California Education and the Environment Initiative

The EEI Curriculum cohesively integrates science and engineering practices (SEPs), content (disciplinary core ideas/DCIs), and crosscutting concepts (CCs) within its lesson procedures. This preliminary analysis intentionally teases apart the individual SEPs, DCIs, and CCs as a means of correlating the EEI unit with specific performance expectations; however, the EEI lessons weave these components back together to provide three-dimensional learning for students.

High School Biology/Life Science

B.8.d. – The Isolation of Species

"The Isolation of Species" engages students in a study of biological evolution and the inheritance of genetic traits by introducing them to California's Channel Islands, a system that provides many examples of evolutionary adaptations similar to those found on the Galápagos Islands. They study the role that reproductive and geographic isolation can play in speciation—the evolution of new animal species. The students analyze allopatric speciation, the most common type of speciation, and explore the role of geographic isolation in this process. After learning how speciation occurs, they discover the influences of isolation and small population sizes on the genetic diversity within a given location. Finally, they examine how a major climatic event, such as El Niño, can affect the flora and fauna of an area like the Galápagos Islands and learn how the resulting rapid environmental changes can affect the organisms that live in small, isolated populations.

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Next Generation Science Standards* Correlation with the California Education and the Environment Initiative (EEI) Curriculum

The EEI Curriculum is a great choice for transitioning to NGSS and contributes toward achievement of the performance expectations for the disciplinary core idea reflected in the Summary Chart below: HS-LS2 Ecosystems: Interactions, Energy, and Dynamics; HS– LS3 Heredity: Inheritance and Variation of Traits; and HS-LS4 Biological Evolution: Unity and Diversity. Each EEI unit highlights a small number of performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts. Therefore, the EEI units contribute to students' overall achievement of the performance expectations by the end of a school year, where they will have had multiple opportunities to engage in all appropriate science and engineering practices, disciplinary core ideas, and crosscutting concepts. While EEI was designed to teach the 1998 California science standards to mastery, it reflects the real world interconnections in science and already incorporates many of the paradigm shifts reflected in the NGSS. To learn more about how EEI supports NGSS, visit http://californiaeei.org/curriculum/correlations/nextgenscience/.

Correlation Chart Key

SEP (Science and Engineering Practices)
DCI (Disciplinary Core Ideas)
CC (Crosscutting Concepts)

	Next Generation Science Standards								
	HS-LS2			HS-LS3			HS-LS4		
California Connection		✓	✓		✓			✓	✓
Lesson 1 –– Examine how species form, with examples of natural causes including isolated populations.	✓		✓	✓	✓		✓	✓	✓
Lesson 2 – Explore differences between island species and mainland source populations, and consider reproductive isolation.	✓		✓	✓	✓		✓	✓	✓
Lesson 3 –Identify how human activities influence genetic isolation and drift.	✓	✓	✓	✓	✓		✓	✓	✓
Lesson 4 – Explore the effects of nonnative species on genetic isolation and speciation.	✓	✓	✓		✓		✓	✓	✓
Lesson 5 –Compare the vulnerability of island and mainland species to environmental changes, such as El Nino.	✓	✓	✓		✓		✓	✓	✓
Traditional Unit Assessment	✓	✓	✓	✓	✓		✓	✓	✓
Alternative Unit Assessment	✓	✓	✓	✓	✓		✓	✓	✓
	SEP	DCI	CC	SEP	DCI	CC	SEP	DCI	CC

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EEI Unit B.8.d. The Isolation of Species

Disciplinary Core Ideas Supported by this EEI Unit

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics
HS– LS3 Heredity: Inheritance and Variation of Traits
HS-LS4 Biological Evolution: Unity and Diversity

Performance Expectations	Suggestions for Using the EEI Unit to Support NGSS
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	Use this unit to have students evaluate the effects of changing ecosystems on geographically-isolated species which could, if the changes are significant, result in new ecosystems.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Use this unit to have students consider solutions for reducing the impacts of human agricultural activities on the ecosystems of geographically-isolated species.
HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during the replication, and/or (3) mutations caused by environmental factors.	Use this unit to have students examine the morphological characteristics of species affected by geographical isolation, such as species being influenced by human activity, native species being impacted by competition from nonnative species, and the susceptibility of island-dwelling species to rapid environmental changes. Have them consider evidence about how these changes can result in mutations of geographically-isolated species.
HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for the limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.	Use this unit to have students construct an explanation for (1) the potential of geographically-isolated species to increase in number, (2) for geographically-isolated species to have genetic variation due to mutation and sexual reproduction, (3) for the effect limited resources have on geographically-isolated species, and (4) for the proliferation of geographically-isolated species that are better able to survive and reproduce in their environment.
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	Use this unit to have students construct an explanation for how natural selection leads to adaptation of populations of geographically-isolated species. Have them gather evidence from the examples used in this unit to explain how natural selection has led to specific adaptations within geographically-isolated populations.
HS-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.	Use this unit to have students determine the cause and effect relationships for how changes to the Channel Islands coastal environment, and the rate of change of the environment in an El Niño weather cycle may affect the distribution of the geographically-isolated populations on the Channel Islands.

Science and Engineering Practices (SEPs)	Suggestions for Using EEI to Support SEPs	Disciplinary Core Ideas (DCIs)	Suggestions for Using EEI to Support DCIs	Crosscutting Concepts (CCs)	Suggestions for Using EEI to Support CCs
Constructing Explanations and Designing Solutions (HS-LS2-7, HS-LS4-2, HS-LS4-4)	Use this unit to have students construct an explanation for how the geographic isolation of populations of organisms can affect speciation (Lessons 1 and 2). Have them explain how human agricultural activities affect the geographical isolation of species (Lesson 3). Have students construct an explanation of the	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience:** • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem	Use this unit to have students analyze the potential impact of human activities and practices that can influence the geographic isolation of populations of organisms (Lesson 3). Have them consider the potential impacts of the introduction of nonnative species for creating geographic isolation (Lesson 4).	**Cause and Effect (HS-LS4-2, HS-LS4-4, HS-LS4-5)**	Use this unit to have students summarize empirical evidence that supports a cause and effect relationship between the geographic isolation of populations of organisms and speciation (Lessons 1 and 2). Have them explain the natural and human-caused variables that can result in populations and species becoming

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Engaging in Argument from Evidence (HS-LS2-6, HS-LS3-2, HS-LS4-5)	consequences of the introduction of nonnative species (Lesson 4). Have them construct an explanation for the factors that cause increased susceptibility of geographically-isolated organisms to rapid environmental changes (Lesson 5). Use this unit to have students evaluate the evidence that the geographic isolation of populations of organisms can affect speciation (Lessons 1 and 2). Have them evaluate the claims, evidence, and reasoning behind the explanation that human activity and practices can influence the geographic isolation of populations of organisms (Lesson 3).	occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-6) • Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) **LS3.B: Variation of Traits:** • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2)	Have students analyze the potential impact of rapid environmental changes on island-dwelling organisms (Lesson 5). Use this unit to have students determine how the geographic isolation of populations of organisms can affect speciation (Lessons 1 and 2). Have them determine the environmental factors that affect speciation of geographically-isolated populations of organisms (Lessons 3, 4, and 5).	**Stability and Change (HS-LS2-6, HS-LS2-7)**	geographically-isolated (Lessons 3, 4, and 5). Use this unit to have students evaluate evidence related to the stability or changes to a population or species that can result from the introduction of nonnative organisms into a geographically-isolated environment (Lesson 4). Have them explain how human activities and practices can influence the stability of a geographically-isolated population of organisms (Lesson 3). Have students identify and describe the potential effects of rapid environmental changes on the long-term survival of island-dwelling organisms (Lesson 5).

Science and Engineering Practices (SEPs)	Suggestions for Using EEI to Support SEPs	Disciplinary Core Ideas (DCIs)	Suggestions for Using EEI to Support DCIs	Crosscutting Concepts (CCs)	Suggestions for Using EEI to Support CCs
		LS4.B: Natural Selection: • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2) **LS4.C: Adaptation:** • Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an	Use this unit to have students determine what variations of genetic information between organisms in a geographically-isolated environment lead to differences among the individuals in a population and thereby affect speciation (Lessons 1 and 2). Have them determine which traits can positively affect the survival of a geographically-isolated population thereby making it more likely to survive and reproduce (Lessons 3, 4, and 5). Use this unit to have students examine how the distribution of traits in a geographically-isolated population can change when conditions change, and how those changes can affect biodiversity (Lessons 3, 4, and 5).		

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		increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-4) • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5) • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) **LS4.D: Biodiversity and Humans:** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(Not associated with a specific Performance Expectation identified above).*	Use this unit to have students study the impact human activity has on the geographical isolation of species. Have them determine how natural events and human activities can influence biodiversity in geographically-isolated ecosystems. Have students identify strategies for lessening the impacts of human activity on geographically-isolated ecosystems (Lesson 3).		