New Jersey
Student Learning Assessment—Science
(NJSLA–S)

Threshold Performance Level Descriptors (PLDs)

Grades 5, 8, and 11

2019

February 2023

State of New Jersey
Department of Education

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Grade 5 Threshold Performance Level Descriptors (Physical Science)
Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
PS3: Energy	• that differences in the movement of energy can cause objects to move at different speeds • that energy in various forms can be transferred from place to place • that energy is transferred when objects collide • that energy can be converted into forms for practical use	• that energy can move from place to place in different forms with varying levels of magnitude • that effects of transferred energy are observable • of the relationship between the transfer of energy and the change in motion when objects collide • that there is a relationship between energy and its conversion for practical uses	• that predictions can be made regarding the interactions of objects based on the amount of energy the objects possess • of the transformation from one type of energy to other type(s) of energy • that when objects collide, there are predictable outcomes • that stored energy is converted energy from the Sun

Grade 5 Threshold Performance Level Descriptors (Physical Science)
Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
PS4: Waves and Their Applications in Technologies for Information Transfer	• that there are similarities and differences in the patterns of waves • that in order for an object to be seen, light must reflect off the object • that information can be transmitted over long distances using communication methods/devices	• that the characteristics of a wave determine the net motion of the wave • that there exists a relationship among the path of light, light reflection, and the visibility of objects • of how different communication methods/devices operate	• of how changing the amount of energy can change the characteristics of a wave • that a change in the path of light or light reflection will cause a change in the visibility of an object • of the advantages of different communication methods/devices and how those devices transmit digitized information over long distances

Grade 5 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS1: From Molecules to	• of the internal or external structures of plants or animals and their functions • that animals or plants reproduce and have life cycles • that both animals and plants take in materials to survive • that animals have sense receptors that they use to guide their actions	• of internal and external structures of plants and animals and how their functions support survival, growth, behavior, or reproduction • that animals and plants reproduce for continued existence and have life cycles that are unique but have some similarities • of the relationship between plants and animals and the materials they take in for specific various functions • that an animal's brain processes information received from specialized sense receptors that they use to guide their actions	• of the variation and function of internal and external structures across the plant and animal kingdoms • of the relationships among the components of life cycles • that animals and plants acquire energy from different sources but use the energy for similar functions • that animals respond to environmental changes using sensory information and stored memories

Grade 5 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS2: Ecosystems: Interactions, Energy, and Dynamics	• that in a food web, all organisms have a role **OR** • of the requirements of a healthy ecosystem • that materials cycle through an environment • that organisms respond to changes in their environment • that living in groups helps animals	• that organisms have different roles in a food web, with a focus on the cycling of materials • that the health and stability of an ecosystem depends on the overall biodiversity and the availability of resources • of how materials cycle through multiple components of an environment • of organisms responding to changes in their environment • that living in specialized groups helps animals, depending on the situation	• that the materials that animals consume can be traced through multiple levels of the food web back to plants • that the balance of the flow of matter can be disrupted by changes in the ecosystem • of the impact of change on the cycling of matter in a system • of how changes in an environment affect multiple organisms • that the dynamics of a group can change over time
LS3: Heredity: Inheritance and Variation of Traits	• that traits and characteristics are based on both inheritance and environmental factors • that organisms have variations in traits	• that while there are similarities in traits between siblings, they each have characteristics that are influenced by the environment • that some traits are inherited in a predictable way while others may be influenced by the environment	• that environmental factors affect traits or functions • that patterns in traits are expressed over multiple generations • that traits, whether inherited or influenced by the environment, have some similarities and some differences

Grade 5 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS4: Biological Evolution: Unity and Diversity	• that fossils are evidence of plant and animal life long ago • that variations among organisms help them survive and reproduce • that some organisms can survive in a particular environment while others cannot • that plants and animals are affected by change in their habitat	• that fossils are evidence of varying environments • that certain characteristics are advantageous to the survival of a species • that an environment must meet the needs of an organism for survival • that plants and animals may adapt to changes in their environment	• that fossils are evidence of changing environments over time • that specific variation in a characteristic can influence an organism's survival • that changes in an environment affect an organism's ability to survive • that the effects of habitat change may cause adaptation to occur

Grade 5 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS1: Earth's Place in the Universe	• that the Sun is an object in the sky and gives off light • that Earth is a rotating body in relative position to the Sun • that the Earth's rotation affects day and night • that there are observable patterns in Moon phases, shadows, and star patterns • that patterns of rock formations can contain fossils and can change due to Earth forces	• that distance affects relative size • of changes in patterns (daylight hours, shadow length, stars, Moon phases) that can be observed during day and night as Earth rotates and orbits around the Sun • that fossil records can help identify rock layer formations because of changes caused by natural processes	• that relative distance affects brightness • that the Earth's orbit and rotation at different times of day and year, together with the orbit of the Moon and position of the Sun, create patterns that affect how humans view objects from Earth • that a geological history can be determined by examining rock layers and fossil records
ESS2: Earth's Systems	• that Earth's four major systems can interact with each other and that components of the systems can change • that maps can be used to locate Earth's features and processes • that Earth has oceans and areas of freshwater • that weather conditions in different areas change over time • that organisms affect the environment	• of how specific processes change components of Earth's four major systems and, in turn, have an effect on the systems themselves • that maps can be used to determine patterns of Earth's features and processes • of the distribution of water on Earth and its availability and accessibility • that patterns of weather form the basis of climate data • of how organisms affect the environment	• of patterns of processes affecting Earth's four major systems and how changes in those processes will likely affect the components of those systems • that the locations of Earth's features are related to geologic changes • that the water cycle affects the distribution of water on Earth • that climatic patterns can be used to predict future weather conditions of an area • that behavior of organisms in an environment can help predict changes to the physical characteristics of that environment

Grade 5 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS3: Earth and Human Activity	• that humans use both renewable and non-renewable resources for fuel and energy and that such use can affect the environment • that humans can identify different types of natural hazards • that humans have different effects on the environment or its resources	• that using fuel from natural sources can be positive and negative in multiple ways • that Earth's processes create unavoidable hazards and that humans have an important role in designing solutions to reduce negative impact • that individuals and communities can protect and reduce the negative effects that human activities can have on the environment	• that humans have to make informed decisions about which natural resources to use by analyzing their risks and benefits • that there are benefits and risks to human-created solutions designed to lessen the impact of natural hazards • that humans have to make informed decisions based on the positive and negative effects of their activities in an effort to protect the Earth

Grade 5 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
Asking Questions (for Science) and Defining Problems (for engineering) (AQDP): A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.	• identify or ask relevant questions that are testable and that can show cause and effect relationships in the natural or designed world	• identify or ask relevant questions that can be investigated • describe problems that can be solved • predict reasonable outcomes • clarify and redesign a solution to a problem	• generate questions based on investigations incorporating variables to determine patterns while defining and solving a design problem
Developing and Using Models (DUM): A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.	• describe or use a model to show the relationship among components in a phenomenon	• develop or refine a model to minimize limitations, or test cause and effect relationships	• evaluate and revise or develop models to show relationships in cause-and-effect systems
Planning and Carrying Out Investigations (PACI): Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.	• plan an investigation and collect observational data using appropriate methods or tools that help identify outcomes from changing a variable	• plan or conduct an investigation by evaluating appropriate methods or tools for collecting data while making predictions about a fair test in which variables are controlled	• plan and conduct multiple trials of an investigation to produce data that can be compared to make predictions, to serve as evidence for an explanation of a phenomenon, or to test a design solution

Grade 5 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
Analyzing and Interpreting Data (AID): Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.	• organize relevant data to identify similarities or differences and describe how the data can be interpreted to make sense of phenomena	• analyze and represent relevant data describing how the data can be interpreted to make sense of phenomena	• evaluate and analyze data to refine a problem statement or make sense of phenomena
Using Mathematics and Computational Thinking (UMCT): In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.	• identify ways to organize or analyze qualitative or quantitative data	• collect and organize data to reveal patterns, determining whether qualitative or quantitative data would be more appropriate	• organize complex data sets of qualitative or quantitative data, as determined to be appropriate, for determining relationships and patterns, creating algorithms, or utilizing mathematical representations to support conclusions

Grade 8 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS2: Ecosystems: Interactions, Energy, and Dynamics	• that organisms are dependent on resources for which they may need to compete • that matter and/or energy are cycled through a food web of an ecosystem • that there are physical and biological components of ecosystems, that changes to those will cause disruption, and that biodiversity is related to species representation and can be used to determine overall health of an ecosystem • that changes in biodiversity have an impact on humans	• of how growth and survival of an organism is dependent on access to limited resources and interactions with other organisms • of how matter and energy transfer between trophic levels • of the dynamic nature of ecosystems and of how biodiversity is used as a measure of an ecosystem's health • of how changing biodiversity can affect humans and the services humans rely on	• of an organism's reliance on the environment and of how populations are limited by access to resources, predatory interactions, and competition • of how a food web can model mechanisms for the cycling of matter, including the role of decomposers, which in turn account for the conservation of energy • of the relationship between biodiversity and ecosystem health, and of the predicted outcomes of disturbances to an ecosystem • of why changes in biodiversity affect humans
LS3: Heredity: Inheritance and Variation of Traits	• that genes are located on inherited chromosomes and that the gene may be slightly different from the parent's • that in sexual reproduction, each parent contributes half of the genetic material and that mutations that occur can be beneficial, harmful, or neutral	• that genes control production of proteins and that mutations cause genetic variation • about genetic contributions during sexual reproduction and the general effects that mutations cause	• of how genes control protein production and of what effect mutations could have on this process • of why individuals have two of each chromosome and how mutations may result in structural and functional changes

Grade 8 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS4: Biological Evolution: Unity and Diversity	• that fossils can show the evolutionary progression of organisms living today, that organisms may be artificially selected for reproduction based on desired traits, and that while embryos across species may have similarities as they develop, the organisms with more advantageous traits are more likely to survive • that environmental conditions will drive trait commonality in species	• of the uses for the fossil record and of embryological development, including similarities not evident in the fully formed anatomy, where certain traits, whether natural or artificially selected, will provide advantages for survival • of how environmental conditions can change a species over generations and of how distributions of traits reflect adaptation by natural selection	• of evolutionary history based on anatomical similarities and to predict predominance of certain traits in a population • to predict trait distribution in a species based on changing environmental conditions

Grade 8 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS1: Earth's Place in the Universe	• that the celestial bodies have observable patterns and that we exist in a galaxy called the Milky Way • that gravity acts on objects, that there are eclipses, and that Earth's tilt causes seasons • that fossils are used to date rock layers and that tectonic processes change Earth	• to predict the observed motion of the Sun, Moon, and stars • that gravity is an attractive force, that alignment of the Earth-Moon-Sun causes solar and lunar eclipses, and that changes in seasons are due to intensity of sunlight • that Earth's history can be determined from rock layers and that tectonic processes create and destroy Earth materials	• to explain the predictable observed patterns of the Sun, Moon, and stars • to predict eclipses and seasonal changes based on data or models • that rock layers and fossils only provide relative dates and that the sea floor has different ages
ESS2: Earth's Systems	• of where Earth's energy comes from and that Earth processes vary in timeframe and size • that Earth's plates move in different ways • that water cycles in Earth's spheres and affects weather patterns, that ocean water density varies, and that moving water affects landforms • that both living and nonliving factors influence complex weather patterns	• that energy and matter have caused, and continue to cause, changes on Earth • that rocks and fossils help determine how Earth's plates have moved • of the way that water cycles, of the factors that affect the movement of water in Earth's spheres, of the causes of ocean density differences, and of the way that moving water affects landforms • of how weather patterns are influenced by living and nonliving factors that vary with location and of how the ocean is a major driving factor	• of the interaction between Earth's processes driven by differing energy sources to explain Earth's history or predict future geological events • to predict effects of plate movement on Earth's landscape • to predict weather patterns that are the result of the cycling of water and of impacts of density on ocean currents • to predict the effect living and nonliving factors, including the ocean, have on weather and climate

Grade 8 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS3: Earth and Human Activity	• that resources are not evenly distributed • that natural hazards can be mapped • that human populations may negatively impact resources and that human activity has both positive and negative impacts on different organisms • of climate science and of the fact that human activities have an effect on global temperatures	• that there are renewable and non-renewable resources • that mapping hazards can help understand geological forces • on how humans have altered the biosphere and that humans are making technological gains to minimize negative impacts • of how human activities affect temperatures and that climate science may help lead to decisions to benefit life on Earth	• of the relationship of past geological processes and the distribution of resources • to predict future hazards based on historical occurrences • to predict whether human activities would be positive or negative and to evaluate solutions based on the rate of resource consumption • to predict when human activities will have significant impacts on the Earth's climate

Grade 8 SEP Threshold Performance Level Descriptors
Students should be able to:

SEP	Level 2	Level 3	Level 4
Analyzing and Interpreting Data (AID): Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.	• identify and/or interpret data, graphical displays, and/or concepts of statistics and/or their limitations to provide evidence for phenomena	• analyze, interpret, and/or use simple data sets and/or concepts of statistics to identify relationships and/or define operational ranges for objects, processes, and/or systems	• analyze and interpret complex or multiple data sets and/or construct graphical displays to identify and/or explain relationships, limitations of data, when to use concepts of statistics, and/or to justify operational ranges for objects, processes, and/or systems
Asking Questions (for science) and Defining Problems (for engineering) (AQDP): A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.	• identify questions that arise from observations and models in order to clarify information and/or arguments, refine models, and/or determine relationships	• ask testable questions that arise from observations of phenomena, models, and/or unexpected results in order to clarify information, evidence, arguments, and/or design problems that can be solved through development of objects/tools, processes, and/or systems	• analyze and/or evaluate testable questions that arise from observations of phenomena, models, and/or unexpected results in order to clarify information, evidence, arguments, and/or design problems that can be solved through development of objects/tools, processes, and/or systems

Grade 8 SEP Threshold Performance Level Descriptors
Students should be able to:

SEP	Level 2	Level 3	Level 4
Constructing Explanations (for science) and Designing Solutions (for engineering) (CEDS): The products of science are explanations and the products of engineering are solutions.	• identify or revise an explanation and/or design project based on models or representations, or by applying scientific reasoning and/or evidence	• construct, revise, and/or use an explanation based on models or representations, or by applying scientific reasoning and/or evidence, or by undertaking a design project to construct and/or implement a solution	• analyze, construct, and/or elaborate on an explanation based on models or representations by applying scientific reasoning and/or evidence, or by evaluating a design project to construct and/or implement solutions and/or optimize performance
Developing and Using Models (DUM): A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.	• use a simple model to show relationships, make predictions, or generate data and/or describe its limitations	• develop and/or revise a simple model to show relationships, make predictions, or generate data and/or evaluate its limitations	• develop, revise, and/or evaluate a complex model to show relationships, make predictions, or generate data and/or evaluate its merits and limitations
Engaging in Argument from Evidence (EAE): Argumentation is the process by which explanations and solutions are reached.	• identify evidence in arguments to support or refute explanations, • provide critiques of procedures or models, and/or • identify competing design solutions	• identify and/or compare multiple pieces of evidence in arguments, • provide critiques about explanations or questions, and/or • write arguments that support or refute the advertised performance of a device, process, or system	• critique arguments, procedures, or models; • construct and/or use written arguments to support or refute explanations, models, and/or solutions; or • analyze empirical evidence to support written arguments

Grade 8 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
Obtaining, Evaluating, and Communicating Information (OEIC): Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.	• read and use information from multiple simple scientific sources to describe patterns, clarify claims, and/or assess accuracy	• integrate information from multiple, complex, qualitative sources to clarify claims, assess accuracy, and evaluate conclusions	• integrate information from multiple, complex, quantitative sources to describe patterns, clarify claims, assess accuracy, and evaluate conclusions
Planning and Carrying Out Investigations (PACI): Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.	• plan and/or conduct an investigation that includes the identification of appropriate tools and methods for collecting data in order to provide evidence or test a design solution	• plan an investigation that includes the identification of variables and/or controls, or indicates how much data is sufficient to serve as evidence necessary to test a design solution, or evaluate an experimental design	• plan and refine an investigation that includes the identification of variables and controls, tools, how data will be collected, and how much data is sufficient to serve as evidence necessary to test a design solution, or revise an experimental design
Using Mathematics and Computational Thinking (UMCT): In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.	• identify qualitative and quantitative data and when the use of digital tools is warranted, • select appropriate mathematical representations, and • use algorithms to solve problems and/or address engineering questions	• decide whether to use qualitative or quantitative data, • use digital tools to analyze large data sets, • use mathematical representations, and • explain and/or evaluate algorithms or mathematical concepts for solving problems and/or addressing engineering questions	• explain when to use qualitative or quantitative data, • evaluate digital tools, • explain mathematical representations, and/or • create algorithms to solve problems and/or address engineering questions

E.2.3 Grade 11 Threshold PLDs

The Threshold Performance Level Descriptors (PLDs) define the minimum knowledge, skills and practices that students must display for each Disciplinary Core Idea and Science and Engineering Practice to reach a certain performance level. They expand upon the brief overall PLDs included in the Score Interpretation Guide.

Grade 11 Threshold Performance Level Descriptors (Physical Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
PS1: Matter and Its Interactions	• of subatomic particles, their interactions, and the involvement of energy in these interactions • of an understanding of how collisions between molecules affect reaction rates • that some reactions are reversible • that atoms are conserved during reactions • that nuclear processes involve energy	• of atomic properties and patterns through the use of the periodic table, as well as different types of particle interactions and the energy involved • of the factors that affect reaction rates and equilibrium systems • of the energy involved in the rearranging of atoms and molecules • of the different types of reactions and how to make predictions about them • that energy and matter are conserved in nuclear processes	• of varying atomic structures • of how the periodic table models the patterns of the properties and electron structure of the elements • of how particle interactions affect bulk properties of substances • of how collisions lead to changes in the sum of all the bond energies • of how atom conservation and chemical properties can be used to make predictions on chemical reactions • of multiple nuclear processes

Grade 11 Threshold Performance Level Descriptors (Physical Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
PS2: Motion and Stability: Forces and Interactions	• of quantified acceleration and momentum • of types of fields and attractive/repulsive forces of gravitational and/or electric fields • that electrical energy can be stored or transmitted	• (quantified knowledge) of factors that affect Newton's second law, single object momentum systems, and conservation of momentum • of how interactions happen at a distance due to fields • of electrical interactions at the atomic level • of the difference between magnetic and electric fields **OR** • (quantified knowledge) of Coulomb's law and Newton's universal law of gravitation • of how electrical energy can be stored in a battery or transmitted by electric currents	• (quantified knowledge) of outside interactions that affect the momentum and acceleration of a single or multiple object system • of how to predict changes in electrical and gravitational forces • of how to describe fields as force and energy fields and predict the effect of electrical and/or magnetic fields due to interactions between the two fields
PS3: Energy	• of how different types of energy can be transferred • of systems in which energy is conserved and how the availability of energy restricts what is possible in a closed system • of the nature of the relationship between two objects interacting in a field using the energy prospective • of how energy can be converted to different forms	• of how energy manifests itself at the microscopic and macroscopic scale and how energy transfers in a system • (quantified knowledge) of how energy transfers in and out of a system **OR** • of possible and impossible events based on energy availability, and defined stable states • of how the distance between two objects affects the energy of a field • of how energy can be converted to less useful forms • of how solar energy can be captured and used for other processes, such as photosynthesis	• of the amount of various types of energy in a given situation and how microscopic changes affect macroscopic manifestations of energy • of how to evaluate physical changes in a system using the conservation of energy • of how to predict changes in energy in a field based on the position and nature of objects • of the importance of energy conservation and efficiency

Grade 11 Threshold Performance Level Descriptors (Physical Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
PS4: Waves and Their Applications in Technologies for Information Transfer	• of how a wave travels through a medium, including understanding of examples of digitized information, and qualitative understanding of superposition principle • of the wave and particle models of electromagnetic radiation, the absorption of electromagnetic radiation, and the relationship between frequency and energy of light • of everyday experiences that involve waves and how wave signals are produced, transmitted, and captured	• (quantified knowledge) of the relationship among frequency, wavelength, and speed in a real-world phenomenon **OR** • of the advantages and disadvantages of digitizing information • of the effect of absorption of electromagnetic waves, features of electromagnetic radiation that can be explained by either the wave or particle model, and the nature of photoelectric materials • of technologies used to produce, transmit, and/or capture signals and technologies used to store and interpret information	• of waves in various media and how combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information • of the difference between the wave- and particle-like behavior of electromagnetic radiation and how either the wave or particle model can be used to explain how an electron is emitted and how it can damage living cells • of how technology can be used to store and/or interpret information

Grade 11 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS1: From Molecules to Organisms: Structures and Processes	• of how multicellular organisms utilize feedback mechanisms and have specialized cells that are organized and function according to the proteins coded by the DNA • of the role of cellular division (mitosis) in creating genetically identical cells that differentiate into complex multicellular organisms • of photosynthesis and cellular respiration as the chemical processes of life that produce or utilize carbon-based molecules that are recombined into different products of living systems	• of how positive and negative feedback mechanisms are beneficial to multicellular organisms, which have systems of specialized cells that perform essential life functions expressed through proteins coded for by genes • of how mitosis and differentiation produce and maintain complex organisms from a single cell • of the chemistry behind photosynthesis, how cellular respiration uses energy to maintain the organism, and how the products of these processes are used to build larger molecules	• of how changing genes (mutation) can lead to functional changes of a protein and how positive and/or negative feedback helps maintain the equilibrium of an organism • of how genetic material from two variants of each chromosome pair is maintained as a single cell (fertilized egg) grows to a multicellular organism • of the interdependence of photosynthesis and cellular respiration and their role in the growth and maintenance of living systems

Grade 11 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS2: Ecosystems: Interactions, Energy, and Dynamics	• of both living and non-living factors that contribute to the carrying capacity of the ecosystem • of how food webs often have photosynthetic producers at the lowest level, how a small amount of matter and energy will transfer upward in the food web reducing the amount of organisms that can exist at higher levels, and how this relates to the carbon cycle • of how ecosystems have interactions that keep the population numbers stable, and ecosystems are resilient to modest changes, but humans can disrupt ecosystems and species survival • of how group behavior has evolved to increase individual and group survival	• of how carrying capacity is affected by challenges and/or availability of resources • of how photosynthesis and cellular respiration are connected and use carbon in maintaining life processes, that the matter and energy of a food web are used and restructured by the organisms in the food web, and that a small amount is used by the next levels of the food web • of complex ecosystem interactions and their effects on population size, including biological and physical disturbances, extreme fluctuations, and the ways human activity can have an effect on an ecosystem • of how group behaviors can increase the chances of survival for individuals and their genetic relatives	• of how carrying capacity affects the population size of a given species within an ecosystem • of how carbon and matter are used in the maintenance of life processes (including photosynthesis and both anaerobic and aerobic respiration) through the food web, including how carbon cycles through Earth's spheres • of how changes to populations and environments caused by human interactions and other physical events within ecosystems can result in changes that affect both the organisms and the environment • of how changes to the group or conditions can affect the survival of individuals and their genetic relatives

Grade 11 Threshold Performance Level Descriptors (Life Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
LS3: Heredity: Inheritance and Variation of Traits	• of how all cells have the same DNA containing genes that are the organisms' characteristics, but not all DNA codes for protein • of the processes within meiosis, errors that can occur during DNA replication, and mutations due to environmental factors that can create genetic diversity, which may be passed to future generations	• that chromosomes contain genes that code for proteins and regions that do not code for proteins, and that different cells express different genes • that while the process of DNA replication is tightly regulated and highly accurate, errors still occur, and combined with mutations due to environmental factors, DNA replication can create genetic diversity that may affect survivability and the transmission of traits to future generations	• of the mechanisms of gene regulation and different possible functions of segments of non-protein coding DNA • of the mechanisms within meiosis that create genetic diversity, as well as the effects of environmental factors on DNA replication and the impact of the changes to DNA on genetic diversity within populations
LS4: Biological Evolution: Unity and Diversity	• of the different types of evidence of evolution • of how natural selection allows inheritable advantageous traits to become more common if they increase chances of survival within populations • that natural selection selects for inheritable traits that provide a survival advantage for a particular environment • that changes to the environment may cause the selection of different traits leading to changes in the population known as adaptation • that the frequency of traits depends on natural selection forces that can change with a changing environment • of how biodiversity increases or decreases and how humans need resources and biodiversity, but are having adverse effects on biodiversity	• of how different sources of evidence for evolution can support each other • of how gene expression and genetic variation in the individual lead to differences in performance of the individuals in a population, and how positively selected traits are more common in a population because they increase survival • that evolution occurs when there is genetic variation, competition, and selective reproduction of organisms with desirable genetic traits • that organisms with desirable traits will become more common, but as the environment changes, different traits may provide the selective advantages • that some populations may increase while others may go extinct • of specific results of human activities that affect the environment and biodiversity and reasons why preservation of biodiversity is desirable	• of how DNA sequences, amino acid sequences, and anatomical and embryological evidence support that evolution has occurred • of how natural selection leads to different levels of performance of the individual • that factors affecting natural selection work together creating changes in the diversity within populations and ecosystems • that changing environments cause changes in selection pressures that result in further adaptation or extinction • of ways that humans can maintain or increase biodiversity while meeting the needs of humanity and why this is beneficial to life on Earth

Grade 11 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS1: Earth's Place in the Universe	• of the Big Bang, which allowed for the creation of galaxies and stars, where many elements are created • of identifying properties of orbits, factors that affect the orbit, and how the orbit affects the stellar body • of plate tectonics and erosion, which cause the destruction of early rock records on Earth and that we have to rely on other objects in the solar system for information on Earth's formation	• that light spectra emitted from a star can give information about its life cycle, composition, and distance • of features of motion of orbital objects, what changes that motion, and the effects of changing the motion of the stellar body • of the fact that that while there is a range in the age of the rocks on Earth, the early rock history has been destroyed, and we rely on studying other stellar bodies to explain how the Earth formed	• of the life cycle of stars and explain how the characteristics of a star can support the Big Bang theory • of the laws explaining motions of orbiting objects, their changes, and the changes to the stellar bodies as a result of those changes • of why different areas of the Earth have rocks of different ages and the processes that are erasing the early rock history
ESS2: Earth's Systems	• of how Earth has a series of interacting dynamic systems • that Earth's surface is in motion, and that motion can create physical features on the Earth's surface • of the properties of water that are essential to Earth's dynamics • of Earth's atmosphere and how it undergoes temperature changes • that dynamic and delicate feedbacks between the Earth's systems and biosphere exist	• of methods of investigation of Earth's dynamic systems and how the data can be used to describe the effects of these systems • that Earth's surface is in motion due to convection, creating physical features that have changed throughout history • of how the properties of water are essential to Earth's processes • of how Earth's atmosphere undergoes short-term and long-term temperature changes at the global scale due to changes in the biosphere, including human activities • of how dynamic and delicate feedbacks between the Earth's systems and biosphere cause a continual co-evolution of Earth's surface and the life that exists on it	• of Earth's dynamic systems in explaining the effects of these systems and the development of the currently accepted model of the structure of the planet • of the theory of plate tectonics allowing for the prediction of future plate movements and interpretations of Earth's geologic history • of how the properties of water can be used to explain Earth's processes • of why Earth's atmosphere undergoes short-term and long-term temperature changes at the global scale • of how positive and/or negative feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it

Grade 11 Threshold Performance Level Descriptors (Earth and Space Science)

Students should be able to demonstrate knowledge:

DCI	Level 2	Level 3	Level 4
ESS3: Earth and Human Activity	• that new technologies have associated costs, risks, and benefits • that natural hazards have shaped human history • that human activities can have both positive and negative impacts on biodiversity • of humans' abilities to use technology to model, predict, and mange current and future impacts	• that new technologies have associated costs, risks, and benefits at the economic, social, environmental, and/or geopolitical level • of how natural hazards and geological events have shaped human history through changes in the human population including through migration at the local, regional, and/or global scale • that human impacts on biodiversity can be mitigated by the development of new technologies and/or responsible resource management • of technologies that allow modeling, predicting, and managing of current and future impacts on oceans, the atmosphere, and the biosphere	• of new technologies in order to explain their associated costs, risks, and benefits at the economic, social, environmental, and/or geopolitical level • of how natural hazards affect human population and migration at the local, regional, and global scale • of new technologies and responsible resource management to predict their effects on biodiversity • to explain how humans' abilities to model, predict, and manage current and future impacts have increased alongside the magnitudes of human impacts

Grade 11 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
(Investigating) **Asking Questions (for Science) and Defining Problems (for engineering) (AQDP):** A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed worlds work and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify ideas. Asking questions and defining problems in 9–12 progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.	• ask relevant questions or define problems in different contexts, based on unexpected results, independent and dependent variables, models, theories, etc.	• ask relevant and testable questions that arise from careful observation of phenomena, unexpected results, or models or theories for the purpose of determining relationships, providing an explanation, or clarifying and refining a design	• analyze, evaluate, and/or revise questions that arise from careful observation of phenomena, unexpected results, or models or theories for the purpose of determining relationships, providing an explanation, or clarifying and refining a design
(Sensemaking) **Developing and Using Models (DUM):** A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling in 9–12 progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.	• use a model to generate data that test the model's reliability and/or evaluates its merits and limitations	• develop simple models and revise different types of models that test and/or predict relationships among systems/phenomena based on the models' merits and limitations	• develop or revise complex models that test and/or predict relationships/ phenomena based on the models' merits and limitations

Grade 11 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
(Investigating) **Planning and Carrying Out Investigations (PACI):** Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Planning and carrying out investigations in 9–12 progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.	• identify ways to conduct an investigation (including making a directional hypothesis) or test a design solution through manipulating variables or acquiring data	• plan and/or conduct an investigation (including making a directional hypothesis) or test a design solution through manipulating variables or acquiring data	• revise and/or evaluate an investigation in which an independent variable is manipulated or an unsatisfactory performance is found
(Sensemaking) **Analyzing and Interpreting Data (AID):** Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Analyzing data in 9–12 progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.	• identify the appropriate statistics and/or data, and/or their limitations, when providing evidence for claims, design solutions, or solving problems	• apply and/or analyze data and statistics to identify or solve scientific and engineering problems, or to make scientific claims	• evaluate the use of data and statistics and/or their limitations to solve problems, make claims, or design solutions

Grade 11 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
(Investigating) **Using Mathematics and Computational Thinking (UMCT):** In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational thinking in 9–12 progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.	• apply/use mathematical concepts to describe conclusions that may require deciding when to use qualitative versus quantitative data	• apply/use mathematical computational representations to see if a model is viable, or decide if qualitative or quantitative data meet criteria for success	• through the use of evaluation of mathematical computations, create a model or justify the choice of qualitative versus quantitative data
(Sensemaking) **Constructing Explanations (for science) and Designing Solutions (for engineering) (CEDS):** The products of science are explanations and the products of engineering are solutions. Constructing explanations and designing solutions in 9–12 progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	• identify and describe appropriate data and/or evidence for supporting claims, solving problems, constructing explanations, or designing solutions	• make or revise claims, explanations, or solutions by applying appropriate data and/or evidence	• evaluate, design, or construct claims, explanations, or solutions by applying appropriate data, evidence, and/or scientific theories and laws

Grade 11 SEP Threshold Performance Level Descriptors

Students should be able to:

SEP	Level 2	Level 3	Level 4
(Critiquing) **Engaging in Argument from Evidence (EAE):** Argumentation is the process by which explanations and solutions are reached. Engaging in argument from evidence in 9–12 progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.	• identify and/or describe the main points of an argument or claim that is based on scientific evidence	• evaluate and/or defend a claim or argument—or choose between competing arguments—related to currently accepted explanations or solutions	• construct and/or critique an argument or claim by using scientific evidence
(Critiquing) **Obtaining, Evaluating, and Communicating Information (OECI):** Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Obtaining, evaluating, and communicating information in 9–12 progresses to evaluating the validity and reliability of the claims, methods, and designs.	• read and compare sources of information to describe patterns in evidence and/or evidence for solving problems or answering scientific questions	• integrate information from multiple sources to gather valid and reliable evidence for solving problems or answering scientific questions	• evaluate information from multiple sources and determine the usefulness of evidence, ensuring it is valid and reliable, for solving problems or answering scientific questions