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# Introduction to Science Performance Standards

(Grade Level Expectations)

The Alaska Science Performance Standards/Grade Level Expectations (PSGLEs) have been developed for grades 3 through 11 in fulfillment of the No Child Left Behind Act of 2001 (NCLB) requirements.

This document is intended to provide a road map for the development of assessment items as well as the basis upon which school districts refine, align, and develop their science curriculum. The content described by the PSGLEs does not represent the entire science curriculum for a grade or course. Nor does it represent the final word on the science content that is presented since one of the basic understandings in science is that our knowledge continues to grow and change as we gather more evidence about a subject. The PSGLEs indicate core content to be mastered by the end of a given grade. Science content can be added and enriched as appropriate for a district program, school, or student. It may be necessary to introduce some skills at an earlier grade in order for students to achieve mastery at a given level. Similarly, skills will need to be maintained after mastery has occurred at a given grade level.

The Alaska Science PSGLEs are aligned to the Alaska Science Content Standards. The Content Standards were revised in 2003 to align with the National Science Education Standards. Participants in the development of the PSGLEs actively researched the concepts and skills contained within this document.

## References

National Research Council (U.S.). (1996). *National Science Education Standards: Observe, interact, change, learn*. Washington, DC: National Academy Press.

Project 2061 (American Association for the Advancement of Science). (2001). *Atlas of science literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

# SCIENCE PERFORMANCE STANDARDS (Grade Level Expectations)

The Science Content Standards are grouped into seven strands, A-1 through G-1.

Each PSGLE includes a bolded statement called the “stem.” Each stem is the same or similar across the grades for a given PSGLE and is meant to communicate the main curriculum and instructional focus of the PSGLE across the grades.

The number in brackets indicates the grade level.

A1—Science as Inquiry and Process		
GR ADE 3	GR ADE 4	GR ADE 5
<p><b>The student demonstrates an understanding of the processes of science by</b></p> <p>[3] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating</p> <p>[3] SA1.2 observing and describing their world to answer simple questions</p>	<p><b>The student demonstrates an understanding of the processes of science by</b></p> <p>[4] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[4] SA1.2 observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate</p>	<p><b>The student demonstrates an understanding of the processes of science by</b></p> <p>[5] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[5] SA1.2 using quantitative and qualitative observations to create their own inferences and predictions</p>
<p><b>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</b></p> <p>[3] SA2.1 answering “how do you know?” questions with reasonable answers</p>	<p><b>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</b></p> <p>[4] SA2.1 supporting their ideas with observations and peer review (L)</p>	<p><b>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</b></p> <p>[5] SA2.1 supporting their <u>statements with facts from a variety of resources and by identifying their sources</u> (L)</p>
<p><b>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</b></p> <p>[3] SA3.1 observing local conditions that determine which plants and/or animals survive (L)</p>	<p><b>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</b></p> <p>[4] SA3.1 identifying the local limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive (L)</p>	<p><b>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</b></p> <p>[5] SA3.1 <u>identifying the limiting factors</u> (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive</p>

PSGLEs repeated with no changes across grade levels are marked with asterisks to indicate that the PSGLE assumes increasing complexity to indicate growth in the PSGLE.

Note: Items differentiated with an “i.e.” indicate that statewide assessment items may be written only to the content contained within the statement in the parentheses. Items differentiated with an “e.g.” do not limit assessment items to that content, but indicate examples of content that may be used in statewide assessment items.

Some PSGLEs have been identified as Local. They are for local assessment and will not be on a state assessment.

The number indicates the Content Standard and the Grade Level Expectation number; thus PSGLE [4] SA3.1 represents Content Standard SA3, and the first PSGLE for that Content Standard for grade 4.

Differences between grade levels are underlined.

Participants in the development of the PSGLEs actively researched the concepts and skills contained within this document.

**References**

National Research Council (U.S.). (1996). *National Science Education Standards: Observe, interact, change, learn*. Washington, DC: National Academy Press.

Project 2061 (American Association for the Advancement of Science). (2001). *Atlas of science literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

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 3	GRADE 4	GRADE 5
<p>The student demonstrates an understanding of the processes of science by</p> <p>[3] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating</p> <p>[3] SA1.2 observing and describing the student’s own world to answer simple questions</p>	<p>The student demonstrates an understanding of the processes of science by</p> <p>[4] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[4] SA1.2 observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate</p>	<p>The student demonstrates an understanding of the processes of science by</p> <p>[5] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[5] SA1.2 using quantitative and qualitative observations to create inferences and predictions</p>
<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[3] SA2.1 answering “how do you know?” questions with reasonable answers</p>	<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[4] SA2.1 supporting the student’s own ideas with observations and peer review (L)</p>	<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[5] SA2.1 supporting the student’s own <u>statements with facts from a variety of resources and by identifying their sources</u> (L)</p>
<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[3] SA3.1 observing local conditions that determine which plants and/or animals survive (L)</p>	<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[4] SA3.1 identifying the local limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive (L)</p>	<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[5] SA3.1 <u>identifying the limiting factors</u> (e.g., weather, human influence, species interactions) that determine which plants and/or animals survive</p>

\* 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 3	GRADE 4	GRADE 5
<p>The student demonstrates an understanding of the structure and properties of matter by</p> <p>[3] SB1.1 classifying matter according to physical properties (i.e., color, size, shape, weight, texture, flexibility)</p>	<p>The student demonstrates an understanding of the structure and properties of matter by</p> <p>[4] SB1.1 identifying and comparing the characteristics of gases, liquids, and solids</p>	<p>The student demonstrates an understanding of the structure and properties of matter by</p> <p>[5] SB1.1 comparing models that represent matter as solids, liquids, or gases and the changes from one state to another (L)</p>
<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[3] SB2.1 classifying materials as insulators or conductors (i.e., fur, metal, wood, plastic) and identifying their applications</p>	<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[4] SB2.1 investigating the effectiveness of different insulating and conducting materials with respect to heat flow and record the results (L)</p>	<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[5] SB2.1 classifying the changes (i.e., heat, light, sound, and motion) that electrical energy undergoes in common household appliances (i.e., toaster, blender, radio, light bulb, heater)</p>
<p>The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[3] SB3.1 recognizing that temperature changes cause changes in phases of substances (e.g., ice changing to liquid, water changing to water vapor, and vice versa)</p>	<p>The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[4] SB3.1 <u>explaining</u> that temperature changes cause changes in phases of substances (e.g., ice changing to liquid water and liquid water to water vapor)</p>	<p>The student demonstrates understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[5] SB3.1 identifying physical and chemical changes based on observable characteristics (e.g., tearing paper vs. burning paper)</p>
<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[3] SB4.2 recognizing that objects can be moved without being touched (e.g., using magnets, falling objects, static electricity)</p>	<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[4] SB4.1 simulating that changes in speed or direction of motion are caused by forces (L)</p>	<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[5] SB4.1 investigating that the greater the force acting on an object, the greater the change in motion will be (L)</p>

SB4.1 is not addressed until grade 4.

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 3	GRADE 4	GRADE 5
<p>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</p> <ul style="list-style-type: none"> <li>[3] SC1.1 sorting Alaskan plants and/or animals using physical characteristics (e.g., leaves, beaks) (L)</li> <li>[3] SC1.2 describing how some traits (e.g., claws, teeth, camouflage) of living organisms have helped them survive as a species</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[4] SC1.1 showing the relationship between physical characteristics of Alaskan organisms and the environment in which they live</li> <li>[4] SC1.2 describing fossil evidence (e.g., casts, track ways, imprints, etc.) of extinct organisms</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[5] SC1.1 contrasting inherited traits (e.g., flower color, number of limbs) with those that are not (riding a bike, scar from an accident)</li> <li>[5] SC1.2 making reasonable inferences about fossil organisms based on physical evidence</li> </ul>
<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[3] SC2.1 sorting animals and plants into groups based on appearance and behaviors</li> <li>[3] SC2.2 observing and comparing external features of plants and of animals that may help them grow, survive, and reproduce</li> </ul>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[4] SC2.1 choosing appropriate tools (i.e., hand lens, microscopes, ruler, balance) to examine the basic structural components (e.g., stems, leaves, fish scales, wings) of living things</li> <li>[4] SC2.2 describing the basic characteristics and requirements of living things</li> </ul>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[5] SC2.1 identifying and sorting animals into groups using basic external and internal features</li> <li>[5] SC2.2 explaining how external features and internal systems (i.e., respiratory, excretory, skeletal, circulatory, and digestive) of plants and animals may help them grow, survive, and reproduce</li> <li>[5] SC2.3 recognizing that organisms are composed of cells</li> </ul>
<p>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</p> <ul style="list-style-type: none"> <li>[3] SC3.1 identifying and sorting examples of living and non-living things in the local environment (L)</li> <li>[3] SC3.2 organizing a simple food chain of familiar plants and animals (L)</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[4] SC3.1 identifying examples of living and non-living things <u>and the relationship between them</u> (e.g., living things need water, herbivores need plants)</li> <li>[4] SC3.2 <u>identifying</u> a simple food chain of familiar plants and animals, diagramming how energy flows through it; describing the effects of removing one link</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[5] SC3.1 diagramming how matter and energy are transferred within and between living and nonliving things</li> <li>[5] SC3.2 <u>organizing</u> a simple food chain of familiar plants and animals <u>that traces the source of the energy back to sunlight</u></li> </ul>

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 3	GRADE 4	GRADE 5
<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[3] SD1.1 recognizing that most rocks are composed of combinations of different substances</li> <li>[3] SD1.2 describing the water cycle to show that water circulates through the crust, oceans, and atmosphere of Earth</li> </ul>	<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[4] SD1.1 describing that most smaller rocks come from the breaking and weathering of larger rocks as part of the rock cycle</li> <li>[4] SD1.2 recognizing the physical properties of water as they relate to the rock cycle</li> </ul>	<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[5] SD1.1 <u>observing a model of the rock cycle</u> showing that smaller rocks come from the breaking and weathering of larger rocks <u>and that smaller rocks (e.g., sediments and sands) may combine with plant materials to form soils</u> (L)</li> </ul>
<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[3] SD2.1 identifying and comparing a variety of Earth’s land features (i.e., rivers, deltas, lakes, glaciers, mountains, valleys, and islands)</li> </ul>	<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[4] SD2.1 observing models of how waves, wind, water, and ice shape and reshape the Earth’s surface by eroding rock and soil (L)</li> <li>[4] SD2.2 identifying causes (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, and avalanches) of rapid changes on the surface</li> </ul>	<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[5] SD2.1 <u>describing</u> how wind and water tear down and <u>build up</u> the Earth’s surface <u>resulting in new land formations (i.e., deltas, moraines, and canyons)</u></li> </ul>
<p>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</p> <ul style="list-style-type: none"> <li>[3] SD3.1 using recorded weather patterns (e.g., temperature, cloud cover, or precipitation) to make reasonable predictions (L)</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[4] SD3.1 recognizing changes to length of daylight over time and its relationship to seasons</li> <li>[4] SD3.2 observing that heat flows from one object to another (L)</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[5] SD3.1 observing a model that shows how the regular and predictable motion of the Earth and moon determine the apparent shape (phases) of the moon over time (L)</li> <li>[5] SD3.2 comparing heat absorption and loss by land and water</li> </ul>

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The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[3] SD4.1 recognizing that objects appear smaller the farther away they are

[3] SD4.2 recognizing that objects have properties, locations, and movements that can be observed and described

[3] SD4.3 recognizing and using appropriate instruments of magnification (e.g., binoculars and telescopes) (L)

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[4] SD4.1 recognizing that stars are like the sun but are so far away that they look like points of light

[4] SD4.2 recognizing that objects have properties, locations, and movements that can be observed and described\*

[4] SD4.3 recognizing and using appropriate instruments of magnification (e.g., binoculars and telescopes)\* (L)

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[5] SD4.1 distinguishing among stars, planets, moons, comets, and meteors (L)

[5] SD4.2 recognizing that the Earth is in regular and predictable motion and this motion explains the length of a day and a year

[5] SD4.3 recognizing and using appropriate instruments of magnification (e.g., binoculars and telescopes)\* (L)

\* *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 3	GRADE 4	GRADE 5
<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[3] SE1.1 identifying local problems and discussing solutions (L)</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[4] SE1.1 recognizing that tools (e.g., spear, hammer, hand lens, kayak, computer) and processes (e.g., drying fish, sewing, photography) are an important part of human cultures</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[5] SE1.1 identifying a community problem or issue and describing the information needed to develop a scientific solution (L)</p>
<p>The student demonstrates an understanding that solving problems involves different ways of thinking, perspectives, and curiosity by</p> <p>[3] SE2.1 identifying local tools and materials used in everyday life (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking, perspectives, and curiosity by</p> <p>[4] SE2.1 identifying the function of a variety of tools (e.g., spear, hammer, hand lens, kayak, computer)</p> <p>[4] SE2.2 identifying multiple explanations (e.g., oral traditions, folklore, scientific theory) of everyday events (e.g., weather, seasonal changes) (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking, perspectives, and curiosity by</p> <p>[5] SE2.1 investigating a problem or project over a specified period of time and identifying the tools and processes used in that project (L)</p> <p>[5] SE2.2 <u>comparing</u> multiple explanations (e.g., oral traditions, folklore, scientific theory) of everyday events (e.g., weather, seasonal changes) (L)</p>
<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[3] SE3.1 listing the positive and negative effects of a single technological development in the local community (e.g., fish trap, fish wheel, four-wheeler, computer) (L)</p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[4] SE3.1 listing the positive and negative effects of a <u>scientific</u> discovery</p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[5] SE3.1 describing the various effects of an innovation (e.g., snow machines, airplanes, immunizations) on the safety, health, and environment of the local community (L)</p>



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 3	GRADE 4	GRADE 5
<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[3] SF1.1-SF3.1 exploring local or traditional stories that explain a natural event (L) Cross referenced with SA3.1.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[4] SF1.1-SF3.1 <u>connecting observations of nature to a local or traditional story</u> that explains a natural event (e.g., <u>animal adaptation, weather, rapid changes to Earth’s surface</u>) (L) Cross referenced with SA3.1.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[5] SF1.1-SF3.1 <u>telling a</u> local or traditional story that explains a natural event (e.g., animal adaptation, weather, rapid changes to Earth’s surface) and <u>relating it to a scientific explanation</u>*(L) Cross referenced with SA3.1.</p>

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 3	GRADE 4	GRADE 5
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[3] SG 1.1**	[4] SG 1.1**	[5] SG 1.1**
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GRADE 3	GRADE 4	GRADE 5
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<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[3] SG2.1 comparing the results of multiple observations of a single local event (L)</p>	<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[4] SG2.1 recognizing the need for repeated measurements</p>	<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[5] SG2.1 reviewing and recording results of investigations into the natural world</p>
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GRADE 3	GRADE 4	GRADE 5
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[3] SG 3.1**	[4] SG 3.1**	[5] SG 3.1**
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GRADE 3	GRADE 4	GRADE 5
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<p>The student demonstrates an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base by</p> <p>[3] SG4.1 asking questions about the natural world</p>	<p>The student demonstrates an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base by</p> <p>[4] SG4.1 using an account of a discovery to recognize that an individual's (e.g., George Washington Carver, Marie Curie) curiosity led to advancements in science</p>	<p>The student demonstrates an understanding that advancements in science depend on curiosity, creativity, imagination, and a broad knowledge base by</p> <p>[5] SG4.1 <u>investigating that scientists' curiosity</u> led to advancements in science (L)</p>
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\*\*“Most of the historical benchmarks do not appear until high school.” (Project 2061 [American Association for the Advancement of Science], 2001, p. 129)

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 6	GRADE 7	GRADE 8
<p>The student demonstrates an understanding of the processes of science by</p> <p>[6] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[6] SA1.2 collaborating to design and conduct simple repeatable investigations (L)</p>	<p>The student demonstrates an understanding of the processes of science by</p> <p>[7] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[7] SA1.2 collaborating to design and conduct simple repeatable investigations, <u>in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings</u> (L)</p>	<p>The student demonstrates an understanding of the processes of science by</p> <p>[8] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*</p> <p>[8] SA1.2 collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings (L)*</p>
<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[6] SA2.1 identifying and differentiating fact from opinion</p>	<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[7] SA2.1 identifying and <u>evaluating</u> the sources used to support scientific statements</p>	<p>The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by</p> <p>[8] SA2.1 recognizing and analyzing differing scientific explanations and models</p>
<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[6] SA3.1 gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion) (L)</p>	<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[7] SA3.1 designing and conducting a simple investigation about the local environment (L)</p>	<p>The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by</p> <p>[8] SA3.1 <u>conducting research</u> to learn how the local environment is <u>used by a variety of competing interests</u> (e.g., <u>competition for habitat/resources, tourism, oil and mining companies, hunting groups</u>) (L)</p>

\* 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 6	GRADE 7	GRADE 8
<p>The student demonstrates understanding of the structure and properties of matter by</p> <p>[6] SB1.1 <u>using</u> models to represent matter as it changes from one state to another</p>	<p>The student demonstrates understanding of the structure and properties of matter by</p> <p>[7] SB1.1 using physical properties (i.e., density, boiling point, freezing point, conductivity) to differentiate among and/or separate materials (i.e., elements, compounds, and mixtures)</p>	<p>The student demonstrates an understanding of the structure and properties of matter by</p> <p>[8] SB1.1 using physical and <u>chemical</u> properties (i.e., density, boiling point, freezing point, conductivity, <u>flammability</u>) to differentiate among materials (i.e., elements, compounds, and mixtures)</p>
<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[6] SB2.1 recognizing that energy can exist in many forms (i.e., heat, light, chemical, electrical, mechanical)</p>	<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[7] SB2.1 <u>explaining</u> that energy (i.e., heat, light, chemical, electrical, mechanical) <u>can change</u> form</p>	<p>The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by</p> <p>[8] SB2.1 identifying the initial source and resulting change in forms of energy in common phenomena (e.g., sun to tree to wood to stove to cabin heat)</p>
<p>The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[6] SB3.1 recognizing that most substances can exist as a solid, liquid, or gas depending on temperature</p>	<p>The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[7] SB3.1 recognizing that most substances can exist as a solid, liquid, or gas depending <u>on the motion of their particles</u></p>	<p>The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by</p> <p>[8] SB3.1 exploring changes of state with increase or decrease of particle speed associated with heat transfer (L)</p> <p>[8] SB3.2 exploring through a variety of models (e.g., gumdrops and toothpicks) how atoms may bond together into well defined molecules or bond together in large arrays (L)</p>
<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[6] SB4.2 stating that every object exerts gravitational force on every other object</p> <p>[6] SB4.3 making waves move through a variety of media (L)</p> <p><i>SB4.1 is not addressed in grade 6.</i></p>	<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[7] SB4.1 illustrating that unbalanced forces will cause an object to accelerate</p> <p>[7] SB4.2 recognizing that electric currents and magnets can exert a force on each other</p> <p>[7] SB4.3 describing the characteristics of a wave (i.e., amplitude, wavelength, and frequency)</p>	<p>The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by</p> <p>[8] SB4.1 demonstrating (L) and explaining circular motion</p> <p>[8] SB4.2 describing the interactions between charges</p>

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 6	GRADE 7	GRADE 8
<p>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</p> <ul style="list-style-type: none"> <li>[6] SC1.1 recognizing sexual and asexual reproduction</li> <li>[6] SC1.2 recognizing that species survive by adapting to changes in their environment</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[7] SC1.1 <u>comparing and contrasting</u> sexual and asexual reproduction</li> <li>[7] SC1.2 describing possible outcomes of mutations (i.e., no effect, damage, benefit)</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[8] SC1.1 describing the role of genes in sexual reproduction (i.e., traits of the offspring)</li> </ul>
<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[6] SC2.1 using a <u>dichotomous key</u> to <u>classify</u> animals <u>and plants</u> into groups using external or internal features</li> <li>[6] SC2.2 identifying basic behaviors (e.g., migration, communication, hibernation) used by organisms to meet the requirements of life</li> <li>[6] SC2.3 describing the levels of organization within a human body (i.e., cells, tissues, organs, systems)</li> </ul>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[7] SC2.1 describing the basic structure and function of plant and animal cells</li> <li>[7] SC2.2 identifying <u>the seven levels of classification</u> of organisms</li> <li>[7] SC2.3 identifying and describing the functions of human organs (i.e., heart, lungs, brain)</li> </ul>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <ul style="list-style-type: none"> <li>[8] SC2.1 placing vertebrates into correct classes of taxonomy based on external, observable features</li> <li>[8] SC2.2 explaining that most organisms utilize inherited and learned behaviors to meet the basic requirements of life</li> <li>[8] SC2.3 describing the functions and interdependence of human body systems (i.e., circulatory, respiratory, nervous)</li> </ul>
<p>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</p> <ul style="list-style-type: none"> <li>[6] SC3.1 recognizing that organisms can cause physical and chemical changes (e.g., digestion, growth, respiration, photosynthesis) to matter and recognizing the importance of energy transfer in these changes</li> <li>[6] SC3.2 organizing a food <u>web</u> using familiar plants and animals</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[7] SC3.1 recognizing <u>and explaining</u> that organisms can cause physical and chemical changes (e.g., digestion, growth, respiration, photosynthesis) to matter and recognizing <u>and explaining</u> the importance of energy transfer in these changes</li> <li>[7] SC3.2 <u>classifying organisms</u> within a food web as <u>producers, consumers, or decomposers</u></li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[8] SC3.1 stating that energy flows and that matter cycles but is conserved within an ecosystem</li> <li>[8] SC3.2 <u>organizing</u> a food web that shows the <u>cycling matter</u></li> </ul>

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 6	GRADE 7	GRADE 8
<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[6] SD1.1 exploring the rock cycle and its relationship to igneous, metamorphic, and sedimentary rocks (L)</li> <li>[6] SD1.2 identifying the physical properties of water within the stages of the water cycle</li> </ul>	<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[7] SD1.1 <u>describing</u> the rock cycle and its relationship to igneous, metamorphic, and sedimentary rocks</li> <li>[7] SD1.2 explaining the water cycle’s connection to changes in the Earth’s surface</li> </ul>	<p>The student demonstrates an understanding of geochemical cycles by</p> <ul style="list-style-type: none"> <li>[8] SD1.1 making connections between components of the locally observable geologic environment and the rock cycle (L)</li> <li>[8] SD1.2 <u>applying knowledge of the water cycle</u> to explain changes in the Earth’s surface</li> </ul>
<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[6] SD2.1 describing the formation and composition (i.e., sand, silt, clay, organics) of soils</li> <li>[6] SD2.2 identifying and describing its layers (i.e., crust, mantle, core)</li> <li>[6] SD2.3 describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches)</li> </ul>	<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[7] SD2.1 identifying strategies (e.g., reforestation, dikes, wind breaks, off road activity guidelines) for minimizing erosion</li> <li>[7] SD2.2 describing how the movement of the tectonic plates results in both slow changes (e.g., formation of mountains, ocean floors, and basins) and short-term events (e.g., volcanic eruptions, seismic waves, and earthquakes) on the surface</li> </ul>	<p>The student demonstrates an understanding of the forces that shape Earth by</p> <ul style="list-style-type: none"> <li>[8] SD2.1 interpreting topographical maps to identify features (i.e., rivers, lakes, mountains, valleys, islands, and tundra)</li> <li>[8] SD2.2 using models to show the relationship between convection currents within the mantle and the large-scale movement of the surface (L)</li> </ul>
<p>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</p> <ul style="list-style-type: none"> <li>[6] SD3.1 connecting the water cycle to weather phenomena</li> <li>[6] SD3.2 identifying that energy transfer is affected by surface conditions (e.g., snow cover, asphalt, vegetation) and that this affects weather</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[7] SD3.1 describing the weather using accepted meteorological terms (e.g., pressure systems, fronts, precipitation)</li> <li>[7] SD3.2 recognizing the relationship between phase changes (i.e., sublimation, condensation, evaporation) and energy transfer</li> </ul>	<p>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</p> <ul style="list-style-type: none"> <li>[8] SD3.1 recognizing the relationship between the seasons and Earth’s tilt relative to the sun and describing the day/night cycle as caused by the rotation of the Earth every 24 hours</li> <li>[8] SD3.2 recognizing types of energy transfer (convection, conduction, and radiation) and how they affect weather</li> </ul>

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The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[6] SD4.1 contrasting characteristics of planets and stars (i.e., light reflecting, light emitting, orbiting, orbited, composition)

[6] SD4.2 defining a light year

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[7] SD4.1 comparing and contrasting characteristics of planets and stars (i.e., light reflecting, light emitting, orbiting, orbited, composition)

[7] SD4.2 using light years to describe distances between objects in the universe

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

[8] SD4.1 creating models of the solar system illustrating size, location/position, composition, moons/rings, and conditions (L)

[8] SD4.2 comparing the brightness of a star to its distance and size

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 6	GRADE 7	GRADE 8
<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[6] SE1.1 recognizing that technology cannot always provide successful solutions for problems or fulfill every human need</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[7] SE1.1 describing how public policy affects the student’s life (e.g., public waste disposal) (L)</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[8] SE1.1 describing how public policy affects the student’s life and <u>participating diplomatically in evidence-based discussions</u> relating to the student’s community (L)</p>
<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[6] SE2.1 identifying and designing a solution to a problem</p> <p>[6] SE2.2 comparing the student’s work to the work of peers in order to identify multiple paths that can be used to investigate a question or problem (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[7] SE2.1 identifying, designing, <u>testing, and revising solutions</u> to a <u>local</u> problem (L)</p> <p>[7] SE2.2 comparing the student’s work to the work of peers in order to identify multiple paths that can be used to investigate a question or problem* (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[8] SE2.1 identifying, designing, testing, and revising solutions to a local problem* (L)</p> <p>[8] SE2.2 comparing the student’s work to the work of peers in order to identify multiple paths that can be used to investigate <u>and evaluate potential solutions</u> to a question or problem (L)</p>
<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[6] SE3.1 describing the various effects of an innovation on a <u>global level</u></p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[7] SE3.1 recognizing the effects of a past scientific discovery, invention, or scientific breakthrough (e.g., DDT, internal combustion engine)</p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[8] SE3.1 <u>predicting the possible effects of a recent</u> scientific discovery, invention, or scientific breakthrough (L)</p>

\* 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 6	GRADE 7	GRADE 8
<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[6] SF1.1-SF3.1 telling a local or traditional story that explains a natural event (e.g., animal adaptation, weather, rapid changes to Earth’s surface) and relating it to a scientific explanation* (L). Cross referenced with SA3.1.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[7] SF1.1-SF3.1 investigating the basis of local knowledge (e.g., describing and predicting weather) and sharing that information (L). Cross referenced with SA3.1.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[8] SF1.1-SF3.1 <u>describing</u> how local knowledge, <u>culture</u>, <u>and the technologies of various activities (e.g., hunting, fishing, subsistence) influence the development of scientific knowledge</u> (L). Cross referenced with SA3.1.</p>

\* Same concept at a higher level

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 6	GRADE 7	GRADE 8
<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[6] SG1.1**</p> <p>[6] SG2.1 recognizing differences in results of repeated experiments</p>	<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[7] SG1.1**</p> <p>[7] SG2.1 <u>explaining</u> differences in results of repeated experiments</p>	<p>The student demonstrates an understanding of the bases of the advancement of scientific knowledge by</p> <p>[8] SG1.1**</p> <p>[8] SG2.1 <u>describing</u> how repeating experiments improves the likelihood of accurate results</p>
<p>See [6] SE 3.1</p>	<p>The student demonstrates an understanding that scientific knowledge is ongoing and subject to change by</p> <p>[7] SG3.1 revising a personal idea when presented with experimental/observational data inconsistent with that personal idea (e.g., the rates of falling bodies of different masses) (L)</p>	<p>The student demonstrates an understanding that scientific knowledge is ongoing and subject to change by</p> <p>[8] SG3.1 revising a personal idea when presented with experimental/observational data inconsistent with that personal idea (e.g., the rates of falling bodies of different masses)* (L)</p>
<p>[6] SG4.1**</p>	<p>[7] SG4.1**</p>	<p>[8] SG4.1**</p>

\* Same concept at a higher level

\*\*“Most of the historical benchmarks do not appear until high school.” (Project 2061 [American Association for the Advancement of Science], 2001, p. 129)

Project 2061 (American Association for the Advancement of Science). (2001). *Atlas of science literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

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

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

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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	GRADE 10	GRADE 11
<p>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</p> <p>[9] SC1.1 recognizing that all organisms have chromosomes made of DNA and that DNA determines traits</p> <p>[9] SC1.2 using probabilities to recognize patterns of inheritance (e.g., Punnett Squares)</p> <p>[9] SC1.3 inferring evolutionary pathways from evidence (e.g., fossils, geologic samples, recorded history)</p>	<p>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</p> <p>[10] SC1.2 explaining how the processes of natural selection can cause speciation and extinction</p> <p>[10] SC1.3 examining issues related to genetics (L)</p> <p><i>SC1.1 is not addressed in grade 10.</i></p>	<p>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</p> <p>[11] SC1.1 relating the structure of DNA to characteristics of an organism</p> <p>[11] SC1.2 researching how the processes of natural selection cause changes in species over time (L)</p>
<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <p>[9] SC2.1 describing and comparing the characteristics of phyla/divisions from each kingdom</p> <p>[9] SC2.3 stating the function of major physiological systems (i.e., circulatory, excretory, digestive, respiratory, reproductive, nervous, immune, endocrine, musculoskeletal, and integumentary)</p> <p><i>SC2.2 is not addressed in grade 9.</i></p>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <p>[10] SC2.1 describing the structure-function relationship (e.g., joints, lungs)</p> <p>[10] SC2.2 explaining that cells have specialized structures in which chemical reactions occur</p> <p>[10] SC2.3 explaining the functions of organs of major systems (i.e., respiratory, digestive, circulatory, reproductive, nervous, musculoskeletal, and excretory)</p> <p>[10] SC2.4 tracing the pathways of the digestive, circulatory, and excretory systems</p>	<p>The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by</p> <p>[11] SC2.1 describing the structure-function relationship*</p> <p>[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</p> <p>[11] SC2.3 describing the functions and interdependencies of the organs within the immune system and within the endocrine system</p>

\* Same concept at a higher level

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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.*

*\* 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

[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

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

\* Same concept at a higher level



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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
- [9] SD4.2 explaining that the position of stars changes in the expanding universe
- [9] SD4.4 identifying the Big Bang Theory

*SD4.3 is not continued in 9-11.*

*\* Same concept at a higher level*

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

- [10] SD 4.1 recognizing phenomena in the universe (i.e., black holes, nebula)
- [10] SD 4.2 explaining that the position of stars changes in the expanding universe\*
- [10] SD 4.4 describing the Big Bang Theory

The student demonstrates an understanding of the theories regarding the origin and evolution of the universe by

- [11] SD4.1 describing phenomena in the universe (i.e., black holes, nebula)
- [11] SD4.2 using evidence to explain how the position of stars changes in the expanding universe
- [11] SD4.4 describing the Big Bang Theory and exploring the evidence that supports it (L)

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
<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[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)</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[10] SE1.1 identifying that progress in science and invention is highly interrelated to what else is happening in society</p>	<p>The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by</p> <p>[11] SE1.1 researching how social, economic, and political forces strongly influence which technology will be developed and used (L)</p>
<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[9] SE2.1 <u>questioning, researching, modeling, simulating,</u> and testing a solution to a problem (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[10] SE2.1 questioning, researching, modeling, simulating, and testing <u>multiple solutions</u> to a problem (L)</p>	<p>The student demonstrates an understanding that solving problems involves different ways of thinking by</p> <p>[11] SE2.1 questioning, researching, modeling, simulating, and testing multiple solutions to a problem* (L)</p>
<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[9] SE3.1 predicting <u>and evaluating</u> the possible effects of a recent scientific discovery, invention, or scientific breakthrough (L)</p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[10] SE3.1 researching a current problem, identifying possible solutions, and evaluating the impact of each solution (L)</p>	<p>The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by</p> <p>[11] SE3.1 researching a current problem, identifying possible solutions, and evaluating the impact of each solution* (L)</p>

\* 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	GRADE 10	GRADE 11
<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[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.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by:</p> <p>[10] SF1.1-SF3.1 analyzing the competition for resources by various user groups to describe these interrelationships. Cross referenced with SA3.1.</p>	<p>The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by</p> <p>[11] SF1.1-SF3.1 investigating the influences of societal and/or cultural beliefs on science (L). Cross referenced with SA3.1.</p>

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