

Biology +ESS Instructional Guide

Updated 05/05/23

Main Biology + ESS Course Folder is linked [here](#)

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Purpose		
The purpose of this instructional guide is to provide teachers with both structure and choice for unit and lesson planning. This guide includes integrated and bundled units guided by Essential Questions, Performance Expectations and examples of Student-Generated Evidence. Additionally, phenomena and resources are provided to drive instruction, and NGSS aligned tasks are provided for student assessment. These components are reflective of NGSS Standards (2013), California Common Core State Standards (2013), California Science Framework (2016), and Sweetwater's one-to-one device initiative. Performance Expectations are grouped by semester, and teachers will provide instruction and assessment on those PEs in that semester. The goal is for teachers to backwards map unit plans in PLCs that engage and support students in the 3 dimensional learning of NGSS by teaching skills and content stated in the Performance Expectations and evaluated through student generated evidence. Teachers should engage students in language and speaking/listening activities within reading and writing experiences on a daily basis.		
Safety		
The safety of students and staff is paramount. Please take the following steps to ensure the safety of everyone in your classroom. Please use the SUHSD Safety Checklist to make sure all of the needed safety equipment is there and working properly. 1. Consult with the California Safety Handbook if you have a question or a concern before starting a lab. 2. All students must be given a safety quiz and corrected to 100% before a lab can be performed. These must be kept on file by the teacher for at least a year. 3. You must have a Safety Data Sheet (SDS) for every chemical in your site and know where to find it. 4. Keep your lab clean and free of hazardous materials, do not block walkways to exit doors, eyewash, safety blankets or drench showers. 5. Classroom pets must be maintained in a healthy way and not neglected or mistreated and a reasonable number of pets per classroom. 6. Check with Robert D. Russell the Safety inspector for disposal of hazardous materials and used specimens. 7. Science classrooms have a maximum cap of 34 students. Please see the SUHSD Science Room Class Cap Guidelines.		

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Semester 1						
<u>IS1: Ecosystem Interactions and Energy</u> Suggested Pacing: 6 weeks		<u>IS 2: History of Earth's Atmosphere: Photosynthesis and Respiration</u> Suggested Pacing: 6 weeks			<u>IS 6: Ecosystem Stability and the Response to Climate Change</u> Suggested Pacing: 6 weeks	
<u>LS 2-1</u> <u>LS 2-2</u>	<u>LS 2-4</u> <u>LS 2-8</u>	<u>LS 1-5</u> <u>LS 1-7</u> <u>LS 2-5</u>	<u>LS 2-3</u> <u>LS 1-6</u>	<u>ESS 1-6</u> <u>ESS 2-6</u> <u>ESS 2-7</u>	<u>LS 2-6</u> <u>LS 4-5</u> <u>ESS 3-5</u>	<u>LS 2-7</u> <u>LS 4-6</u> <u>ESS 3-6</u> <u>ETS 1-1</u> <u>ETS 1-2</u>
Bundle 1.1	Bundle 1.2	Bundle 2.1	Bundle 2.2	Bundle 2.3 Fall PT	Bundle 6.1	Bundle 6.2 Semester 1 EOC

Semester 2						
<u>IS 5: Structure, Function, and Growth</u> Suggested Pacing: 6 weeks		<u>IS 4: Inheritance of Traits</u> Suggested Pacing: 6 weeks		<u>IS 3: Evidence of Evolution</u> Suggested Pacing: 6 weeks		
<u>LS 1-1</u> <u>LS 1-2</u>	<u>LS 1-3</u> <u>LS 1-4</u>	<u>LS 3-1</u> <u>LS 3-2</u> <u>LS 3-3</u>	<u>LS 4-3</u> <u>ETS1-3</u>	<u>LS 4-1</u> <u>LS 4-2</u> <u>LS 4-4</u> <u>LS 4-5</u>	<u>ESS 1-5</u> <u>ESS 2-5</u>	<u>ESS 3-1</u> <u>ESS 3-4</u>
Bundle 5.1	Bundle 5.2	Bundle 4.1	Bundle 4.2 Spring PT	Bundle 3.1	Bundle 3.2	Bundle 3.3 Semester 2 EOC

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IS1: Ecosystem Interactions and Energy

Storyline from California Science Framework:

Anchoring Phenomena Ideas: The significantly high percentage of biomass in terrestrial ecosystems found in producers; The numbers of organisms found at each trophic level; The inefficient transfer of energy between trophic levels; The low standing biomass of primary producers in aquatic ecosystems; Organisms that can occupy more than one trophic level

Bundle 1a Essential Question

How do matter and energy move through an ecosystem?

How (and why) do organisms interact with their environment and what are the effects of these interactions?

Bundle 1a Investigative Phenomena

Pacing: 2 weeks

Disciplinary Core Ideas

LS2.B Cycles of Matter and Energy Transfer in Ecosystems

Crosscutting Concepts

Systems and Systems Models
[Energy and Matter](#)

Science + Engineering Practices

[Use Mathematical and Computational Thinking](#) (ISLP)

Performance Expectations For Students

[HS-LS-2-4](#) Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem

Resources

[What is Ecology?](#)
[Food Chains and Food Webs](#)
[Cycling of Matter and Energy](#)
[Owl Pellets Lab](#)
SEL Prompts [Connections](#); [Basic needs](#)
Achieve 3000 Text Set

Formative Assessments

[CFAs](#)
[Food Web Gizmo CER](#)
[Vocabulary checks](#)
[Conceptual checks](#)

[CAST Resources](#)

[HS LS2-4 Item Spec](#)

Bundle 1b Essential Question

How do organisms interact with the living and nonliving environments to obtain matter and energy?

What happens to ecosystems when the environment changes?

How do organisms interact in groups so as to benefit individuals?

Bundle 1b Investigative Phenomena

Pacing 4 weeks

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Disciplinary Core Ideas LS2.A Interdependent Relationships in Ecosystems LS2.C Ecosystem Dynamics, Functioning, and Resiliency LS2.D Social Interactions and Group Behavior	Crosscutting Concept Cause and Effect Scale, Proportion and Quantity	Science and Engineering Practices Use Mathematical and Computational Thinking Engage in Argument from Evidence
Performance Expectations For Students HS LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales. HS LS2-2 Use mathematical representations of biodiversity and populations to design solutions to support and revise explanations HS LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce		
Resources Pre-Assessment linked here Group Behavior and Survival Swarming Up a Storm podcast Ecosystem Interactions and Dynamics Population Growth and Carrying Capacity Biodiversity Group Behavior and Survival Review Questions (MC)- Ecology SEL Prompts Energy , Changes , Limits, Competition, Groups Achieve 3000 Text Set	Formative Assessment CFAs Vocabulary checks Conceptual checks	CAST Resources HS LS2-1 CAST Item HS LS2-2 Cast Item HS LS2-8 CAST Item
Key Terms: (from MS) abiotic factor, biotic factor, ecology, producer, consumer, herbivore, carnivore, decomposer, food chain, food web, conservation of matter, conservation of energy (for HS mastery) predator-prey relationship, succession, mutualism, parasitism, commensalism, exponential growth, carrying capacity, abundance, growth rate, death rate, limiting factor, nutrient cycle, trophic level, biomass, trophic cascade	Essential Learning Outcomes Linked here	

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Highlighted California Environmental Principles and Concepts: Principle II The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies. Principle IV The exchange of matter between natural systems and human societies affects the long-term functioning of both. CA CCSS Math Connections: N-Q.1–3; S-ID.1; S-IC.1, 6; MP.2, MP.4 CA CCSS for ELA/Literacy Connections: RST.9–10.8; RST.11–12.1, 7, 8; WHST.9–12.2a–e CA ELD Connections: ELD.PI.11–12.1, 5, 6a–b, 9, 10, 11a	Summative Assessment Resources for IS 1 linked here
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IS 2: History of Earth’s Atmosphere: Photosynthesis and Respiration			
Anchoring Phenomena			
Bundle 2a Essential Question How do organisms obtain and use the matter and energy they need to live and grow? How do organisms live, grow, respond to their environment and reproduce?		Bundle 2a Investigative Phenomena Pacing 2.5 weeks	
	Disciplinary Core Ideas LS1.C: Organization for Matter and Energy Flow in Organism	Crosscutting Concepts Systems and System Models Energy and Matter Flows Stability and Change	Science and Engineering Practices Develop and Use Models
	Performance Expectations For Students LS 1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. LS 1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a <i>net transfer of energy</i> . LS 2-5 Develop a model to <i>illustrate the role</i> of photosynthesis and cellular respiration in the cycling of carbon <i>among the biosphere, atmosphere, hydrosphere, and geosphere</i> .		

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	Resources “What Do Plants Do in the Dark?”	Student Generated Evidence for Formative Assessment Light Vs. Dark	CAST Sample HS CAST Sample Item LS1-5
Bundle 2b Essential Question How do matter and energy move through an ecosystem? How (and why) do organisms interact with their environment and what are the effects of these interactions?		Bundle 2b Investigative Phenomena Pacing 2.5 weeks	
	Disciplinary Core Ideas LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Crosscutting Concept Patterns Systems and System Models Energy and Matter Flows	Science and Engineering Practices Using Math and Computational Thinking Engaging in Argument from Evidence
Performance Expectations For Students LS 2-3 Construct and revise an explanation based on evidence for <i>the cycling of matter</i> and flow of energy in aerobic and anaerobic conditions. LS 1-6 Construct and revise evidence for how carbon, hydrogen, and oxygen from sugar molecules may <i>combine with other elements</i> to form amino acids and/or other large carbon-based molecules.			
	Resources Why is a covered planet a healthy planet?	Student Generated Evidence for Formative Assessment	HS CAST Sample Item LS1-6
Bundle 2c Essential Question How do people reconstruct and date events in Earth's planetary history? What regulates weather and climate? How do living organisms alter Earth's processes and structures?		Bundle 2c Investigative Phenomena Pacing 1 week	
	Disciplinary Core Ideas ESS1.C: The History of Planet Earth ESS2.D: Weather and Climate ESS2.E Biogeology	Crosscutting Concept Patterns Systems and System Models Stability and Change	Science and Engineering Practices Constructing an Explanation

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	Performance Expectations For Students ESS 1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces <i>to construct an account of Earth's formation</i> and early history. ESS 2-6 Develop a quantitative model to describe <i>the cycling of carbon</i> among the hydrosphere, atmosphere, geosphere, and biosphere. ESS 2-7 Construct an argument based on evidence about <i>the simultaneous coevolution</i> of Earth's systems and life on Earth.		
	Resources	Student Generated Evidence for Formative Assessment	HS CAST Sample Item ESS1-6 HS CAST Sample Item ESS 2-6 HS CAST Sample Item ESS 2-7
Highlighted California Environmental Principles and Concepts: Principle II The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. Principle III Natural systems proceed through cycles that humans depend upon, benefit from and can alter. Principle IV The exchange of matter between natural systems and human societies affects the long-term functioning of both. CA CCSS Math Connections: N-Q.1–3; F.IF.5; S-ID.6.a–c; MP.2, MP.4 CA CCSS for ELA/Literacy Connections: SL.11–12.5; RST.11–12.1; WHST.9–12.2a–e, 5, 8, 9 CA ELD Connections: ELD.PI.11–12.1, 5, 6a–b, 9, 10, 11a		Student Generated Evidence for Summative Assessment for IS 2	

IS 6: Ecosystem Stability and the Response to Climate Change

Anchoring Phenomena

Bundle 6a Essential Question

What happens to ecosystems when the environment changes?
 How does the environment influence populations of organisms over multiple generations?

Bundle 6a Investigative Phenomena Pacing 4 weeks

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How do people model and predict the effects of human activities on Earth's climate?			
	Disciplinary Core Ideas LS2.C Ecosystem Dynamics, Functioning, and Resilience LS4.C Adaptation ESS3.D Global Climate Change	Crosscutting Concepts Stability and Change Cause and Effect	Science and Engineering Practices Engaging in Argument from Evidence Analyzing and Interpret Data
	Performance Expectations For Students LS 2-6 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. LS 4-5 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. ESS 3-5 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.		
	Resource Folder Trophic Cascades	Student Generated Evidence for Formative Assessment	HS CAST Sample Item LS4-5
Bundle 6b Essential Question		Bundle 6b Investigative Phenomena Pacing 4 weeks	
	Disciplinary Core Ideas	Crosscutting Concept	Science and Engineering Practices
	Performance Expectations For Students LS 2-7 LS 4-6 ESS 3-6 ETS 1-1		

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	ETS 1-2		
	Resources HHMI BioInteractive Coral Bleaching	Student Generated Evidence for Formative Assessment	HS CAST Sample Item LS4-6 HS CAST Sample Item ESS3-5 HS CAST Sample Item ETS1-1 HS CAST Sample Item ETS1-2 HS CAST Sample Item ETS1-3 HS CAST Sample Item ETS1-4
Highlighted California Environmental Principles and Concepts: Principle I The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. Principle II The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. Principle III Natural systems proceed through cycles that humans depend upon, benefit from and can alter. Principle IV The exchange of matter between natural systems and human societies affects the long-term functioning of both. Principle V Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. CA CCSS Math Connections: N-Q.1-3; S-ID.1; S-IC.1, 6; MP.2 CA CCSS for ELA/Literacy Connections: RST.9-10.8; RST.11-12.1, 2, 7, 8; WHST.9-12.2.a-e, 7, 8, 9 CA ELD Connections: ELD.PI.11-12.1, 5, 6a-b, 9, 10, 11a		Student Generated Evidence for Summative Assessment for IS 6	

End of Semester 1

See Next Page for Semester 2

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Semester 2

IS 5: Structure, Function, and Growth

Anchoring Phenomena

Essential Question 5a

How do the structures of organisms enable life's functions?

Investigative Phenomena 5a

Pacing 3 weeks

Disciplinary Core Ideas

LS1.A: Structure and Function

Crosscutting Concept

Structure and Function

Science and Engineering Practices

Developing and Using Models
Constructing Explanations

Performance Expectations For Students

[HS LS 1-1](#) 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.

[HS LS 1-2](#) Develop and use a model to illustrate the hierarchical organization of *interacting systems* that provide specific functions within multicellular organisms.

Key Vocabulary: DNA, nucleotide, base pair, codon, mutation, transcription, translation, RNA, protein, synthesis, cell, tissue, organ, system, organism, multicellular, digestive system, muscular system, nervous system, circulatory system, reproductive system, stimuli, cellular communications

Sentence Frames:

How do the systems of specialized cells help a body perform essential functions of life?

What evidence can be used to support the idea that DNA affects the structure and function of a body?

Can you develop a model that demonstrates the relevant parts and processes of body systems in a multicellular organism?

Can you describe how two of the systems in the model are interacting, including their energy, matter, and information flows?

Resources

[Rewriting Life \(Full Lesson Plan\)](#)
[Structure, Function, Growth Padlet](#)

Student Generated Evidence for Formative Assessment

More options linked [here](#)

CAST Sample

[CAST Sample Item HS LS1-1](#)

[CAST Sample Item HS LS1-3](#)

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Essential Question 5b How do the structures of organisms enable life's functions? How do organisms grow and develop? How do organisms live, grow, respond to their environment and reproduce?		5b Investigative Phenomena Pacing 3 weeks	
	Disciplinary Core Ideas LS1.B Growth and Development of Organisms LS1.A Structure and Function	Crosscutting Concept Systems and system model Stability and change	Science and Engineering Practices Developing and Using Models Planning and Conducting an Investigation
Performance Expectations For Students HS LS 1-3 Plan and conduct an investigation to provide evidence that <i>feedback mechanisms maintain homeostasis</i> . HS LS 1-4 Use a model to <i>illustrate the role of</i> cellular division (mitosis) and differentiation in producing and maintaining complex organisms.			
Key Vocabulary: homeostasis, negative feedback system, positive feedback system, DNA replication, mitosis, reproduction, sexual reproduction, daughter cell, differentiate, specialization, gene expression Sentence Frames: Describe homeostasis and provide examples of feedback mechanisms that maintain homeostasis as a living thing functions and remains alive as external conditions change. How can changes in the external environment be measured and how can the response of a living thing be measured? How can you determine if the internal conditions are stabilized or destabilized? How do organisms grow and develop? Using a given model, identify each chromosome pair, where the genetic material came from, the parent cell and the daughter cell. Using a given model, explain how growth is occurring through the process of mitosis. Using a given model, explain how differentiation, or cell specialization, is occurring through gene expression			
	Resources	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	
CA CCSS Math Connections: F-IF.7.a-e, F-BF.1a-c; MP.2, MP.4 CA CCSS for ELA/Literacy Connections: RST.11-12.1, 8; WHST.9-12.2.a-e, 7, 9 CA ELD Connections: ELD.PI.11-12.1, 5, 6a-b, 9, 10, 11a		Student Generated Evidence for Summative Assessment for IS 5	

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IS 4: Inheritance of Traits

Anchoring Phenomena

Essential Question 4a

How are the characteristics of one generation related to the previous generation?
How do individuals of the same species vary in how they look, function and behave?

Investigative Phenomena 4a

Pacing 3 weeks

Disciplinary Core Ideas

LS1.A Structure and Function
LS3.A Inheritance of Traits
LS3.B Variation of Traits

Crosscutting Concept

Cause and Effect
Scale, Proportion and Quantity

Science and Engineering Practices

Asking Questions and Defining Problems
Engaging in Argument from Evidence

Performance Expectations For Students

[LS 3-1](#) Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
[LS 3-2](#) 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.
[LS 3-3](#) Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Key Vocabulary: trait, chromosome, gene, variation, dominant, recessive, inherit, allele, genotype, phenotype, meiosis, gene, mutations, mutagens, heterozygous, homozygous, dominant, recessive, probability, punnett square, dominant, recessive, genotypic ratio; phenotypic ratio, offspring, frequency, distribution

Sentence Frames:

How are the characteristics of one generation related to the previous generation?
Is the structure of a protein in the body affecting DNA or is the structure of the DNA affecting the proteins? How could we know?
Is all DNA in a body equally important to the function? How could we know?
How do individuals of the same species vary in how they look, function and behave?
How can individuals of the same species and even siblings have different characteristics?
What are three causes of observed variations in a population?
What evidence can be used to support this claim: The variation and distribution of traits observed depends on both genetic and environmental factors.

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	Which piece(s) of evidence presented are strongest to support the claim and why. How do you interpret the frequency and distribution data of the expressed traits in this population? Describe the relationship for a trait and surrounding environmental factors using the data. How can you explain differences of probability with the data shown to you?		
	Resources	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	
Essential Question 4b How does genetic variation among organisms affect survival and reproduction? What is the process for developing potential design solutions?		Investigative Phenomena 4b Pacing 2 weeks	
	Disciplinary Core Ideas LS4.B Natural Selection	Crosscutting Concept Patterns	Science and Engineering Practices Analyzing and Interpreting Data
	Performance Expectations For Students LS 4-3 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. ETS1-3 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.		
	Key Vocabulary: distribution, variations of a trait, natural selection, survivorship, fitness, adaption, heritable Sentence Frames: How does genetic variation among organisms affect survival and reproduction? How does the environment influence populations of organisms over multiple generations? Explain the data collected over many generations. What patterns are seen in the data over many generations? If a trait was advantageous for a particular environment, what shifts in numerical distribution would you expect to see? Describe the process that explains those shifts.		

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What is reproductive success, and how is it measured? Is it an important statistic to a species? Why or why not?		
Resources	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	CAST Resources CAST Item Sample HS LS3-2, 3-3, 4-2, 4-3
Highlighted California Environmental Principles and Concepts: Principle I The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. Principle II The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. Principle III Natural systems proceed through cycles that humans depend upon, benefit from and can alter. Principle IV The exchange of matter between natural systems and human societies affects the long-term functioning of both. CA CCSS Math Connections: MP.2; MP.4 CA CCSS for ELA/Literacy Connections: RST.11–12.1, 9; WHST.9–12.1.a–e, 2.a–e, 7, 9 CA ELD Connections: ELD.PI.11–12.1, 5, 6a–b, 9, 10, 11a		Student Generated Evidence for Summative Assessment for IS 4

Instructional Segment #3: Evidence of Common Ancestry and Diversity

LIVING EARTH INSTRUCTIONAL SEGMENT 3: EVIDENCE OF COMMON ANCESTRY AND DIVERSITY

The bundle of performance expectations above focuses on the following elements from the NRC document *A Framework for K–12 Science Education*:

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Crosscutting Concepts
[SEP-3] Planning and Carrying Out Investigations [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering) [SEP-7] Engaging in Argument from Evidence [SEP-8] Obtaining, Evaluating, and Communicating Information	LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems PS1.C: Nuclear Processes ETS1.B: Developing Possible Solutions	[CCC-1] Patterns [CCC-2] Cause and Effect: Mechanism and Explanation [CCC-6] Structure and Function [CCC-7] Stability and Change

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Units within IS 3	PE bundled	# Weeks
1. Impact of Plate Tectonics and Geological Processes ☐ Plate tectonics results in movement and shifts in the Earth's crust through seafloor spreading and continental drift. ☐ Newer crustal rock formations are found closest to seafloor spreading zones along the Mid Ocean Ridges, and older rock formations are found farther from spreading zones and near convergent zones and farthest from the core. ☐ Within sedimentary rock layers, the oldest rock layers are found deepest within and farthest from the surface according to the Law of Superposition. ☐ Water transforms the landscape of the Earth through erosion and deposition. ☐ Humans have impacted the Earth through land use processes that disrupt the geosphere.	HS-ESS 1-5, 2-5, 3-4	1 week
2. Evidence for Evolution ☐ Evidence of common ancestry includes similarities in DNA sequences, anatomical structures, and in the order of appearance of structures in embryological development. ☐ Common ancestry and phylogenetic relationships between species can be demonstrated by studying morphology, homology and DNA/protein sequences and illustrated through cladograms.	HS-LS 4-1	1 week
3. Changes in climate and natural processes can drive evolution ☐ Climatic changes, natural disasters, and natural processes on Earth have provided selective pressures that result in adaptations within populations and the evolution of new species. ☐ Data reveals that biotic and abiotic changes within ecosystems have resulted in adaptations within populations. ☐ Modern day humans evolved over time from a common primate ancestor and share some similar physical and behavioral traits with other hominins.	HS-LS 4-4, 4-5; HS-ESS 3-1, 3-4	2 weeks
4. Darwin's Theory of Natural Selection ☐ Darwin's Theory of Natural Selection proposed a mechanism for evolution based on evidence which involves variation, inheritance, differential survival and reproduction, and adaptation. ☐ Evolution may occur gradually over time or in short bursts due to natural or anthropogenic impacts.	HS-LS 4-2, 4-4	1.5 weeks
5. Evolution of Antibiotic Resistance ☐ Antibiotic resistance can evolve when some individuals within a population with natural resistance survive and reproduce to result in adaptation of the population. ☐ Some antibiotics are not as effective as they used to be, so novel antibiotics need to constantly be developed.	HS-LS 4-2; HS-ETS 1-3	2-3 days

IS 3: Evidence of Evolution

Anchoring Phenomena

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Essential Question 3a What evidence shows that different species are related? How does genetic variation among organisms affect survival and reproduction? How does the environment influence populations of organisms over multiple generations?		Investigative Phenomena 3a Pacing 3 weeks	
	Disciplinary Core Ideas LS 4.A Evidence of Common Ancestry and Diversity LS 4.B Natural Selection LS 4.C Adaptation	Crosscutting Concept Patterns Cause and Effect	Science and Engineering Practices Constructing Explanations Engaging in Argument from Evidence Obtaining, Evaluating and Communicating Information
	Performance Expectations For Students HS LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS LS4-2 Construct an explanation based on evidence that the process of evolution <i>primarily results from</i> 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 HS LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations. HS LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions <i>may result in</i> : (1) increases in the number of individuals of some species, (2) the emergence of a new species over time, and (3) the extinction of other species		
	Key Vocabulary: evolution, homologous structures, DNA analysis, common ancestor, amino acid sequence, cladogram, embryology, derived trait, theory of evolution, allele frequency, genetic variation, competition for resources, selection pressure, reproductive behaviors, environmental pressure, adaption, fitness, advantage, natural selection, adaptation, extinction, extinction rates, disruption to ecosystem, adaption Sentence Frames: How can there be so many similarities among organisms yet so many different kinds of plants, animals and microorganisms? What evidence shows that different species are related? Identify at least 2 different sources of evidence (ie. DNA sequencing, amino acid sequencing, fossil record, anatomical similarities and embryological similarities) and communicate a causal relationship for their use as evidence of common ancestry and evolution. How does genetic variation among organisms affect survival and reproduction? There are 4 factors that can influence the process of evolution. Explain each of them, and identify their effect on the population (number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources, survive as individuals and the adaptation of the species.) How does the environment influence populations of organisms over multiple generations? How do environmental pressures and natural selection lead to adaptations of a population in a specific environment? Which biotic and abiotic factors support a casual relationship that the environment is selecting for the most fit individuals in an area? What can cause changes to the environment? How do those disruptions affect the environment?		

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	What evidence exists that disruptions <i>cause</i> changes, rather than <i>correlate</i> with it? To what degree does the evidence presented identify causal links between environmental changes and changes in the number of individuals or species?		
	Resources HHMI Human Skin Color: Evidence For Selection Human Skin Color: Race, Racism and Science How natural hazards, resource availability and climate change affected human activity?	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	HS CAST Item Sample LS4-1 HS CAST Item Sample LS4-2 HS CAST Item Sample LS4-4 HS CAST Item Sample LS4-5
Essential Question 3b How do people reconstruct and date events in Earth's planetary history? How do the properties and movements of water shape Earth's surface and affect its systems?		3b Investigative Phenomena Pacing 2 weeks	
	Disciplinary Core Ideas ESS1.C: The History of Planet Earth ESS2.C: The Roles of Water ESS2.B: Plate Tectonics PS1.C: Nuclear Processes	Crosscutting Concept Patterns Structure and Function	Science and Engineering Practices Engaging in Argument from Evidence Planning and Carrying Out Investigations
Performance Expectations For Students HS ESS 1-5 Evaluate evidence of <i>the past and current movements</i> of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks HS ESS 2-5 Plan and conduct an investigation of <i>the properties of water and its effects</i> on Earth materials and surface processes.			
Key Vocabulary: tectonic plate, continental crust, oceanic crust, plate boundary, fossil distribution map, crustal rocks, mid ocean ridges, radioactive decay, radiometric dating, erosion, landslides, rock cycle, water cycle, geosphere, hydrosphere, deposition, stream table, physical and chemical properties of water, heat capacity, density of water, polarity of H ₂ O, mechanical and chemical effects of water, investigation plan for data collection, independent variable, dependent variable, control variable Sentence Frames: What patterns exist about the location of newly formed rock and Earth's oldest rocks? Explain the theory of plate tectonics. What piece(s) of evidence are the strongest to support the relationship between the motion of plates and the patterns in the ages? How do we know the age of the rocks on Earth? How do the physical and chemical properties of water affect soil? Describe an experiment design that would determine if soil moisture levels affect erosion rates. Which variables are factors in how the water cycle and rock cycle are interacting in this scenario?			

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	Resources	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	HS CAST Item Sample ESS 1-5 HS CAST Item Sample ESS 2-5 HS CAST Item Sample #2 ESS2-5
Essential Question 3c How do humans depend on Earth's resources? How do natural hazards affect individuals and societies? How do humans change the planet?		Investigative Phenomena Pacing 3 weeks	
	Disciplinary Core Ideas ESS3.A Natural Resources ESS3.B Natural Hazards ESS3.C Human Impacts on Earth Systems	Crosscutting Concept Cause and Effect Stability and Change	Science and Engineering Practices Constructing Explanations
Performance Expectations For Students HS ESS 3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate <i>have influenced human activity</i> . HS ESS 3-4 Evaluate or refine a technological solution <i>that reduces impacts</i> of human activities on natural systems.			
Key Vocabulary: natural resources, groundwater, fossil fuels, resource availability, earthquakes, volcanoes, tsunamis, hurricane, flood, drought, volcanoes, geospatial, population density, migration, mitigation; feedback, stabilizing, destabilizing, mitigate, technology, criteria and constraints of the solution, trade offs, environmental impact, system Sentence Frames: How are our population sizes and locations affected by the availability of natural resources? How are our population sizes and locations affected by natural disasters? Can you explain some ways in which technology helps us mitigate the negative effects that natural disasters can have on human populations? What causes human migration patterns? What evidence supports this claim? Describe the system that is being impacted. How is the technology or mitigation impacting the system? What are the criteria and constraints of this solution? Refine the solution to reduce the human impacts on the natural system.			
	Resources	Student Generated Evidence for Formative Assessment <i>More options linked here</i>	CAST Sample HS CAST Item Sample ESS3-4

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Highlighted California Environmental Principles and Concepts:

Principle I The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

Principle II The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.

Principle III Natural systems proceed through cycles that humans depend upon, benefit from and can alter.

Principle IV The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Principle V Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

CA CCSS Math Connections: MP.2; MP.4

CA CCSS for ELA/Literacy Connections: SL.11–12.4; RST.11–12.1, 8; WHST.9–12.2.a–e, 7, 9

CA ELD Connections: ELD.PI.11–12.1, 5, 6a–b, 9, 10, 11a

Student Generated Evidence for Summative Assessment for IS 3

End of Semester 2