

High School Biology: Year at a Glance

UNIT 1, MATTER AND ENERGY				Instructional days: 10		
Essential questions: How do organisms obtain and use the energy they need to live and grow? How do matter and energy move through ecosystems?						
Unit abstract: In this unit of study, students will construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They will apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration, and they will develop models to communicate these explanations. Students will understand organisms’ interactions with each other and their physical environment and how organisms obtain resources. Students can utilize the crosscutting concepts of matter and energy, systems, and system models to make sense of ecosystem dynamics.						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS2-3 LS2.B	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	PS1.B PS3.B PS3.D		ESS2.A	Constructing explanations and designing solutions	Energy and Matter
HS-LS2-4 LS2.B	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	PS3.B PS3.D			Using mathematics and computational thinking	Energy and Matter
HS-LS2-5 LS2.B PS3.D	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	PS1.B		ESS2.D	Developing and using models	Systems and System Models
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UNIT 2, INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS				Instructional days: 10		
Essential questions: How and why do living organisms interact with each other and their environment? What are the effects of organisms’ interactions with each other and their environment?						
Unit abstract: In this unit of study, students formulate answers to the question “how and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?” Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students can use mathematical reasoning and models to demonstrate fundamental concepts such as carrying capacity, factors affecting biodiversity and populations, and the previously learned cycling of matter and flow of energy. Studying the role of animal behavior in interactions among individuals and species increases student understanding of interactions among organisms and how these interactions influence the dynamics of ecosystems.						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS2-2 LS2.A LS2.C	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.			ESS2.E ESS3.A ESS3.C ESS3.D	Using Mathematics and Computational Thinking	Scale, Proportion and Quantity
HS-LS2-6 LS2.C	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.			ESS2.E	Engaging in Argument from Evidence	Stability and Change
HS-LS2-1 LS2.A	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.				Using Mathematics and Computational Thinking	Scale, Proportion and Quantity
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UNIT 3, HUMAN ACTIVITY AND CLIMATE				Instructional days: 16		
Essential questions: How do humans depend on Earth’s resources? How and why do humans interact with their environment and what are the effects of these interactions?						
Unit abstract: In this unit of study, students will examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters. Students will use computational representations to analyze how earth systems and their relationships are being modified by human activity. Students will develop an understanding of how human activities affect natural resources and of the interdependence between humans and Earth’s systems, which affect the availability of natural resources. Students will apply their engineering capabilities to reduce human impacts on earth systems and improve social and environmental cost–benefit ratios. The crosscutting concepts of cause and effect, systems and systems models, stability and change, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for this unit.						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-ESS3-1 ESS3.A ESS3.B	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.				Constructing Explanations and Designing Solutions	Cause and Effect
HS-ESS3-6 ESS2.D ESS3.D	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.		LS2.B LS2.C LS4.D		Using Mathematics and Computational Thinking	Systems and System Models
HS-ESS3-5 ESS3.D	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.	PS3.B PS3.D	LS1C	ESS2.D	Analyzing and Interpreting Data	Stability and Change
HS-ESS3-4* ESS3.C ETS1.B	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.			ESS3.C	Constructing Explanations and Designing Solutions	Stability and Change
HS-ETS1-3 ETS1.B	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.				Constructing Explanations and Designing Solutions	

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UNIT 4, HUMAN ACTIVITY AND BIODIVERSITY				Instructional days: 20		
Essential questions:		How do humans depend on Earth’s resources? How and why do humans interact with their environment and what are the effects of		these interactions?		
<p>Unit abstract: In this unit of study, mathematical models provide support for students’ conceptual understanding of systems and students’ ability to design, evaluate, and refine solutions for reducing the impact of human activities on the environment and maintaining biodiversity. Students will create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity. Crosscutting concepts of systems and system models play a central role in students' understanding of science and engineering practices and core ideas of ecosystems.</p> <p>Mathematical models provide support for students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.</p>						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-ESS3-3 ESS3.C	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	PS1.B	LS2.A LS2.B LS2.C LS4.D	ESS2.A ESS2.E	Using Mathematics and Computational Thinking	Stability and Change
HS-LS2-7* LS2.C LS4.D ETS1.B	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.			ESS2.D ESS2.E ESS3.A ESS3.C	Constructing Explanations and Designing Solutions	Stability and Change
HS-LS4-6* LS4.C LS4.C ETS1.B	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.			ESS2.D ESS2.E ESS3.A ESS3.C ESS3.D	Using Mathematics and Computational Thinking	Cause and Effect
HS-ETS1-1 ETS1.A	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.				Asking Questions and Defining Problems	
HS-ETS1-2 ETS1.C	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.				Constructing Explanations and Designing Solutions	
HS-ETS1-3 ETS1.B	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.				Constructing Explanations and Designing Solutions	
HS-ETS1-4 ETS1.B	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.				Using Mathematics and Computational Thinking	Systems and System Models

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UNIT 5, CELL STRUCTURE				Instructional days: 18		
Essential question: How do the structures of organisms enable life’s functions?						
Unit abstract: In this unit of study, students formulate an answer to the question “How do the structures of organisms enable life’s functions?” High school students are able to investigate explanations of the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. Students demonstrate understanding through critical reading, using models, and conducting investigations. The crosscutting concepts of structure and function, matter and energy, and systems and system models in organisms are called out as organizing concepts.						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS1-1 LS1.A	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.		LS3.A		Constructing Explanations and Designing Solutions	Structure and Function
HS-LS1-2 LS1.A	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.				Developing and Using Models	Systems and System Models
HS-LS1-3 LS1.A	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.				Planning and Carrying Out Investigations	Stability and Change
HS-LS1-4 LS1.B	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.				Developing and Using Models	Systems and System Models
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UNIT 6, DNA AND INHERITANCE				Instructional days: 18		
Essential question: How are characteristics from one generation related to the previous generation?						
<p>Unit abstract: In this unit of study, students will demonstrate an understanding of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students can determine why individuals of the same species vary in how they look, function, and behave. Students develop conceptual models of the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions.</p> <p>The crosscutting concepts of structure and function, patterns, and cause and effect developed in this unit help students generalize understanding of inheritance of traits to other applications in science.</p>						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS3-1 LS1.A LS3.A	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.				Asking Questions and Defining Problems	Cause and Effect
HS-LS3-2 LS3.B	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.				Engaging in Argument from Evidence	Cause and Effect
HS-LS3-3 LS3.B	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.		LS2.A LS2.C LS4.B LS4.C		Analyzing and Interpreting Data	Scale, Proportion, and Quantity
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UNIT 7, NATURAL SELECTION				Instructional days: 20		
Essential question: How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms?						
Unit abstract: In this unit of study, high school students can investigate patterns to find the relationship between the environment and natural selection. Students demonstrate understanding of the factors causing natural selection of species over time. They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. Students demonstrate an understanding of these concepts by constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS4-4 LS4.C	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.		LS2.A LS2.D		Constructing Explanations and Designing Solutions	Cause and Effect
HS-LS4-3 LS4.B LS4.C	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.		LS2.A LS2.D LS3.B		Analyzing and Interpreting Data	Patterns
HS-LS4-5 LS4.C	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.		LS2.A LS2.D LS3.B		Engaging in Argument from Evidence	Cause and Effect
HS-LS2-8 LS2.D	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.				Engaging in Argument from Evidence	Cause and Effect
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UNIT 8, EVOLUTION				Instructional days: 22		
Essential question: What evidence shows that different species are related?						
<p>Unit abstract: In this unit of study, students can construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students can evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.</p>						
PE DCI	Performance Expectations	Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-LS4-1 LS4.A	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.		LS2.A LS2.D LS3.A LS3.B	ESS1.C ESS2.E ESS3.A	Obtaining, Evaluation, and Communicating Information	Patterns
HS-LS4-2 LS4.B LS4.C	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.		LS2.A LS2.D LS3.B	ESS2.E ESS2.A	Constructing Explanations and Designing Solutions	Cause and Effect
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UNIT 9, BIOECOLOGY				Instructional days: 18		
Essential question: How do the major systems of Earth interact?						
Unit abstract: In this unit of study, students develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth’s surface. Students will learn that Earth’s history includes the coevolution of the biosphere with Earth’s other systems. Students will demonstrate understanding by engaging in argument from evidence. The crosscutting concept of stability and change is called out as an organizing element.						
PE DCI Performance Expectation		Grade Band DCI Connections			Science and Engineering Practices	Crosscutting Concepts
		Physical Science	Life Science	Earth and Space Science		
HS-ESS2-7 ESS2.D ESS2.E	Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.		LS2.A LS2.C LS4.A LS4.B LS4.C LS4.D		Engaging in Argument from Evidence	Stability and Change
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