Biology

Kansas City, Kansas Public Schools – Inspiring Excellence: Every Grownup, Every Child, Every Day.

(Updated May 2026)

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Biology Performance Expectations and Priority Standards At-A-Glance

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HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. *[Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]*	X			
HS-LS2-1:	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. *[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]*	X			
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.]*	X			
HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. *[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*	X			X
HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. *[Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]*	X			
HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. *[Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]*		X		

HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. *[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.]* *[Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]*		X		
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. *[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]*		X		
HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. *[Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*		X		
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 the 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.]*		X		
HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. *[Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]*		X		
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.]*		X		
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. *[Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]*		X		
HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells *[Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]*			X	
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms			X	

	[Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]				
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. *[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]*			X	
HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*			X	
HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors *[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.]* *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*			X	
HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. *[Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]*			X	
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 the 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.]*			X	X
HS-LS4-3	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. *[Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]*			X	X
HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations. *[Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]*			X	X

HS-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. *[Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]*			X	X
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.]*			X	X
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. *[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]*				X
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. *[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]*				X
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* *[Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]*				X
HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. *[Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]*				X

Biology B.1: Ecosystems Interactions and Dynamics - First Quarter
Recommended Time Frame: 26 - 45 minute sessions

Learning Focus:
Students use mathematical and computational representations, evidence, and argumentation to explain how resource availability, carrying capacity, biodiversity, group behavior, and changing conditions affect ecosystem stability and sustainability.

Anchoring Phenomenon / Problem:
How should we decide which lands and waters to protect as part of the 30 by 30 conservation initiative? Students investigate conservation examples and use the Serengeti as a case study to explain how resources, carrying capacity, group behavior, keystone species, biodiversity, and disturbances affect ecosystem stability and resilience.

Essential Question:
How do ecosystems work and how can understanding them help us protect them?

Student Product / Evidence to Collect:
Students produce mathematical or computational representations, a revised ecosystem model, and an evidence-based conservation recommendation that accounts for ecosystem dynamics, human needs, interest-holder perspectives, criteria, constraints, and trade-offs.

Curriculum Resource:
B.1 Landing Page in Canvas

Standards

HS-ESS3-3: NGSS Evidence Statement
Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. *[Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]*

HS-LS2-1: NGSS Evidence Statement
Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. *[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]*

HS-LS2-2: NGSS Evidence Statement
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-LS2-6: NGSS Evidence Statement
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. *[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*

HS-LS2-8. NGSS Evidence Statement
Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. *[Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]*

Science and Engineering Practices: (for more details see the NGSS Evidence Statements)

- **Using Mathematics and Computational Thinking**
- **Engaging in Argument from Evidence**

Disciplinary Core Ideas: (for more details see the NGSS Evidence Statements)

- **ESS3.C: Human Impacts on Earth Systems**
- **LS2.A: Interdependent Relationships in Ecosystems**
- **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**
- **LS2.D: Social Interactions and Group Behavior**

Crosscutting Concepts: (for more details see the NGSS Evidence Statements)

- **Stability and Change**
- **Scale, Proportion, and Quantity**
- **Cause and Effect**

Vocabulary Word Wall Ideas	Words we co-construct: • carrying capacity (L5) • algorithm (L5) • group behavior (L7) • mechanism (L8) • resilience (L8) • keystone species (L8) • disturbance (L8)	Words we encounter: • conservation (L1) • criteria (L1)** • ecosystem (L1) • nature-culture relations (L2) • biodiversity (L2) • conservation plan (L2) • empirical evidence (L3) • mortality factors (L3) • limiting factor (L4) • biomass (L6) • biodiversity ** {revisit} (L 8) • criteria {revisit} (L9) • constraints** (L9) • interest holder (L9)
	** Development in the middle school grade band of NGSS	

Resources:

[B.1 ESOL Supports Folder]

[B.1 Teacher Manual]

Teacher Planning Reminder: The essential question should guide student sensemaking across the unit. Instruction should prioritize the identified science and engineering practice, the disciplinary core idea, and the crosscutting concept rather than treating the unit as a list of facts or vocabulary to cover.

Notes:

- It is expected that the start of the year can sometimes have a few weeks before instruction while norms are established and relationships are built. If the unit is completed before the end of the first quarter, the learning can be extended or unit B.2 can be started.

Biology B.2: Ecosystems: Energy and Matter

Recommended Time Frame: 28 - 45 minute sessions

Learning Focus:
Students develop models, use mathematical or computational representations, and construct explanations to show how photosynthesis, cellular respiration, carbon cycling, and human activity affect matter and energy flow through organisms, ecosystems, and Earth systems.

Anchoring Phenomenon / Problem:
How can “zombie fires” continue burning beneath Arctic snow and ice and reappear near previous burn scars? Students investigate peat, permafrost, decomposition, photosynthesis, cellular respiration, and fire to explain how matter and energy move through ecosystems and how increased fires affect the global carbon cycle.

Essential Question:

What causes fires to burn in ecosystems and how should we manage them?

Student Product / Evidence to Collect:
Students produce a revised system model and quantitative explanation tracing matter, energy, and carbon through organisms, ecosystems, and Earth systems, then develop a solution for disrupting harmful fire and climate feedbacks.

Curriculum Resource:
B.2 Landing Page in Canvas

Standards

HS-ESS2-6: NGSS Evidence Statement
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. *[Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]*

HS-ESS3-6: NGSS Evidence Statement
Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. *[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]*

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

HS-LS1-5: NGSS Evidence Statement
Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. *[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]*

HS-LS1-6: NGSS Evidence Statement
Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. *[Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]*

HS-LS1-7: NGSS Evidence Statement
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-LS2-3: NGSS Evidence Statement
Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. *[Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]*

HS-LS2-4: NGSS Evidence Statement
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-LS2-5: NGSS Evidence Statement
Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. *[Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]*

Science and Engineering Practices: (for more details see the NGSS Evidence Statements)
- **Developing and Using Models**
- **Using Mathematics and Computational Thinking**
- **Constructing Explanations and Designing Solutions**

Disciplinary Core Ideas: (for more details see the NGSS Evidence Statements)
- **ESS2.D: Weather and Climate**
- **ESS3.D: Global Climate Change**
- **ETS1.C: Optimizing the Design Solution**
- **LS1.C: Organization for Matter and Energy Flow in Organisms**
- **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**
- **PS3.D: Energy in Chemical Processes**

Crosscutting Concepts: (for more details see the NGSS Evidence Statements)
- **Energy and Matter**
- **Systems and System Models**

Vocabulary Word Wall Ideas	Words we co-construct: • zombie fire (L1) • fuel (L2) • peat (L2) • energy** (L2) • matter** (L2) • carbon sink (L3) • photosynthesis**(L4) • chemical energy (L5) • zombie fire (revise) (L6) • climate change (L8)	Words we encounter: • Burn scar (L1) • Socio-ecological systems (L1) • components* (L1) • interactions* L1) • matter**(L1) • energy**(L1) • systems (L1) • scale (l1) • permafrost (L2) • cellular respiration**(L3) • aerobic (L3)

	• greenhouse gasses (L8) • feedback effects (L9) • carbon cycle (L9) • trade-offs (L11)	• anaerobic (L3) • tilt (L4) • directional hypothesis (L5) • fire suppression (L7) • biosphere**(L7) • atmosphere**(L7) • geosphere**(L9) • hydrosphere**(L9) • biomass*(L10) • food web** (L10) • criteria* (L11) • constraints* (L11) • interest holder*(L11) • dissolved oxygen (revisit) (L12)
	*Co-Constructed in a previous OpenSciEd High School Unit. **Co-Constructed or encountered in the middle school grade band of NGSS/OpenSciEd Middle School.	

Resources:
B.2 ESOL Supports Folder
B.2 Teacher Manual

Teacher Planning Reminder: The essential question should guide student sensemaking across the unit. Instruction should prioritize the identified science and engineering practice, the disciplinary core idea, and the crosscutting concept rather than treating the unit as a list of facts or vocabulary to cover.

Biology B.3: Inheritance and Variation of Traits

Recommended Time Frame: 26 - 45 minute sessions

Learning Focus:
Students use models, evidence, questions, claims, and statistical reasoning to explain how DNA, chromosomes, cell division, mutations, meiosis, and genetic or environmental factors influence proteins, traits, variation, and disease.

Anchoring Phenomenon / Problem:
Why do some people develop cancer while others do not, and what can be done to prevent or treat it? Students investigate cell division, DNA, proteins, the p53 gene, inherited and acquired mutations, environmental factors, treatment options, and differences in cancer incidence and outcomes.

Essential Question:

What causes cancer and why? What can we do about it?

Student Product / Evidence to Collect:
Students produce an evidence-based model and explanation connecting DNA, proteins, cell division, mutations, inheritance, environmental factors, and cancer, then apply their learning

Curriculum Resource:
B.3 Landing Page in Canvas

Standards

HS-ETS1-3: NGSS Evidence Statement
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-LS1-: NGSS Evidence Statement
Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. *[Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]*

HS-LS1-2: NGSS Evidence Statement
Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. *[Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]*

HS-LS1-4: NGSS Evidence Statement
Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. *[Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]*

HS-LS3-1: NGSS Evidence Statement
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. *[Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*

HS-LS3-2: NGSS Evidence Statement
Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. *[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]*

HS-LS3-3: NGSS Evidence Statement
Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. *[Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]*

Science and Engineering Practices: (for more details see the NGSS Evidence Statements)

- **Constructing Explanations and Designing Solutions**
- **Developing and Using Models**
- **Asking Questions and Defining Problems**

- **Engaging in Argument from Evidence**
- **Analyzing and Interpreting Data**

Disciplinary Core Ideas: (for more details see the NGSS Evidence Statements)

- **ETS1.B: Developing Possible Solutions**
- **LS1.A: Structure and Function**
- **LS1.B: Growth and Development of Organisms**
- **LS3.A: Inheritance of Traits**
- **LS3.B: Variation of Traits**

Crosscutting Concepts: (for more details see the NGSS Evidence Statements)

- **Structure and Function**
- **Systems and System Models**
- **Cause and Effect**
- **Scale, Proportion, and Quantity**

Vocabulary Word Wall Ideas	Words we co-construct: • hierarchical organization (L2) • cell cycle (L3) • mitosis (L3) • mutation**(L4) • replication (L4) • complementary base pairs (L4) • DNA (L4) • gene expression (L5) • meiosis (L8) • allele (L8)	Words we encounter: • correlation (L1) • causation (L1) • P53 (L1) • tissue (L2) • organ (L2) • body system (L2) • organism (L2) • tumor (L2) • benign (L 2) • malignant (L2) • metastasis (L2) • organelle (L3) • nutrient** (L3) • protein** (L3) • chromosome** (L3) • cell membrane** (L3) • nucleus (L3) • spindle (L3) • synthesis (L3) • relative (L3) • RNA (L5) • ribosome (L5) • amino acid (L5) • helicase (L5) • complementary base pairs (L5) • inheritance** (L8)

		• crossing over (L8) • melanoma (L9) • chemotherapy (L11) • radiation (L11) • surgery (L11) • immunotherapy (L11) • social determinants of health (L 12) • health equity (L12)
	*Co-Constructed in a previous OpenSciEd High School Unit. **Co-Constructed or encountered in the middle school grade band of NGSS/OpenSciEd Middle School.	

Resources:
B.3 ESOL Supports Folder
B.3 Teacher Manual

Teacher Planning Reminder: The essential question should guide student sensemaking across the unit. Instruction should prioritize the identified science and engineering practice, the disciplinary core idea, and the crosscutting concept rather than treating the unit as a list of facts or vocabulary to cover.

Biology B.4: Natural Selection and Evolution of Populations

Recommended Time Frame: 23 - 45 minute sessions

Learning Focus:
Students analyze data, apply statistics and probability, construct explanations, and evaluate or revise solutions to explain how heritable variation, environmental pressures, urbanization, and human activity affect natural selection, adaptation, biodiversity, and population change.

Anchoring Phenomenon / Problem:
Why do urban populations of hawksbeard, rats, and juncos differ from populations of the same organisms living in less urban environments? Students analyze data and investigations to explain how heritable variation, environmental pressures, competition, and differential survival and reproduction cause populations to change over generations.

Essential Question:

How does urbanization affect non-human populations, and how can we minimize harmful effects?

Student Product / Evidence to Collect:
Students produce a data-supported explanation of natural selection and population change, then evaluate or revise an urban-development solution that balances human needs with the resilience and biodiversity of nonhuman populations.

Curriculum Resource:
B.4 Landing Page in Canvas

Standards

HS-ETS1-3: NGSS Evidence Statement
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-LS4-2: NGSS Evidence Statement

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 the 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-LS4-3: **NGSS Evidence Statement**

Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. *[Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]*

HS-LS4-4: **NGSS Evidence Statement**

Construct an explanation based on evidence for how natural selection leads to adaptation of populations. *[Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]*

HS-LS4-5: **NGSS Evidence Statement**

Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. *[Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]*

HS-LS4-6: **NGSS Evidence Statement**

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.]*

Science and Engineering Practices: (for more details see the NGSS Evidence Statements)

- **Constructing Explanations and Designing Solutions**
- **Analyzing and Interpreting Data**
- **Engaging in Argument from Evidence**
- **Using Mathematics and Computational Thinking**

Disciplinary Core Ideas: (for more details see the NGSS Evidence Statements)

- **ETS1.B: Developing Possible Solutions**
- **LS4.B: Natural Selection**
- **LS4.C: Adaptation**
- **LS4.D: Biodiversity and Humans**
- **ETS1.B: Developing Possible Solutions**

Crosscutting Concepts: (for more details see the NGSS Evidence Statements)

- **Cause and Effect**
- **Patterns**

Vocabulary Word Wall Ideas	Words we co-construct: • adaptation**(L2) • natural selection**(L2) • selection pressure (L2) • physiological adaptation (L3) • behavioral adaptation (L4) • fitness (L4) • evolution (L5) • biodiversity* (L7) • resilience* (L7) • fitness(revised) (L8) • standard deviation (L9)	Words we encounter: • urban (L1) • urbanization (L1) • fragmentation (L2) • hypothesis (L2) • common garden experience (L2) • allele* (L3) • trait** (L4) • theory (L5) • gene pool (L 8) • allele frequency (L8) • correlation coefficient (L9) • r^2 value(extension) (L9) • washes (L10) • floodways (L10)
	*Co-Constructed in a previous OpenSciEd High School Unit. **Co-Constructed or encountered in the middle school grade band of NGSS/OpenSciEd Middle School.	

Resources:

[B.4 ELL Supports Folder]

[B.4 Teacher Manual]

Teacher Planning Reminder: The essential question should guide student sensemaking across the unit. Instruction should prioritize the identified science and engineering practice, the disciplinary core idea, and the crosscutting concept rather than treating the unit as a list of facts or vocabulary to cover.

Biology B.5: Common Ancestry and Speciation
Recommended Time Frame: 21 - 45 minute sessions

Learning Focus:
Students use evidence, models, investigations, arguments, and scientific communication to explain common ancestry, natural selection, adaptation, speciation, ecosystem change, homeostasis, and human impacts on biodiversity.

Anchoring Phenomenon / Problem:
Why were polar bears, grizzly bears, and hybrid bears observed in the same Canadian Arctic region, and what might happen to these populations as the environment changes? Students use Traditional Knowledge and Western scientific evidence to investigate common ancestry, adaptation, speciation, hybridization, changing Arctic habitats, and extinction risk.

Essential Question:
What will happen to arctic bear populations as their environment changes?

Student Product / Evidence to Collect:
Students produce an evidence-based evolutionary model and argument explaining relationships among Arctic bear species and predicting how environmental change may affect their future, then apply their reasoning to evaluate a biodiversity-protection strategy or explain another species' extinction risk.

Curriculum Resource:
B.5 Landing Page in Canvas

Standards

HS-LS4-2: NGSS Evidence Statement

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 the 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-LS4-4: **NGSS Evidence Statement**
Construct an explanation based on evidence for how natural selection leads to adaptation of populations. *[Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]*

HS-LS4-5: **NGSS Evidence Statement**
Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. *[Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]*

HS-ESS2-7: **NGSS Evidence Statement**
Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. *[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]*

HS-LS1-3: **NGSS Evidence Statement**
Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. *[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]*

HS-LS2-6: NGSS Evidence Statement
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. *[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]*

HS-LS2-7: NGSS Evidence Statement
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
[Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

HS-LS4-1: NGSS Evidence Statement
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. *[Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]*

Science and Engineering Practices: (for more details see the NGSS Evidence Statements)

- **Constructing Explanations and Designing Solutions**
- **Engaging in Argument from Evidence**
- **Planning and Carrying Out Investigations**
- **Obtaining, Evaluating, and Communicating Information**

Disciplinary Core Ideas: (for more details see the NGSS Evidence Statements)

- **LS4.B: Natural Selection**
- **LS4.C: Adaptation**
- **ESS2.D: Weather and Climate**
- **ESS2.E Biogeology**
- **LS1.A: Structure and Function**
- **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**
- **LS4.D: Biodiversity and Humans**
- **ETS1.B: Developing Possible Solutions**
- **LS4.A: Evidence of Common Ancestry and Diversity**

Crosscutting Concepts: (for more details see the NGSS Evidence Statements)

- **Cause and Effect**
- **Stability and Change**
- **Patterns**

Vocabulary	Words we co-construct: • thermoregulation (L2)	Words we encounter: • seasonably available ice (L1)

Word Wall Ideas	• common ancestry (L3) • speciation (L4)	• permanent ice (L1) • species* (L1) • adaptation* (L1) • population* (L1) • convergent (L1) • divergent (L1) • archipelago (L1) • refute (L2) • glacial period (L4) • interglacial period (L4) • hybrid (L6) • family (L7) • mass extinction (L7)
	*Co-Constructed in a previous OpenSciEd High School Unit. **Co-Constructed or encountered in the middle school grade band of NGSS/OpenSciEd Middle School.	

Resources:
B.5 ESOL Supports Folder
B.5 Teacher Manual

Teacher Planning Reminder: The essential question should guide student sensemaking across the unit. Instruction should prioritize the identified science and engineering practice, the disciplinary core idea, and the crosscutting concept rather than treating the unit as a list of facts or vocabulary to cover.