

Introduction

Science, Technology & Engineering, and Environmental Literacy & Sustainability (STEELS) Standards guide the study of the natural and human-made world through inquiry, problem-solving, critical thinking, and authentic exploration. This document displays a curriculum framework for High School Life Science. It is designed to focus curriculum and teaching, provide guidance for multiple approaches to curriculum development, encourage less reliance on textbooks as curriculum, and avoid activity-oriented teaching without focus/purpose.

Science Long Term Transfer Goals

In support of the Curriculum Framework, Long Term Transfer Goals (LTTG) provide the overarching practices that ground the foundation for a robust curriculum; thus, all curriculum should relate to one or more of the LTTGs detailed below – as they highlight the effective uses of understanding, knowledge, and skill that we seek in the long run; i.e., what we want students to be able to do when they confront new challenges – both in and outside of school.

Students will be able to engage as technological and engineering literate members of a global society, using their learning to:

- 1. Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
- 2. Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
- 3. Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
- 4. Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
- 5. Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Note: The 2014 Assessment Anchors and Eligible Content will be used for the Biology Keystone Exam during the 2024-2025 school year. For the 2025-2026 school year, the Biology Keystone Exam will not have Assessment Anchors/Eligible Content. The Biology Keystone Exam will be based upon the STEELS Life Science Standards and Assessment Boundaries.

August 2024 1 | P a g e



Grade 9-12 Life Science

Structure and Fu	nction			_			
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts	Vocabulary	Assessment Anchor Eligible Content
Organisms have	How do the	3.1.9-12.A	Constructing	Systems of specialized	Structure and	DNA	BIO.B.1.2.1
characteristic	structures of	Construct an	Explanations and	cells within organisms	Function	RNA	BIO.B.1.2.2
structures which	organisms enable	explanation based on	Designing Solutions	help them perform the	Investigating or	Genes	BIO.B.2.2.1
enable functions	life's functions?	evidence for how the	Construct an	essential functions of	designing new	Protein	BIO.B.2.2.2
and behaviors		structure of DNA	explanation based on	life.	systems or structures	Protein Synthesis	
that allow them to		determines the	valid and reliable		requires a detailed	DNA replication	
grow, reproduce,		structure of proteins,	evidence obtained from	All cells contain genetic	examination of the	transcription	
and die.		which carry out the	a variety of sources	information in the form	properties of different	translation	
		essential functions of	(including students' own	of DNA molecules.	materials, the		
		life through systems	investigations, models,	Genes are regions in	structures of different		
		of specialized cells.	theories, simulations,	the DNA that contain	components, and		
			peer review) and the	the instructions that	connections of		
			assumption that	code for the formation	components to reveal		
			theories and laws that	of proteins, which carry	its function and/or		
			describe the natural	out most of the work of	solve a problem.		
			world operate today as	cells.			
			they did in the past and				
			will continue to do so in				
			the future.				
Organisms have	How do the	3.1.9-12.B	Developing and Using	Multicellular organisms	Systems and System	unicellular	BIO.A.1.1.1
characteristic	structures of	Develop and use a	Models	have a	Models	multicellular	BIO.A.1.2.2
structures which	organisms enable	model to illustrate	Develop and use a	hierarchical structural	Models (e.g., physical,	prokaryotic	
enable functions	life's functions?	the hierarchical	model based on	organization, in which	mathematical,	eukaryotic	
and behaviors		organization of	evidence to illustrate	any one	computer models) can	tissue	
that allow them to		interacting systems	the relationships	system is made up of	be used to simulate	organ	
grow, reproduce,		that provide specific	between systems or	numerous parts and is	systems and	organ system	
and die.		functions within		itself a	interactions—	organism	

August 2024 2 | Page



		multicellular organisms.	between components of a system.	component of the next level.	including energy, matter, and information flows— within and between systems at different scales.	stimuli circulatory system nutrient levels of biological organization model system	
Organisms have characteristic structures which enable functions and behaviors that allow them to grow, reproduce, and die.	How do the structures of organisms enable life's functions?	3.1.9-12.C Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	Planning and Carrying Out Investigations 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.	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.	Stability and Change Feedback (negative or positive) can stabilize or destabilize a system.	homeostasis feedback loops stomate transpiration temperature regulation osmoregulation excretory system	BIO.A.4.2.1 BIO.A.4.1.1 BIO.A.4.1.2

August 2024 3 | Page



Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The characteristic structures, functions and behaviors of organisms change in predictable ways as they progress through their life cycle.	How do organisms grow and develop?	3.1.9-12.D Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	Developing and Using Models Use a model based on evidence to illustrate the relationships between systems or between components of a system.	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.	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.	mitosis gene expression differentiation multicellular differentiation tissue organ organ system organism input output system model	BIO.B.1.1.1 BIO.B.1.1.2

August 2024 4 | Page



Organization for	Matter and Energy Flo	ow in Organisms					
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The structures,	How do organisms	3.1.9-12.E	Developing and Using	The process of	Energy and Matter	photosynthesis	BIO.A.3.1.1
functions, and	obtain and use the	Use a model to	Models	photosynthesis converts	Changes of energy and	glucose	BIO.A.3.2.1
behaviors of	matter and energy	illustrate how	Use a model based on	light energy to stored	matter in a system can	input	BIO.A.3.2.2
organisms allow	they need to live and	photosynthesis	evidence to illustrate	chemical energy by	be described in terms of	output	
them to obtain,	grow?	transforms light	the relationships	converting carbon dioxide	energy and matter flows	reactant	
use, transport,		energy into stored	between systems or	plus water into sugars plus	into, out of, and within	product	
and remove the		chemical energy.	between components	released oxygen.	that system.	chemical energy	
matter and energy			of a system.			light energy	
needed to live.							
The structures,	How do organisms	3.1.9-12.F	Constructing	The sugar molecules thus	Energy and Matter	organic	BIO.A.2.2.1
functions, and	obtain and use the	Construct and revise	Explanations and	formed contain carbon,	Changes of energy and	molecules	BIO.A.2.2.2
behaviors of	matter and energy	an explanation based	Designing Solutions	hydrogen, and oxygen:	matter in a system can	monomer	BIO.A.2.2.3
organisms allow	they need to live and	on evidence for how	Construct and revise	their hydrocarbon	be described in terms of	polymer	BIO.A.2.3.2
them to obtain,	grow?	carbon, hydrogen,	an explanation based	backbones are used to	energy and matter flows	macromolecules	BIO.A.2.3.1
use, transport,		and oxygen from	on valid and reliable	make amino acids and	into, out of, and within	protein	
and remove the		sugar molecules may	evidence obtained	other carbon-based	that system.	hydrocarbon	
matter and energy		combine with other	from a variety of	molecules that can be		amino acid	
needed to live.		elements to form	sources (including	assembled into larger		cellular	
		amino acids and/or	students' own	molecules (such as		respiration	
		other large carbon-	investigations,	proteins or DNA), used for		matter	
		based molecules.	models, theories,	example to form new		element	
			simulations, peer	cells.		metabolism	
			review) and the	As matter and energy flow			
			assumption that	through different			
			theories and laws that	organizational levels of			
			describe the natural	living systems, chemical			
			world operate today	elements are recombined			
			as they did in the past	in different ways to form			
			and will continue to	different products.			
			do so in the future.				

August 2024 5 | Page



The structures,	How do organisms	3.1.9-12.G	Developing and Using	As matter and energy flow	Energy and Matter	mitochondria	BIO.A.2.3.1
functions, and	obtain and use the	Use a model to	Models	through different	Energy cannot be	cellular	BIO.A.2.3.2
behaviors of	matter and energy	illustrate that cellular	Use a model based on	organizational levels of	created or destroyed—it	respiration	BIO.A.3.1.1
organisms allow	they need to live and	respiration is a	evidence to illustrate	living systems, chemical	only moves between	reactants	BIO.A.3.2.1
them to obtain,	grow?	chemical process	the relationships	elements are recombined	one place and another	products	BIO.A.3.2.2
use, transport,		whereby the bonds of	between systems or	in different ways to form	place, between objects	chemical energy	
and remove the		food molecules and	between components	different products.	and/or fields, or	stored energy	
matter and energy		oxygen molecules are	of a system.	As a result of these	between systems.	input	
needed to live.		broken and the bonds		chemical reactions, energy		output	
		in new compounds		is transferred from one		food molecule	
		are formed resulting		system of interacting		net transfer	
		in a net transfer of		molecules to another.		ADP/ATP	
		energy.		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.			
Interdependent F	Relationships in Ecosys	stems					
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Ecosystems are	How do organisms	3.1.9-12.H	Using Mathematical	Plants or algae form the	Energy and Matter	food chains/webs	BIO.B.4.1.1
complex systems	interact with the	Use mathematical	and Computational	lowest level of the food	Energy cannot be	trophic levels	
that include both	living and nonliving	representations to	Thinking	web. At each link upward	created or destroyed—it	energy	

August 2024 6 | Page



			[I
living (biotic) and	environments to	support claims for the	Simple computational	in a food web, only a small	only moves between	conservation of	BIO.B.4.1.2
non-living (abiotic)	obtain matter and	cycling of matter and	simulations are	fraction of the matter	one place and another	energy	BIO.B.4.2.1
components that	energy?	flow of energy among	created and used	consumed at the lower	place, between objects		BIO.B.4.2.2
interact with each		organisms in an	based on	level is transferred	and/or fields, or		BIO.B.4.2.3
other.		ecosystem.	mathematical models	upward, to produce	between systems.		BIO.B.4.2.4
!			of basic assumptions.	growth and release			
!			Use mathematical	energy in cellular			
!			representations of	respiration at the higher			
!			phenomena or design	level. Given this			
!			solutions to support	inefficiency, there are			
!			claims.	generally fewer organisms			
!				at higher levels of a food			
!				web. Some matter reacts			
1				to release energy for life			
!				functions, some matter is			
1				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			
1				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.			
Ecosystems are	How do organisms	3.1.9-12.l	Using Mathematics	Ecosystems have carrying	Scale Proportion and	carrying capacity	BIO.B.4.1.1
complex systems	interact with the	Use mathematical	and Computational	capacities, which are	Quantity	limiting factors	BIO.B.4.1.2
that include both	living and nonliving	and/or computational	Thinking	limits to the numbers of	The significance of a	ecosystem	BIO.B.4.2.1
living (biotic) and	environments to	representations to		organisms and	phenomenon is	predation	

August 2024 7 | P a g e



non-living (abiotic) components that interact with each other.	obtain matter and energy?	support explanations of factors that affect carrying capacity of ecosystems at different scales.	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.	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	dependent on the scale, proportion, and quantity at which it occurs.	competition biotic abiotic scale proportion	BIO.B.4.2.2 BIO.B.4.2.5
Cycles of Matter	and Energy Transfer in	n Ecosystems		resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.			
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the	How do matter and energy move through an ecosystem?	3.1.9-12.J Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	Constructing Explanations and Designing Solutions Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations,	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	Energy and Matter Energy drives the cycling of matter within and between systems.	anaerobic respiration aerobic respiration photosynthesis cellular respiration energy transfer	BIO.A.3.2.1 BIO.A.3.2.2

August 2024 8 | Page



	Т	Г	1	1	Г	1	
physical environment.			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.				
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment.	How do matter and energy move through an ecosystem?	3.1.9-12.K Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Developing and Using Models Develop a model based on evidence to illustrate the relationships between systems or components of a system.	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.	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.	carbon cycle photosynthesis cellular respiration carbon cycle biosphere atmosphere hydrosphere geosphere	BIO.B.4.1.1 BIO.B.4.1.2 BIO.B.4.2.1 BIO.B.4.2.2 BIO.B.4.2.3
The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and	How do matter and energy move through an ecosystem?	3.1.9-12.L Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and	Using Mathematics and Computational Thinking Simple computational simulations are created and used based on	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	Scale Proportion and Quantity Using the concept of orders of magnitude allows one to understand how a model at one scale	carrying capacity limiting factors biodiversity biotic abiotic population ecosystem predation	BIO.B.4.1.1 BIO.B.4.1.2 BIO.B.4.2.1 BIO.B.4.2.2 BIO.B.4.2.5

August 2024 9 | P a g e



between		populations in	mathematical models	and nonliving resources	relates to a model at	competition	
organisms and the		ecosystems of	of basic assumptions.	and from such challenges	another scale.	Competition	
physical		different scales.	Use mathematical	such as predation,	another scale.		
environment.		unierent scales.		competition, and disease.			
environment.			representations of				
			phenomena or design	Organisms would have the			
			solutions to support	capacity to produce			
			and revise	populations of great size			
			explanations.	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.			
Ecosystem Dynar	nics, Functioning, and	Resilience					
		resilience					
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
	1			Disciplinary Core Idea A complex set of	Cross-Cutting Concepts Stability and Change	Vocabulary ecological	
Big Idea	Essential Question	Standard	Practices	. ,		-	Eligible Content
Big Idea As the	Essential Question How do	Standard 3.1.9-12.M	Practices Engaging in Argument	A complex set of	Stability and Change	ecological	Eligible Content BIO.B.4.2.4
Big Idea As the environment and	Essential Question How do environmental	Standard 3.1.9-12.M Evaluate the claims,	Practices Engaging in Argument from Evidence	A complex set of interactions within an	Stability and Change Much of science deals	ecological relationships	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and	Practices Engaging in Argument from Evidence Evaluate the claims,	A complex set of interactions within an ecosystem can keep its	Stability and Change Much of science deals with constructing	ecological relationships niche	Eligible Content BIO.B.4.2.4
As the environment and populations of species change,	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and	A complex set of interactions within an ecosystem can keep its numbers and types of	Stability and Change Much of science deals with constructing explanations of how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted explanations or	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	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to	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	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits	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	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits	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	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4
Big Idea As the environment and populations of species change, there are resulting changes in	Essential Question How do environmental changes impact	Standard 3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable	Practices Engaging in Argument from Evidence Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits	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	Stability and Change Much of science deals with constructing explanations of how things change and how	ecological relationships niche succession	Eligible Content BIO.B.4.2.4

August 2024 10 | Page



As the environment and populations of species change, there are resulting changes in ecosystems	How do environmental changes impact ecosystems?	3.1.9-12.N Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Constructing Explanations and Designing Solutions Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	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. 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.	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.	human disturbances ecosystem biodiversity	BIO.B.4.2.4 BIO.B.4.2.5
Social Interaction Big Idea	ns and Group Behavior	Standard	Science and Engineering	Dissiplinary Caro Idea	Cross Cutting Consents	Vacabulary	Assessment Anchors
	Essential Question		Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Eligible Content
Many species live	How do organisms	3.1.9-12.0	Engaging in Argument	Group behavior has	Cause and Effect	group behaviors	N/A
in groups,	interact in groups so	Evaluate the evidence	from Evidence	evolved because	Empirical evidence is	genetic	
increasing the	as to benefit	for the role of group	Engaging in argument	membership can increase	required to differentiate	relatedness	
chances of	individuals?	behavior on	from evidence in 9–12	the chances of survival for	between cause and	species	
survival for		individual and	builds on K–8	individuals and their	correlation and make	group behaviors	
Sui Vivai IUI		species' chances to	experiences and	genetic relatives.		natural selection	

August 2024 11 | P a g e



individuals and		survive and	progresses to using		claims about specific	evolution	
their relatives.		reproduce.	appropriate and		causes and effects.	cause and effect	
			sufficient evidence			correlation	
			and scientific				
			reasoning to defend				
			and critique claims				
			and explanations				
			about natural and				
			designed worlds.				
			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.				
Inheritance of Tr	aits						
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Offspring	How are the	3.1.9-12.P	Asking Questions and	Each chromosome	Cause and Effect	DNA	BIO.B.1.2.2
resemble, but are	characteristics of one	Ask questions to	Defining Problems	consists of a single very	Empirical evidence is	gene	
not identical to,	generation related to	clarify relationships	Ask questions that	long DNA molecule, and	required to differentiate	allele	
their parents due	the previous	about the role of DNA	arise from examining	each gene on the	between cause and	chromosome	
to traits being	generation?	and chromosomes in	models or a theory to	chromosome is a	correlation and make	gene expression	
passed from one		coding the	clarify relationships.	particular segment of that	claims about specific	protein	
generation to the		instructions for		DNA. The instructions for	causes and effects.	traits	
next via genes.		characteristic traits		forming species'		inheritance	
				characteristics are carried			

August 2024 12 | P a g e



		passed from parents		in DNA. All cells in an			
		to offspring.		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.			
Variation of Trait	:s						
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Variation among	Why do individuals of	3.1.9-12.Q	Engaging in Argument	In sexual reproduction,	Cause and Effect	meiosis	BIO.B.2.1.2
individuals of the	the same species	Make and defend a	from Evidence	chromosomes can	Empirical evidence is	genetic mutation	BIO.B.2.3.1
same species can	vary in how they	claim based on	Make and defend a	sometimes swap sections	required to differentiate	genetic variation	BIO.B.2.4.1
be explained by	look, function, and	evidence that	claim based on	during the process of	between cause and		
both genetic and	behave?	inheritable genetic	evidence about the	meiosis (cell division),	correlation and make		
environmental		variations may result	natural world that	thereby creating new	claims about specific		
factors.		from (1) new genetic	reflects scientific	genetic combinations and	causes and effects.		
		combinations through	knowledge, and	thus more genetic			
		meiosis, (2) viable	student-generated	variation. Although DNA			
		errors occurring	evidence.	replication is tightly			
		during replication,		regulated and remarkably			
		and/or (3) mutations		accurate, errors do occur			
		caused by		and result in mutations,			
		environmental		which are also a source of			
		factors.		genetic variation.			
				Environmental factors can			
				also cause mutations in			
		1		also cause matations in	1	l	

August 2024 13 | P a g e



Variation among individuals of the same species can be explained by both genetic and environmental factors.	Why do individuals of the same species vary in how they look, function, and behave?	3.1.9-12.R Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	Analyzing and Interpreting 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	genes, and viable mutations are inherited. 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. 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.	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).	genotype phenotype inheritance traits gene expression population	BIO.B.2.1.1 BIO.B.3.3.1
		•	feasible.				
Evidence of Comr	mon Ancestry and Div	ersity					
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
Comparisons	What evidence	3.1.9-12.S	Obtaining, Evaluating,	Genetic information, like	Patterns	evolution	BIO.B.3.2.1
between species provides evidence	supports the	Communicate scientific information	and Communicating Information	the fossil record, provides evidence of evolution.	Different patterns may be observed at each of	evolutionary evidence	BIO.B.3.3.1

August 2024 14 | Page



that they evolved	relationship between	that common	Communicate	DNA sequences vary	the scales at which a		
from common	species?	ancestry and	scientific information	among species, but there	system is studied and		
ancestors,		biological evolution	(e.g., about	are many overlaps; in fact,	can provide evidence for		
explaining the		are supported by	phenomena and/or	the ongoing branching	causality in explanations		
similarities and		multiple lines of	the process of	that produces multiple	of phenomena.		
differences		empirical evidence.	development and the	lines of descent can be			
between species.			design and	inferred by comparing the			
			performance of a	DNA sequences of			
			proposed process or	different organisms. Such			
			system) in multiple	information is also			
			formats (including	derivable from the			
			orally, graphically,	similarities and			
			textually, and	differences in amino acid			
			mathematically).	sequences and from			
				anatomical and			
				embryological evidence.			
Natural Selection	ı						
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content
In any	How does genetic	3.1.9-12.T	Constructing	Natural selection occurs	Cause and Effect	natural selection	BIO.B.3.1.1
environment,	variation among						
	variation annong	Construct an	Explanations and	only if there is both (1)	Empirical evidence is	evolution	BIO.B.3.3.1
individuals with	organisms affect	Construct an explanation based on	Explanations and Designing Solutions	only if there is both (1) variation in the genetic	Empirical evidence is required to differentiate	evolution biological fitness	BIO.B.3.3.1
individuals with particular traits			•	, ,	•		BIO.B.3.3.1
	organisms affect	explanation based on	Designing Solutions	variation in the genetic	required to differentiate	biological fitness	BIO.B.3.3.1
particular traits	organisms affect survival and	explanation based on evidence that the	Designing Solutions Construct an	variation in the genetic information between	required to differentiate between cause and	biological fitness genetic variation	BIO.B.3.3.1
particular traits may be more	organisms affect survival and	explanation based on evidence that the process of evolution	Designing Solutions Construct an explanation based on	variation in the genetic information between organisms in a population	required to differentiate between cause and correlation and make	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others	organisms affect survival and	explanation based on evidence that the process of evolution primarily results from	Designing Solutions Construct an explanation based on valid and reliable	variation in the genetic information between organisms in a population and (2) variation in the	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others to survive and	organisms affect survival and	explanation based on evidence that the process of evolution primarily results from four factors: (1) the	Designing Solutions Construct an explanation based on valid and reliable evidence obtained	variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others to survive and	organisms affect survival and	explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species	Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of	variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others to survive and	organisms affect survival and	explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in	Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including	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	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others to survive and	organisms affect survival and	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	Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own	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	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1
particular traits may be more likely than others to survive and	organisms affect survival and	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	Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations,	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	required to differentiate between cause and correlation and make claims about specific	biological fitness genetic variation mutation	BIO.B.3.3.1

August 2024 15 | P a g e



		mutation and sexual	assumption that				
		reproduction, (3)	theories and laws that				
		competition for	describe the natural				
		limited resources, and	world operate today				
		(4) the proliferation	as they did in the past				
		of those organisms	and will continue to				
		that are better able to	do so in the future.				
		survive and					
		reproduce in the					
		environment.					
In any	How does genetic	3.1.9-12.U	Analyzing and	Natural selection occurs	Patterns	natural selection	BIO.B.3.1.1
environment	variation among	Apply concepts of	Interpreting Data	only if there is both (1)	Different patterns may	evolution	BIO.B.3.3.1
individuals with	organisms affect	statistics and	Analyzing data in 9–12	variation in the genetic	be observed at each of	allele frequency	
particular traits	survival and	probability to support	builds on K–8	information between	the scales at which a	biological fitness	
may be more	reproduction?	explanations that	experiences and	organisms in a population	system is studied and		
likely than others		organisms with an	progresses to	and (2) variation in the	can provide evidence for		
to survive and		advantageous	introducing more	expression of that genetic	causality in explanations		
produce offspring.		heritable trait tend to	detailed statistical	information—that is, trait	of phenomena.		
		increase in proportion	analysis, the	variation—that leads to			
		to organisms lacking	comparison of data	differences in			
		this trait.	sets for consistency,	performance among			
			and the use of models	individuals.			
			to generate and	The traits that positively			
			analyze data.	affect survival are more			
			Apply concepts of	likely to be reproduced,			
			statistics and	and thus are more			
			probability (including	common in the			
			determining function	population.			
			fits to data, slope,				
			intercept, and				
			correlation coefficient				
			for linear fits) to				
			scientific and				

August 2024 16 | P a g e



				1		1	 		
			engineering questions and problems, using digital tools when feasible.						
Adaptation									
Big Idea	Essential Question	Standard	Science and Engineering Practices	Disciplinary Core Idea	Cross-Cutting Concepts	Vocabulary	Assessment Anchors Eligible Content		
When the	How does the	3.1.9-12.V	Using Mathematics	Changes in the physical	Cause and Effect	biodiversity	BIO.B.4.2.4		
environment	environment	Create or revise a	and Computational	environment, whether	Empirical evidence is	speciation	BIO.B.4.2.5		
changes, some	influence populations	simulation to test a	Thinking	naturally occurring or	required to differentiate	biological			
individuals in a	of organisms over	solution to mitigate	Simple computational	human induced, have thus	between cause and	extinction			
population may	multiple	the adverse impacts	simulations are	contributed to the	correlation and make	human			
have traits that	generations?	of human activity on	created and used	expansion of some	claims about specific	disturbances			
provide a		biodiversity.	based on	species, the emergence of	causes and effects.				
reproductive			mathematical models	new distinct species as					
advantage which			of basic assumptions.	populations diverge under					
over many			Create or revise a	different conditions, and					
generations can			simulation of a	the decline-and					
change the make-			phenomenon,	sometimes the extinction-					
up of a			designed device,	of some species.					
population.			process, or system.						
When the	How does the	3.1.9-12.W	Constructing	Natural selection leads to	Cause and Effect	Adaptation	BIO.B.3.2.1		
environment	environment	Construct an	Explanations and	adaptation, that is, to a	Empirical evidence is	Biological fitness	BIO.B.3.3.1		
changes, some	influence populations	explanation based on	Designing Solutions	population dominated by	required to differentiate	natural selection			
individuals in a	of organisms over	evidence for how	Construct an	organisms that are	between cause and	evolution			
population may	multiple	natural selection	explanation based on	anatomically,	correlation and make				
have traits that	generations?	leads to adaptation of	valid and reliable	behaviorally, and	claims about specific				
provide a		populations.	evidence obtained	physiologically well suited	causes and effects.				
reproductive			from a variety of	to survive and reproduce					
advantage which			sources (including	in a specific environment.					
over many			students' own	That is, the differential					
generations can			investigations,	survival and reproduction					
change the make-			models, theories,	of organisms in a			l l		

August 2024 17 | P a g e



		T	1	1	T	T	T
up of a			simulations, peer	population that have an			
population.			review) and the	advantageous heritable			
			assumption that	trait leads to an increase			
			theories and laws that	in the proportion of			
			describe the natural	individuals in future			
			world operate today	generations that have the			
			as they did in the past	trait and to a decrease in			
			and will continue to	the proportion of			
			do so in the future.	individuals that do not.			
When the	How does the	3.1.9-12.X	Engaging in Argument	Changes in the physical	Cause and Effect	Biodiversity	BIO.B.3.2.1
environment	environment	Evaluate the evidence	from Evidence	environment, whether	Empirical evidence is	species	BIO.B.3.3.1
changes, some	influence populations	supporting claims	Arguments may also	naturally occurring or	required to differentiate	speciation	
individuals in a	of organisms over	that changes in	come from current or	human induced, have thus	between cause and	extinction	
population may	multiple	environmental	historical episodes in	contributed to the	correlation and make	divergent	
have traits that	generations?	conditions may result	science.	expansion of some	claims about specific	evolution	
provide a		in (1) increases in the	Evaluate the evidence	species, the emergence of	causes and effects.	convergent	
reproductive		number of individuals	behind currently	new distinct species as		evolution	
advantage which		of some species, (2)	accepted explanations	populations diverge under			
over many		the emergence of	or solutions to	different conditions, and			
generations can		new species over	determine the merits	the decline–and			
change the make-		time, and (3) the	of arguments.	sometimes the extinction-			
up of a		extinction of other		of some species.			
population.		species.					
				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.			

August 2024 18 | P a g e