture, local knowledge, history, and interaction with the environment contribute to the development of scientific knowledge, and that local applications provide opportunity for understanding scientific concepts and global issues.

GRADE 9	GRADE 10	GRADE 11
The student demonstrates an understanding of the processes of science by [9] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating* [9] SA1.2 hypothesizing, designing a controlled experiment, making qualitative and quantitative observations, interpreting data, and using this information to communicate conclusions	The student demonstrates an understanding of the processes of science by [10] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating [10] SA1.2 reviewing pertinent literature, hypothesizing, making qualitative and quantitative observations, controlling experimental variables, analyzing data statistically (i.e., mean, median, mode), and using this information to draw conclusions, compare results to others, suggest further experimentation, and apply student's conclusions to other problems (L)	The student demonstrates an understanding of the processes of science by [11] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating* [11] SA1.2 recognizing and analyzing multiple explanations and models, using this information to revise student's own explanation or model if necessary (L)
The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by [9] SA2.1 formulating conclusions that are logical and supported by evidence	The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by [10] SA2.1 examining methodology and conclusions to identify bias and determining if evidence logically supports the conclusions	The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by [11] SA2.1 evaluating the credibility of cited sources when conducting the student's own scientific investigation (L)
		The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by [11] SA3.1 conducting research and communicating results to solve a problem (e.g., fish and game management, building permits, mineral rights, land use policies) (L)

**Same concept at a higher level*

B1—Concepts of Physical Science

SB Students develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.

SB1 Students develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior.

SB2 Students develop an understanding that energy appears in different forms, can be transformed from one form to another, can be transferred or moved from one place or system to another, may be unavailable for use, and is ultimately conserved.

SB3 Students develop an understanding of the interactions between matter and energy, including physical, chemical, and nuclear changes, and the effects of these interactions on physical systems.

SB4 Students develop an understanding of motions, forces, their characteristics and relationships, and natural forces and their effects.

GRADE 9	GRADE 10	GRADE 11
The student demonstrates an understanding of the structure and properties of matter by	The student demonstrates an understanding of the structure and properties of matter by	The student demonstrates an understanding of the structure and properties of matter by
[9] SB1.1 describing atoms and their base components (i.e., protons, neutrons, electrons)	[10] SB1.1 using the periodic table to describe atoms in terms of their base components (i.e., protons, neutrons, electrons)	[11] SB1.1 predicting the properties of an element (i.e., reactivity, metal, non-metal) using the periodic table and verifying the predictions through experimentation (L)
The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by	The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by	The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by
[9] SB2.1 applying the concepts of heat transfer (i.e., conduction, convection, radiation) to Alaskan dwellings [9] SB2.2 recognizing simple electrical circuits	[10] SB2.1 examining energy (i.e., nuclear, electromagnetic, chemical, mechanical, thermal) transfers, transformations, and efficiencies by comparing useful energy to total energy	[11] SB2.1 demonstrating energy (e.g., nuclear, electromagnetic, chemical, mechanical, thermal) transfers and transformations by comparing useful energy to total energy (entropy) (L)
The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by	The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by	The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by
[9] SB3.1 recognizing that a chemical reaction has taken place [9] SB3.2 explaining that in chemical and nuclear reactions, energy (e.g., heat, light, mechanical, and electrical) is transferred into and out of a system [9] SB3.3 recognizing that atoms emit and absorb electromagnetic radiation	[10] SB3.1 describing the behavior of electrons in chemical bonding [10] SB3.2 recognizing that radioactivity is a result of the decay of unstable nuclei [10] SB3.3 comparing the relative wavelengths and applications of different forms of electromagnetic radiation (i.e., x-ray, visible, infrared, microwaves, radio)	[11] SB3.1 predicting how an atom can interact with other atoms based on its electron configuration and verifying the results (L) [11] SB3.2 researching applications of nuclear reactions in which a small amount of matter is converted directly into a huge amount of energy (i.e., $E=MC^2$) (L)

The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by

[9] SB4.1 explaining the relationship of motion to an object's mass and the applied force

[9] SB4.2 recognizing that the gravitational attraction between objects is proportional to their masses and decreasing with their distance

[9] SB4.3 describing the interactions of waves (i.e., reflection, refraction, wave addition)

The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by

[10] SB4.1 recognizing that when one thing exerts a force on another, an equal amount of force is exerted back on it

[10] SB4.2 explaining that different kinds of materials respond to electric and magnetic forces (i.e., conductors, insulators, magnetic, and non-magnetic materials)

The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by

[11] SB4.1 conducting an experiment to demonstrate that when one thing exerts a force on another, an equal amount of force is exerted back on it (L)

[11] SB4.2 conducting an experiment to explore the relationship between magnetic forces and electric forces to show that they can be thought of as different aspects of a single electromagnetic force (e.g., generators and motors) (L)

C1—Concepts of Life Science

SC Students develop an understanding of the concepts, models, theories, facts, evidence, systems, and processes of life science.

SC1 Students develop an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution.

SC2 Students develop an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms.

SC3 Students develop an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy.

GRADE 9

The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by

[9] SC1.1 recognizing that all organisms have chromosomes made of DNA and that DNA determines traits

[9] SC1.2 using probabilities to recognize patterns of inheritance (e.g., Punnett Squares)

[9] SC1.3 inferring evolutionary pathways from evidence (e.g., fossils, geologic samples, recorded history)

GRADE 10

The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by

[10] SC1.2 explaining how the processes of natural selection can cause speciation and extinction

[10] SC1.3 examining issues related to genetics (L)

SC1.1 is not addressed in grade 10.

GRADE 11

The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by

[11] SC1.1 relating the structure of DNA to characteristics of an organism

[11] SC1.2 researching how the processes of natural selection cause changes in species over time (L)

The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by

[9] SC2.1 describing and comparing the characteristics of phyla/divisions from each kingdom

[9] SC2.3 stating the function of major physiological systems (i.e., circulatory, excretory, digestive, respiratory, reproductive, nervous, immune, endocrine, musculoskeletal, and integumentary)

SC2.2 is not addressed in grade 9.

The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by

[10] SC2.1 describing the structure-function relationship (e.g., joints, lungs)

[10] SC2.2 explaining that cells have specialized structures in which chemical reactions occur

[10] SC2.3 explaining the functions of organs of major systems (i.e., respiratory, digestive, circulatory, reproductive, nervous, musculoskeletal, and excretory)

[10] SC2.4 tracing the pathways of the digestive, circulatory, and excretory systems

The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by

[11] SC2.1 describing the structure-function relationship*

[11] SC2.2 describing the learned behaviors (e.g., classical conditioning, imprinting, trial and error) that are utilized by living organisms to meet the requirements of life

[11] SC2.3 describing the functions and interdependencies of the organs within the immune system and within the endocrine system

** Same concept at a higher level*

The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by

[9] SC3.1 describing the carbon and nitrogen cycle within an ecosystem and how the continual input of energy from sunlight keeps the process going (L)

[9] SC3.3 identifying dynamic factors (e.g., carrying capacity, limiting factors, biodiversity, and productivity) that affect population size

SC3.2 is not addressed in grade 9.

The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by

[10] SC3.1 relating the carbon cycle to global climate change

[10] SC3. 2 exploring ecological relationships (e.g., competition, niche, feeding relationships, symbiosis) (L)

The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by

[11] SC3.1 relating the carbon cycle to global climate change*

[11] SC3.2 analyzing the potential impacts of changes (e.g., climate change, habitat loss/gain, cataclysms, human activities) within an ecosystem

** Same concept at a higher level*

D1—Concepts of Earth Science

SD Students develop an understanding of the concepts, processes, theories, models, evidence, and systems of earth and space sciences.

SD1 Students develop an understanding of Earth's geochemical cycles.

SD2 Students develop an understanding of the origins, ongoing processes, and forces that shape the structure, composition, and physical history of the Earth.

SD3 Students develop an understanding of the cyclical changes controlled by energy from the sun and by Earth's position and motion in our solar system.

SD4 Students develop an understanding of the theories regarding the evolution of the universe.

GRADE 9	GRADE 10	GRADE 11
The student demonstrates an understanding of geochemical cycles by	The student demonstrates an understanding of geochemical cycles by	The student demonstrates an understanding of geochemical cycles by
[9] SD1.1 using a model to demonstrate the rock cycle (L)	[10] SD1.1 using a model to explain the processes (i.e., formation, sedimentation, erosion, reformation) of the rock cycle	[11] SD1.1 creating a model to demonstrate the rock cycle (L)
[9] SD1.2 applying knowledge of the water cycle to explain changes in the Earth's surface*	[10] SD1.2 describing their interrelationships (i.e., water cycle, carbon cycle, oxygen cycle)	[11] SD1.2 integrating knowledge of the water cycle and biogeochemical cycling to explain changes in the Earth's surface (L)
The student demonstrates an understanding of the forces that shape Earth by	The student demonstrates an understanding of the forces that shape Earth by	The student demonstrates an understanding of the forces that shape Earth by
[9] SD2.1 recognizing the dynamic interaction of erosion and deposition including human causes	[10] SD2.1 recognizing the dynamic interaction of erosion and deposition including human causes*	[11] SD2.1 recognizing the dynamic interaction of erosion and deposition including human causes*
[9] SD2.2 describing how the theory of plate tectonics explains the dynamic nature of its surface	[10] SD2.2 describing how the theory of plate tectonics explains the dynamic nature of its surface*	[11] SD2.2 describing how the theory of plate tectonics explains the dynamic nature of its surface*
The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by	The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by	The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by
[9] SD3.1 recognizing the effect of the moon and sun on tides	[10] SD3.1 describing causes, effects, preventions, and mitigations of human impact on climate	[11] SD3.1 describing causes, effects, preventions, and mitigations of human impact on climate*
[9] SD3.2 explaining the phenomena of the aurora		[11] SD3.2 exploring causes and effects related to phenomena (e.g., the aurora, solar winds, Coriolis Effect) (L)

** Same concept at a higher level*

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by	The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by	The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by
[9] SD4.1 recognizing that a star changes over time	[10] SD 4.1 recognizing phenomena in the universe (i.e., black holes, nebula)	[11] SD4.1 describing phenomena in the universe (i.e., black holes, nebula)
[9] SD4.2 explaining that the position of stars changes in the expanding universe	[10] SD 4.2 explaining that the position of stars changes in the expanding universe*	[11] SD4.2 using evidence to explain how the position of stars changes in the expanding universe
[9] SD4.4 identifying the Big Bang Theory	[10] SD 4.4 describing the Big Bang Theory	[11] SD4.4 describing the Big Bang Theory and exploring the evidence that supports it (L)

SD4.3 is not continued in 9-11.

** Same concept at a higher level*

E1—Science and Technology

SE Students develop an understanding of the relationships among science, technology, and society.

SE1 Students develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events.

SE2 Students develop an understanding that solving problems involves different ways of thinking, perspectives, and curiosity that lead to the exploration of multiple paths that are analyzed using scientific, technological, and social merits.

SE3 Students develop an understanding of how scientific discoveries and technological innovations affect and are affected by our lives and cultures.

GRADE 9	GRADE 10	GRADE 11
The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by	The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by	The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by
[9] SE1.1 recognizing that the value of any given technology may be different for different groups of people and at different points in time (e.g., different uses of snow machines in different regions of Alaska)	[10] SE1.1 identifying that progress in science and invention is highly interrelated to what else is happening in society	[11] SE1.1 researching how social, economic, and political forces strongly influence which technology will be developed and used (L)
The student demonstrates an understanding that solving problems involves different ways of thinking by	The student demonstrates an understanding that solving problems involves different ways of thinking by	The student demonstrates an understanding that solving problems involves different ways of thinking by
[9] SE2.1 questioning, researching, modeling, simulating, and testing a solution to a problem (L)	[10] SE2.1 questioning, researching, modeling, simulating, and testing multiple solutions to a problem (L)	[11] SE2.1 questioning, researching, modeling, simulating, and testing multiple solutions to a problem* (L)
The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by	The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by	The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by
[9] SE3.1 predicting and evaluating the possible effects of a recent scientific discovery, invention, or scientific breakthrough (L)	[10] SE3.1 researching a current problem, identifying possible solutions, and evaluating the impact of each solution (L)	[11] SE3.1 researching a current problem, identifying possible solutions, and evaluating the impact of each solution* (L)

** Same concept at a higher level*

F1—Cultural, Social, Personal Perspectives, and Science

SF Students develop an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives.

SF1 Students develop an understanding of the interrelationships among individuals, cultures, societies, science, and technology.

SF2 Students develop an understanding that some individuals, cultures, and societies use other beliefs and methods in addition to scientific methods to describe and understand the world.

SF3 Students develop an understanding of the importance of recording and validating cultural knowledge.

GRADE 9

The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by

[9] SF1.1-SF3.1 describing the scientific principles involved in a subsistence activity (e.g., hunting, fishing, gardening) (L). Cross referenced with SA3.1.

GRADE 10

The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by:

[10] SF1.1-SF3.1 analyzing the competition for resources by various user groups to describe these interrelationships. Cross referenced with SA3.1.

GRADE 11

The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by

[11] SF1.1-SF3.1 investigating the influences of societal and/or cultural beliefs on science (L). Cross referenced with SA3.1.

G1—History and Nature of Science

SG Students develop an understanding of the history and nature of science.

SG1 Students develop an understanding that historical perspectives of scientific explanations demonstrate that scientific knowledge changes over time, building on prior knowledge.

SG2 Students develop an understanding that the advancement of scientific knowledge embraces innovation and requires empirical evidence, repeatable investigations, logical arguments, and critical review in striving for the best possible explanations of the natural world.

SG3 Students develop an understanding that scientific knowledge is ongoing and subject to change as new evidence becomes available through experimental and/or observational confirmation(s).

SG4 Students develop an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base.

GRADE 9	GRADE 10	GRADE 11
The student demonstrates an understanding of changes in historical perspectives of science by [9] SG1.1 identifying those perspectives (i.e., cultural, political, religious, philosophical) that have impacted the advancement of science	The student demonstrates an understanding of changes in historical perspectives of science by [10] SG1.1 describing how those perspectives (i.e., cultural, political, religious, philosophical) have impacted the advancement of science	
The student demonstrates an understanding of the bases of the advancement of scientific knowledge by [9] SG2.1 explaining the importance of innovations (i.e., microscope, immunization, computer)	The student demonstrates an understanding of the bases of the advancement of scientific knowledge by [10] SG2.1 using an account of an event to recognize the processes of science used by historically significant scientists (e.g., Goodall, Watson & Crick, Newton)	The student demonstrates an understanding of the bases of the advancement of scientific knowledge by [11] SG2.1 describing the importance of logical arguments (i.e., thought experiments by Einstein, Hawking, Newton)
The student demonstrates an understanding that scientific knowledge is ongoing and subject to change by [9] SG3.1 describing the role of serendipity in scientific discoveries	The student demonstrates an understanding that scientific knowledge is ongoing and subject to change by [10] SG3.1 using experimental or observational data to evaluate a hypothesis	The student demonstrates an understanding that scientific knowledge is ongoing and subject to change by [11] SG3.1 investigating instances when scientists' observations were not in accord with prevailing ideas of the time (L)
	The student demonstrates an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base by [10] SG4.1 recognizing the role of these factors on scientific advancements	