DCI: Biological Evolution: Unity and Diversity

MS.LS4.A: Evidence of Common Ancestry and Diversity

The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.A: Evidence of Common Ancestry and Diversity

Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.A: Evidence of Common Ancestry and Diversity

Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.B: Natural Selection

Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.B: Natural Selection

In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.C: Adaptation

Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.A: Interdependent Relationships in Ecosystems

Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

DCI: Heredity: Inheritance and Variation of Traits

MS.LS3.A: Inheritance of Traits

Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)

MS.LS3.B: Variation of Traits

In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

MS.LS1.B: Growth and Development of Organisms

Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (MS-LS3-2)

MS.LS3.A: Inheritance of Traits

Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

MS.LS3.B: Variation of Traits

In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)

MS.ESS1.C: The History of Planet Earth

Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (MS-ESS2-3)

MS.ESS2.B: Plate Tectonics and Large-Scale System Interactions

Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

DCI: Earth's Place in the Universe

MS.ESS1.C: The History of Planet Earth

The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)

DCI: Ecosystems: Interactions, Energy, and Dynamics

MS.LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

DCI: Biological Evolution: Unity and Diversity

MS.LS4.D: Biodiversity and Humans

Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on— for example, water purification and recycling. (MS-LS2-5)

MS.ETS1.B: Developing Possible Solutions

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-LS2-5)

MS-LS4-1: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.

Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.

MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.

Assessment Boundary: none

Performance Expectation

MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.

Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.

Performance Expectation

MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.

Assessment Boundary: none

Performance Expectation

MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

Assessment Boundary: none

Performance Expectation

MS-LS4-6: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.

Assessment Boundary: Assessment does not include Hardy Weinberg calculations.

Performance Expectation

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

Assessment Boundary: none

Performance Expectation

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.

Assessment Boundary: none

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.
Assessment Boundary: none

MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.
Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.

MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.
Assessment Boundary: none

Performance Expectation

MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, contintental shapes, and seafloor structures to provide evidence of the past plate motions.

Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).

Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.

Performance Expectation

MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.

Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.

Performance Expectation

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.

Assessment Boundary: none

* This performance expectation integrates traditional science content with engineering through a practice or disciplinary code idea.

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 6–8 level builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

Develop and use a model to describe phenomena. (MS-LS3-1)

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

Develop and use a model to describe phenomena. (MS-LS3-2)

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

Crosscutting Concepts

Patterns

Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1), (MS-LS4-3)

Crosscutting Concepts

Patterns

Patterns can be used to identify cause-and-effect relationships. (MS-LS4-2)

Crosscutting Concepts

Cause and Effect

Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-5), (MS-LS4-6)

Crosscutting Concepts

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Patterns

Patterns can be used to identify cause-and-effect relationships. (MS-LS2-2)

Stability and Change

Small changes in one part of a system might cause large changes in another part. (MS-LS2-4)

Structure and Function

Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Patterns

Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)

Scale, Proportion, and Quantity

Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4)

Stability and Change

Small changes in one part of a system might cause large changes in another part. (MS-LS2-5)

Science Knowledge Is Based on Empirical Evidence

Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1), (MS-LS4-2)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)

Connections to Engineering, Technology, and Applications of Science

Science Knowledge Is Based on Empirical Evidence

Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

Connections to Engineering, Technology, and Applications of Science

Scientific Knowledge Is Open to Revision in Light of New Evidence

Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)

Connections to Engineering, Technology, and Applications of Science

Science Addresses Questions About the Natural and Material World

Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5)

Reading in Science

RST.6-8.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts. (MS-LS4-1), (MS-LS4-2), (MS-LS4-3), (MS-LS4-5)

Reading in Science

RST.6-8.7 - Integration of Knowledge and Ideas

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1), (MS-LS4-3)

Reading in Science

RST.6-8.9 - Integration of Knowledge and Ideas

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3), (MS-LS4-4)

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.8.1 - Comprehension and Collaboration

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2), (MS-LS4-4)

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.8.4 - Presentation of Knowledge and Ideas

Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS4-2), (MS-LS4-4)

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.6-8.2 - Text Types and Purposes

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS4-2), (MS-LS4-4)

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.6-8.8 - Research to Build and Present Knowledge

Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.6-8.9 - Research to Build and Present Knowledge

Draw evidence from informational texts to support analysis reflection, and research. (MS-LS4-2), (MS-LS4-4)

Common Core State Standards for Mathematics

Expressions & Equations

6.EE.B.6 - Reason about and solve one-variable equations and inequalities.

Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-1), (MS-LS4-2)

Ratios & Proportional Relationships

6.RP.A.1 - Understand ratio concepts and use ratio reasoning to solve problems.

Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4), (MS-LS4-6)

Statistics & Probability

6.SP.B.5 - Summarize and describe distributions.

Summarize numerical data sets in relation to their context. (MS-LS4-4), (MS-LS4-6)

Ratios & Proportional Relationships

7.RP.A.2 - Analyze proportional relationships and use them to solve real-world and mathematical problems.

Recognize and represent proportional relationships between quantities. (MS-LS4-4), (MS-LS4-6)

Common Core State Standards for Mathematics

Mathematical Practices

MP.4 - Model with mathematics

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. A student might apply proportional reasoning to plan a school event or analyze a problem in the community. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose. (MS-LS4-6)