DCI: Biological Evolution: Unity and Diversity

HS.LS4.B: Natural Selection

Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.

(HS-LS4-2), (HS-LS4-3)
UT.BIO.4.3

HS-LS4-2 is not included in UT BIO Standards

DCI: Biological Evolution: Unity and Diversity

HS.LS4.C: Adaptation

Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

(HS-LS4-2)

HS-LS4-2 is not included in UT BIO Standards

DCI: Biological Evolution: Unity and Diversity

HS.LS4.C: Adaptation

Adaptation also means that the distribution of traits in a population can change when conditions change.

(HS-LS4-3)
UT.BIO.4.3

DCI: Biological Evolution: Unity and Diversity

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

Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.

(HS-LS4-1) **UT.BIO.4.1**

DCI: Biological Evolution: Unity and Diversity

HS.LS4.B: Natural Selection

The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.

(HS-LS4-3)
UT.BIO.4.3

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DCI: Biological Evolution: Unity and Diversity

HS.LS4.C: Adaptation

Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.

(HS-LS4-5), (HS-LS4-6)
UT.BIO.4.4

DCI: Biological Evolution: Unity and Diversity

HS.LS4.C: Adaptation

Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.

(HS-LS4-5)
UT.BIO.4.4

DCI: Biological Evolution: Unity and Diversity

HS-LS4-6 is not included in UT BIO Standards

HS.LS4.D: Biodiversity and Humans

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

HS-LS4-6 is not included in UT BIO Standards

DCI: Engineering Design

HS.ETS1.B: Developing Possible Solutions

When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

(HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

HS-LS4-6 is not included in UT BIO Standards

DCI: Engineering Design

HS.ETS1.B: Developing Possible Solutions

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

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Performance Expectation

UT.BIO.4.1 Obtain, evaluate, and communicate information to identify the patterns in the evidence that support biological evolution. Examples of evidence could include DNA sequences, amino acid sequences, anatomical structures, the fossil record, or order of appearance of structures during embryological development.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS4-1**

HS-LS4-2 is not included in UT BIO Standards

Performance Expectation

HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors:(1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.

Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.

HS-LS4-2 is not included in UT BIO Standards

Performance Expectation

UT.BIO.4.3 Analyze and interpret data to identify patterns that explain the claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Emphasize analyzing shifts in the numerical distribution of traits and using these shifts as evidence to support explanations.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS4-3**

Performance Expectation

UT.BIO.4.5 **Evaluate design solutions that can best solve a real-world problem caused by natural selection and adaptation of populations. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Examples of real-world problems could include bacterial resistance to drugs, plant resistance to herbicides, or the effect of changes in climate on food sources and pollinators.**

For Clarification Statements and Assessment Boundaries, please see NGSS.

HS-LS4-4

Performance Expectation

UT.BIO.4.4 **Engage in argument from evidence that changes in environmental conditions may cause increases in the number of individuals of some species, the emergence of new species over time, and/or the extinction of other species. Emphasize the cause and effect relationships for how changes and the rate of change to the environment affect distribution or disappearance of traits in a species. Examples of changes in environmental conditions could include deforestation, application of fertilizers, drought, or flood.**

For Clarification Statements and Assessment Boundaries, please see NGSS.

HS-LS4-5

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Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

(HS-LS4-3) **UT.BIO.4.3**

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and 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. Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

HS-LS4-6 is not included in UT BIO Standards

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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.

(HS-LS4-2), (HS-LS4-4) **UT.BIO.4.5**

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.

(HS-LS4-5) **UT.BIO.4.4**

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

(HS-LS4-1) **UT.BIO.4.1**

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DCI: Biological Evolution: Unity and Diversity

HS.LS4.C: Adaptation

Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.

(HS-LS4-3), (HS-LS4-4) **UT.BIO.4.3, UT.BIO.4.5**

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.A: Structure and Function

All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

(HS-LS3-1)
UT.BIO.3.2

DCI: Heredity: Inheritance and Variation of Tr

HS.LS3.A: Inheritance of Traits

Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

(HS-LS3-1) **UT.BIO.3.2**

Crosscutting Concepts

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

(HS-LS4-2), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6)
UT.BIO.4.5, UT.BIO.4.4

Crosscutting Concepts

Patterns

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

(HS-LS4-1), (HS-LS4-3)
UT.BIO.4.1, UT.BIO.4.3

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Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.8 - Integration of Knowledge and Ideas

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

(HS-LS4-5) **UT.BIO.4.4**

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.11-12.4 - Presentation of Knowledge and Ideas

Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

(HS-LS4-1), (HS-LS4-2) **UT.BIO.4.1**

Common Core State Standards for ELA/Literacy

HS-LS4-6 is not included in UT BIO Standards

Writing in Science

WHST.11-12.7 - Research to Build and Present Knowledge

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

(HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

(HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4) **UT.BIO.4.1, UT.BIO.4.3, UT.BIO.4.5**

HS-LS4-6 not included in UT BIO Standards

Performance Expectation

HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.

Assessment Boundary: none

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

HS-LS4-6 not included in UT BIO Standards

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Writing in Science

WHST.11-12.9 - Research to Build and Present Knowledge

Draw evidence from informational texts to support analysis, reflection, and research.

(HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4), (HS-LS4-5)

UT.BIO.4.1, UT.BIO.4.3, UT.BIO.4.5, UT.BIO.4.4

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.2 - Text Types and Purposes

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

(HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4)

UT.BIO.4.1, UT.BIO.4.3, UT.BIO.4.5

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.5 - Production and Distribution of Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

(HS-LS4-6)

HS-LS4-6 is not included in UT BIO Standards

HS-LS4-6 is not included in UT BIO Standards

Common Core State Standards for Mathematics

Mathematical Practices

MP.2 - Reason abstractly and quantitatively

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects. (HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4), (HS-LS4-5) **UT.BIO.4.1, UT.BIO.4.3, UT.BIO.4.5, UT.BIO.4.4**

HS-LS4-2 is not included in UT BIO Standards.

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 use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. 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. (HS-LS4-2)

HS-LS4-2 is not included in UT BIO Standards.

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Performance Expectation

UT.BIO.3.4 Plan and carry out an investigation and use computational thinking to explain the variation and patterns in distribution of the traits expressed in a population. Emphasize the distribution of traits as it relates to both genetic and environmental influences on the expression of those traits. Examples of variation and patterns in distribution of traits could include sickle-cell anemia and malaria, hemoglobin levels in humans at high elevation, or antibiotic resistance.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS3-3**

Performance Expectation

UT.BIO.3.2 Use computational thinking and patterns to make predictions about the expression of specific traits that are passed in genes on chromosomes from parents to offspring. Emphasize that various inheritance patterns can be predicted by observing the way genes are expressed. Examples of tools to make predictions could include Punnett squares, pedigrees, or karyotypes. Examples of allele crosses could include dominant/recessive, incomplete dominant, codominant, or sex-linked alleles.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS3-1**

Performance Expectation

UT.BIO.3.3 Engage in argument from evidence that inheritable genetic variation is caused during the formation of gametes. Emphasize that genetic variation may be caused by epigenetics, during meiosis from new genetic combinations, or viable mutations.

For Clarification Statements and Assessment Boundaries, please see NGSS.

HS-LS3-2

DCI: Heredity: Inheritance and Variation of Traits

HS.LS3.B: Variation of Traits

Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.

(HS-LS3-2), (HS-LS3-3)

UT.BIO.3.3, UT.BIO.3.4

DCI: Heredity: Inheritance and Variation of Traits

HS.LS3.B: Variation of Traits

In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.

(HS-LS3-2) **UT.BIO.3.3**

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Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

(HS-LS3-2) **UT.BIO.3.3**

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that arise from examining models or a theory to clarify relationships.

(HS-LS3-1) **UT.BIO.3.2**

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

(HS-LS3-3) **UT.BIO.3.4**

Crosscutting Concepts

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

(HS-LS3-1), (HS-LS3-2) **UT.BIO.3.2, UT.BIO.3.3**

Crosscutting Concepts

Scale, Proportion, and Quantity

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

(HS-LS3-3) **UT.BIO.3.4**

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DCI: Energy

HS.PS3.D: Energy in Chemical Processes and Everyday Life

The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.

(HS-LS2-5)
UT.BIO.1.3

DCI: Ecosystems: Interactions, Energy, and Dynamics

HS.LS2.A: Interdependent Relationships in Ecosystems

Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

(HS-LS2-1), (HS-LS2-2) **UT.BIO.1.1**

DCI: Ecosystems: Interactions, Energy, and Dynamics

HS.LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.

(HS-LS2-3)
UT.BIO.1.2

DCI: Biological Evolution: Unity and Diversity

HS.LS4.D: Biodiversity and Humans

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

(HS-LS2-7) **UT.BIO.1.5**

DCI: Engineering Design

HS.ETS1.B: Developing Possible Solutions

When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

(HS-LS2-7)
UT.BIO.1.5

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DCI: Ecosystems: Interactions, Energy, and Dynamics

HS-LS2-4 is not included in UT BIO standards.

HS.LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)

HS-LS2-4 is not included in UT BIO standards.

DCI: Ecosystems: Interactions, Energy, and Dynamics

HS.LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.

(HS-LS2-5)
UT.BIO.1.3

DCI: Ecosystems: Interactions, Energy, and Dynamics

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

A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2), (HS-LS2-6) **UT.BIO.1.4**

DCI: Ecosystems: Interactions, Energy, and Dynamics

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

Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

(HS-LS2-7)
UT.BIO.1.5

DCI: Ecosystems: Interactions, Energy, and Dynamics

HS.LS2.D: Social Interactions and Group Behavior

Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

(HS-LS2-8)
UT.BIO.4.2

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Performance Expectation

HS-LS2-2 is not included in UT BIO standards.

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. **Assessment Boundary:** Assessment is limited to provided data.

HS-LS2-2 is not included in UT BIO standards.

Performance Expectation

UT.BIO.1.2 Develop and use a model to explain cycling of matter and flow of energy among organisms in an ecosystem. Emphasize the movement of matter and energy through the different living organisms in an ecosystem. Examples of models could include food chains, food webs, energy pyramids or pyramids of biomass.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-3**

Performance Expectation

HS-LS2-4 is not included in UT BIO standards.

HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem. **Assessment Boundary:** Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.

HS-LS2-4 is not included in UT BIO standards.

Performance Expectation

UT.BIO.1.1 Plan and carry out an investigation to analyze and interpret data to determine how biotic and abiotic factors can affect the stability and change of a population. Emphasize stability and change in populations' carrying capacities and an ecosystem's biodiversity.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-1**

Performance Expectation

UT.BIO.4.2 Construct an explanation based on evidence that natural selection is a primary cause of evolution. Emphasize that natural selection is primarily caused by the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-8**

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Performance Expectation

UT.BIO.1.3 Analyze and interpret data to determine the effects of photosynthesis and cellular respiration on the scale and proportion of carbon reservoirs in the carbon cycle. Emphasize the cycling of carbon through the biosphere, atmosphere, hydrosphere, and geosphere and how changes to various reservoirs impact ecosystems. Examples of changes to the scale and proportion of reservoirs could include deforestation, fossil fuel combustion, or ocean uptake of carbon dioxide.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-5**

Performance Expectation

UT.BIO.1.4 Develop an argument from evidence for how ecosystem maintain relatively consistent numbers and types of organisms in stable conditions. Emphasize how changing conditions may result in changes to an ecosystem. Examples of changes in ecosystem conditions could include moderate biological or physical changes such as moderate hunting or a seasonal flood; and extreme changes, such as climate change, volcanic eruption, or sea level rise.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-6**

Performance Expectation

UT.BIO.1.5 Design a solution that reduces the impact caused by human activities on the environment and biodiversity. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of human activities could include building dams, pollution, deforestation, or introduction of invasive species.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS2-7**

DCI: Biological Evolution: Unity and Diversity

HS.LS4.D: Biodiversity and Humans

Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).

(HS-LS2-7)

UT.BIO.1.5

Common Core State Standards for Mathematics

Statistics & Probability » Interpreting Categorical & Quantitative Data

HSS-ID.A.1 - Summarize, represent, and interpret data on a single count or measurement variable

Represent data with plots on the real number line (dot plots, histograms, and box plots).

(HS-LS2-6)

UT.BIO.1.4

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Science and Engineering Practices

HS-LS2-2 is not included in UT BIO standards.

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and 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. Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)

HS-LS2-2 is not included in UT BIO standards.

Science and Engineering Practices

HS-LS2-4 is not included in UT BIO standards.

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and 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.

Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

HS-LS2-4 is not included in UT BIO standards.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. (HS-LS2-3) **UT.BIO.1.2**

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and 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. Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1) **UT.BIO.1.1**

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS2-5) **UT.BIO.1.3**

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Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7) **UT.BIO.1.5**

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) **UT.BIO.1.4**

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.
(HS-LS2-8) **UT.BIO.4.2**

Crosscutting Concepts

Stability and Change

Much of science deals with constructing explanations of how things change and how they remain stable.

(HS-LS2-6), (HS-LS2-7)
UT.BIO.1.4, UT.BIO.1.5

Crosscutting Concepts

Energy and Matter

Energy drives the cycling of matter within and between systems.

(HS-LS2-3)
UT.BIO.1.2

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Crosscutting Concepts

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

(HS-LS2-8)
UT.BIO.4.2

Crosscutting Concepts

Scale, Proportion, and Quantity

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

(HS-LS2-1)
UT.BIO.1.1

Crosscutting Concepts

Scale, Proportion, and Quantity

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

(HS-LS2-2)

HS-LS2-2 is not included in UT BIO standards.

HS-LS2-2 is not included in UT BIO standards.

Crosscutting Concepts

Systems and System Models

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

(HS-LS2-5)
UT.BIO.1.3

HS-LS2-4 is not included in UT BIO standards.

Crosscutting Concepts

Energy and Matter

Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

(HS-LS2-4)

HS-LS2-4 is not included in UT BIO standards.

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Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.7 - Integration of Knowledge and Ideas

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

(HS-LS2-6), (HS-LS2-7), (HS-LS2-8)

UT.BIO.1.4, UT.BIO.1.5, UT.BIO.4.2

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.8 - Integration of Knowledge and Ideas

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

(HS-LS2-6), (HS-LS2-7), (HS-LS2-8)

UT.BIO.1.4, UT.BIO.1.5, UT.BIO.4.2

Common Core State Standards for ELA/Literacy

Reading in Science

RST.9-10.8 - Integration of Knowledge and Ideas

Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

(HS-LS2-6), (HS-LS2-7), (HS-LS2-8)

UT.BIO.1.4, UT.BIO.1.5, UT.BIO.4.2

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

(HS-LS2-1), (HS-LS2-2), (HS-LS2-3), (HS-LS2-6), (HS-LS2-8)

UT.BIO.1.1, UT.BIO.1.2, UT.1.4, UT.BIO.4.2

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.5 - Production and Distribution of Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

(HS-LS2-3)

UT.BIO.1.2

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Common Core State Standards for ELA/Literacy

Writing in Science
WHST.11-12.7 - Research to Build and Present Knowledge

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

(HS-LS2-7) **UT.BIO.1.5**

Common Core State Standards for ELA/Literacy

Writing in Science
WHST.11-12.9 - Research to Build and Present Knowledge

Draw evidence from informational texts to support analysis, reflection, and research.

(HS-LS2-3)
UT.BIO.1.2

Common Core State Standards for ELA/Literacy

Writing in Science
WHST.9-12.2 - Text Types and Purposes

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

(HS-LS2-1), (HS-LS2-3)
UT.BIO.1.1, UT.BIO.1.2

Common Core State Standards for Mathematics

Number and Quantity » Quantities
HSN-Q.A.2 - Reason quantitatively and use units to solve problems.

Define appropriate quantities for the purpose of descriptive modeling.

(HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-7)
UT.BIO.1.1, UT.BIO.1.5

Common Core State Standards for Mathematics

Number and Quantity » Quantities
HSN-Q.A.1 - Reason quantitatively and use units to solve problems.

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

(HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-7)
UT.BIO.1.1, UT.BIO.1.5

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Common Core State Standards for Mathematics

Number and Quantity » Quantities

HSN-Q.A.3 - Reason quantitatively and use units to solve problems.

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

(HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-7)
UT.BIO.1.1, UT.BIO.1.5

Common Core State Standards for Mathematics

Statistics & Probability » Making Inferences & Justifying Conclusions

HSS-IC.A.1 - Understand and evaluate random processes underlying statistical experiments

Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

(HS-LS2-6)
UT.BIO.1.4

Common Core State Standards for Mathematics

Statistics & Probability » Making Inferences & Justifying Conclusions

HSS-IC.B.6 - Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Evaluate reports based on data.

(HS-LS2-6)
UT.BIO.1.4

Common Core State Standards for Mathematics

Mathematical Practices

MP.2 - Reason abstractly and quantitatively

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects. (HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-6), (HS-LS2-7) **UT.BIO.1.1, UT.BIO.1.4, UT.BIO.4.2**

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 use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. 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.

(HS-LS2-1), (HS-LS2-2), (HS-LS2-4) **UT.BIO.1.1**

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DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.A: Structure and Function

Systems of specialized cells within organisms help them perform the essential functions of life.

(HS-LS1-1)
UT.BIO.2.2, UT.BIO.3.1

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.A: Structure and Function

All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

(HS-LS1-1)
UT.BIO.2.2, UT.BIO.3.1

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.A: Structure and Function

Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

(HS-LS1-2)
UT.BIO.2.6

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.A: Structure and Function

Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

(HS-LS1-3) **UT.BIO.2.7**

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.B: Growth and Development of Organisms

In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.

(HS-LS1-4) **UT.BIO.2.5**

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.C: Organization for Matter and Energy Flow in Organisms

As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

(HS-LS1-6), (HS-LS1-7)
UT.BIO.2.1

DCI: From Molecules to Organisms: Structures and Processes

HS.LS1.C: Organization for Matter and Energy Flow in Organisms

The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) **UT.BIO.2.1**

DCI: From Molecules to Organisms: Structures and Processes

HS-LS1-7 is not included in UT BIO standards.

HS.LS1.C: Organization for Matter and Energy Flow in Organisms

As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

HS-LS1-7 is not included in UT BIO standards.

HS.LS1.C: Organization for Matter and Energy Flow in Organisms

The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.

(HS-LS1-5)
UT.BIO.2.3

HS-LS1-7 is not included in UT BIO standards.

Performance Expectation

HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration

Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.

HS-LS1-7 is not included in UT BIO standards.

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Performance Expectation

UT.BIO.2.2 Ask questions to plan and carry out an investigation to determine how (a) the structure and function of cells, (b) the proportion and quantity of organelles, and (c) the shape of cells result in cells with specialized functions. Examples could include mitochondria in muscle and nerve cells, chloroplasts in leaf cells, ribosomes in pancreatic cells, or the shape of nerve cells and muscle cells.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-1**

Performance Expectation

UT.BIO.2.6 Ask questions to develop an argument for how the structure and function of interacting organs and organ systems, that make up multicellular organisms, contribute to homeostasis within the organism. Emphasize the interactions of organs and organ systems with the immune, endocrine, and nervous systems.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-2**

Performance Expectation

UT.BIO.2.7 Plan and carry out an investigation to provide evidence of homeostasis and that feedback mechanisms maintain stability in organisms. Examples of investigations could include heart rate response to changes in activity, stomata response to changes in moisture or temperature, or root development in response to variations in water level.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-3**

Performance Expectation

UT.BIO.2.5 Construct an explanation about the role of mitosis in the production, growth, and maintenance of systems within complex organisms. Emphasize the major events of the cell cycle including cell growth and DNA replication, separation of chromosomes, and separation of cell contents.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-4**

Performance Expectation

UT.BIO.2.3 Develop and use a model to illustrate the cycling of matter and flow of energy through living things by the processes of photosynthesis and cellular respiration. Emphasize how the products of one reaction are the reactants of the other and how the energy transfers in these reactions.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-5**

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Performance Expectation

UT.BIO.3.1 Construct an explanation for how the structure of DNA is replicated, and how DNA and RNA code for the structure of proteins which regulate and carry out the essential functions of life and result in specific traits. Emphasize a conceptual understanding that the sequence of nucleotides in DNA determines the amino acid sequence of proteins through the processes of transcription and translation.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-1**

Performance Expectation

BIO.2.4 Plan and carry out an investigation to determine how cells maintain stability within a range of changing conditions by the transport of materials across the cell membrane. Emphasize that large and small particles can pass through the cell membrane to maintain homeostasis.

This standard has no NGSS equivalent.

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2) **UT.BIO.2.6**

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4), (HS-LS1-5), (HS-LS1-7) **UT.BIO.2.5, UT.BIO.2.3**

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3) **UT.BIO.2.7**

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. (HS-LS1-6) **UT.BIO.2.1**

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) 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. (HS-LS1-1) **UT.BIO.2.2, UT.BIO.3.1**

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Crosscutting Concepts

Energy and Matter

Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

(HS-LS1-7)

HS-LS1-7 is not included in UT BIO standards.

HS-LS1-7 is not included in UT BIO standards.

Crosscutting Concepts

Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

(HS-LS1-1)

UT.BIO.2.2, UT.BIO.3.1

Crosscutting Concepts

Stability and Change

Feedback (negative or positive) can stabilize or destabilize a system.

(HS-LS1-3)

UT.BIO.2.7

Crosscutting Concepts

Energy and Matter

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

(HS-LS1-5), (HS-LS1-6)

UT.BIO.2.3, UT.BIO.2.1

Crosscutting Concepts

Systems and System Models

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

(HS-LS1-2), (HS-LS1-4)

UT.BIO.2.6, UT.BIO.2.5

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Common Core State Standards for ELA/Literacy

Writing in Science

WHST.11-12.7 - Research to Build and Present Knowledge

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

(HS-LS1-3) **UT.BIO.2.7**

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.11-12.8 - Research to Build and Present Knowledge

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

(HS-LS1-3) **UT.BIO.2.7**

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.11-12.9 - Research to Build and Present Knowledge

Draw evidence from informational texts to support analysis, reflection, and research.

(HS-LS1-1)

UT.BIO.2.2, UT.BIO.3.1

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.11-12.5 - Presentation of Knowledge and Ideas

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

(HS-LS1-2), (HS-LS1-4), (HS-LS1-5), (HS-LS1-7)

UT.BIO.2.6, UT.BIO.2.5

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

(HS-LS1-1), (HS-LS1-6)

UT.BIO.2.2, UT.BIO.3.1, UT.BIO.2.1

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Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.2 - Text Types and Purposes

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

(HS-LS1-1), (HS-LS1-6)
UT.BIO.2.2, UT.BIO.3.1, UT.BIO.2.1

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.5 - Production and Distribution of Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

(HS-LS1-6) **UT.BIO.2.1**

Performance Expectation

UT.BIO.2.1 Construct an explanation based on evidence that all organisms are primarily composed of carbon, hydrogen, oxygen, and nitrogen, and that the matter taken into an organism is broken down and recombined to make macromolecules necessary for life functions. Emphasize that molecules are often transformed through enzymatic processes and the atoms involved are used to make carbohydrates, proteins, fats/lipids, and nucleic acids.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-LS1-6**

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.9-12.1 - Text Types and Purposes

Write arguments focused on discipline-specific content.

(HS-LS3-2)
UT.BIO.3.3

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

(HS-LS3-1), (HS-LS3-2)
UT.BIO.3.2, UT.BIO.3.3

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Common Core State Standards for Mathematics

Interpreting Functions

HSF-IF.C.7 - Analyze functions using different representations.

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

(HS-LS1-4)
UT.BIO.2.5

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 use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. 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. (HS-LS1-4) **UT.BIO.2.5**

Common Core State Standards for Mathematics

Building Functions

HSF-BF.A.1 - Build a function that models a relationship between two quantities. Write a function that describes a relationship between two quantities

(HS-LS1-4)
UT.BIO.2.5

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.9 - Integration of Knowledge and Ideas

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

(HS-LS3-1) **UT.BIO.3.2**

Common Core State Standards for Mathematics

Mathematical Practices

MP.2 - Reason abstractly and quantitatively

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects. (HS-LS3-2), (HS-LS3-3) **UT.BIO.3.3, UT.BIO.3.4**

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DCI: Engineering Design

Integrated into multiple content standards.

HS.ETS1.A: Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

(HS-ETS1-1)

Integrated into multiple content standards.

DCI: Engineering Design

Integrated into multiple content standards.

HS.ETS1.A: Defining and Delimiting Engineering Problems

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

(HS-ETS1-1)

Integrated into multiple content standards.

DCI: Engineering Design

HS.ETS1.B: Developing Possible Solutions

When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

(HS-ETS1-3)

UT.BIO.3.5

DCI: Engineering Design

Integrated into multiple content standards.

HS.ETS1.B: Developing Possible Solutions

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

Integrated into multiple content standards.

DCI: Engineering Design

Integrated into multiple content standards.

HS.ETS1.C: Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

(HS-ETS1-2)

Integrated into multiple content standards.

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Performance Expectation

UT.BIO.3.5 Evaluate design solutions where biotechnology was used to identify and/or modify genes in order to solve (effect) a problem. Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Emphasize arguments that focus on how effective the solution was at meeting the desired outcome.

For Clarification Statements and Assessment Boundaries, please see NGSS. **HS-ETS1-3**

Performance Expectation

Integrated into multiple content standards.

HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.*

Clarification Statement: none

Assessment Boundary: none

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

Integrated into multiple content standards.

Performance Expectation

Integrated into multiple content standards.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.*

Clarification Statement: none

Assessment Boundary: none

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

Integrated into multiple content standards.

Performance Expectation

Integrated into multiple content standards.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. *

Clarification Statement: none

Assessment Boundary: none

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

Integrated into multiple content standards.

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Integrated into multiple content standards.

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)

Integrated into multiple content standards.

Integrated into multiple content standards.

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and 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.

Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

Integrated into multiple content standards.

Integrated into multiple content standards.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)

Integrated into multiple content standards.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

(HS-ETS1-3) **UT.BIO.3.5**

Integrated into multiple content standards.

Crosscutting Concepts

Systems and System Models

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

(HS-ETS1-4)

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Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.8 - Integration of Knowledge and Ideas

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

(HS-ETS1-1), (HS-ETS1-3) **UT.BIO.3.5**

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.9 - Integration of Knowledge and Ideas

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

(HS-ETS1-1), (HS-ETS1-3) **UT.BIO.3.5**

Common Core State Standards for ELA/Literacy

Reading in Science

RST.11-12.7 - Integration of Knowledge and Ideas

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

(HS-ETS1-1), (HS-ETS1-3) **UT.BIO.3.5**

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 use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. 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.

(HS-ETS1-1), (HS-ETS1-2), (HS-ETS1-3), (HS-ETS1-4) **UT.BIO.3.5**

Common Core State Standards for Mathematics

Mathematical Practices

MP.2 - Reason abstractly and quantitatively

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

(HS-ETS1-1), (HS-ETS1-3), (HS-ETS1-4) **UT.BIO.3.5**

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