2019 Unit 05: Natural Selection

Content Area: **Science**
Course(s): **Honors Biology**
Time Period: **April**
Length: **2 weeks**
Status: **Published**

Unit Overview

Students *constructing explanations* and *designing solutions*, *analyzing and interpreting data*, and *engaging in argument from evidence investigate* to make sense of the relationship between the environment and natural selection. Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. The crosscutting concepts of *patterns* and *cause and effect* serve as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Enduring Understandings

- Natural Selection can lead to the formation of new species
- Natural Selection is a driving force behind evolutionary change.

Essential Questions

- How can natural selection contribute to the formation of new species?
- How does natural selection lead to evolutionary changes in species?

Student Learning Objectives (Performance Expectations)

- Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.] (HS-LS4-3)
- Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.] (HS-LS4-4)
- Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.] (HS-LS2-8)
- Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1)

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

- Make predictions about the effects of artificial selection on the genetic makeup of a population over time. (LS4.C)

Science & Engineering Practices

9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-2.6.1	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Disciplinary Core Ideas

9-12.HS-LS2-8.LS2.D.1	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
9-12.HS-LS4-2.LS4.B.1	Natural selection occurs only if there is both
9-12.HS-LS4-2.LS4.B.1.1	variation in the genetic information between organisms in a population and
9-12.HS-LS4-2.LS4.B.1.2	variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.
9-12.HS-LS4-2.LS4.C	Adaptation
9-12.HS-LS4-2.LS4.C.1	Evolution is a consequence of the interaction of four factors:
9-12.HS-LS4-2.LS4.C.1.1	the potential for a species to increase in number,
9-12.HS-LS4-2.LS4.C.1.2	the genetic variation of individuals in a species due to mutation and sexual reproduction,
9-12.HS-LS4-2.LS4.C.1.3	competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and
9-12.HS-LS4-2.LS4.C.1.4	the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Cross Cutting Concepts

9-12.HS-LS4-3.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-LS3-2.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed

	systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-LS2-7.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Unit Sequence

- • Adaptation also means that the distribution of traits in a population can change when conditions change.
- • Analyze shifts in numerical distribution of traits and, using these shifts as evidence, support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- • Changes in the physical environment, whether naturally occurring or human induced, have 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.
- • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review), and on 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, for how natural selection leads to adaptation of populations.
- • Determine cause-and-effect relationships for how changes to the environment affect distribution or disappearance of traits in species.
- • Develop logical and reasonable arguments based on evidence to evaluate the role of group behavior on individual and species' chances to survive and reproduce.
- • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- • Distinguish between group and individual behavior.
- • Empirical evidence is required to differentiate between cause and correlation and make claims about how natural selection leads to adaptation of populations.
- • Empirical evidence is required to differentiate between cause and correlation and make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations.
- • Empirical evidence is required to differentiate between cause and correlation and make 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.
- • Empirical evidence is required to differentiate between cause and correlation and to make claims about the role of group behavior in individual and species' chances to survive and reproduce.
- • Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- • 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.

- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
- Identify evidence supporting the outcome of group behavior.
- 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 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.
- 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 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.
- 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.
- Observe patterns at each of the scales at which a system is studied to provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in the revision of an explanation about the role of group behavior on individual and species' chances to survive and reproduce.
- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and will continue to do so in the future.
- 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.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.
- Use data to differentiate between cause and correlation and to make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations.
- Use empirical evidence to differentiate between cause and correlation and to make claims about the role of group behavior on individual and species' chances to survive and reproduce.
- Use empirical evidence to differentiate between cause and correlation and to make 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.

- Concepts
- Concepts
- Concepts
- Concepts
- Formative Assessment
- Formative Assessment
- Formative Assessment
- Formative Assessment
- Part A: How does natural selection lead to adaptations of populations?
- Part B: Why is it so important to take all of the antibiotics in a prescription if I feel better?

- Part C: How are species affected by changing environmental conditions?
- Part D: Why do some species live in groups and others are solitary?

Standards / Indicators

SCI.HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
SCI.HS-LS4-3	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
SCI.HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
SCI.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.
SCI.HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Lesson Titles

- genetic variation within populations
- Hardy-Weinberg equilibrium
- isolation mechanisms and speciation
- natural selection in populations
- other mechanisms of evolution
- patterns of evolution

21st Century Skills and Career Ready Practices

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Interdisciplinary Connections:

LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.

LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.WHST.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
LA.WHST.9-10.6	Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.WHST.9-10.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.

ELA/Literacy & Math Standards

- • Assess the extent to which the reasoning and evidence in a text support the author's claim about the role of group behavior on individual and species' chances to survive and reproduce.

- • Cite specific textual evidence to support analysis of science and technical texts about the role of group behavior on individual and species' chances to survive and reproduce.

- • Cite specific textual evidence to support analysis of science and technical texts describing how natural selection leads to adaptation of populations, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- • Cite specific textual evidence to support analysis of science and technical texts that provide explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- • Draw evidence from information texts making 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 to support analysis, reflection, and research.
- • Draw evidence from information texts to support analysis, reflection, and research about organisms with an advantageous heritable trait and their proportional increase as compared to organisms lacking this trait.
- • Draw evidence from informational texts to support analysis, reflection, and research about how natural selection leads to adaptation of populations.
- • Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text about the role of group behavior on individual and species' chances to survive and reproduce, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- • Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text 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, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- • Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address the role of group behavior on individual and species' chances to survive and reproduce.
- • Represent how natural selection leads to adaptation of populations symbolically, and manipulate the representing symbols. Make sense of quantities and relationships between specific biotic and abiotic differences in ecosystems and their contributions to a change in gene frequency over time that leads to adaptation of populations.
- • Represent symbolically the proportional increase in organisms with an advantageous heritable trait as compared with organisms lacking this trait, and manipulate the representing symbols. Make sense of quantities and relationships between the proportional increase in organisms with an advantageous heritable trait as compared with the numbers of organisms lacking this trait.
- • Write informative/explanatory texts about explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait, including the narration of historical events, scientific procedures/experiments, or technical processes.
- • Write informative/explanatory texts describing how natural selection leads to adaptation of populations, including the narration of historical events, scientific procedures/experiments, or technical processes.
- English Language Arts/Literacy
- Mathematics

Instructional Strategies, Learning Activities, Levels of Blooms / DOK

- class discussion
- class notes
- demonstration

- natural selection lab
- peppered moth lab
- poster presentation
- slide presentation
- TED talk
- video clip
- webquest
- worksheets

Modifications

ELL Modifications

- Focus on domain specific vocabulary and keywords
- Group students
- K-W-L charts (what I know - what I want to know - what I've learned).
- Provide ELL students with multiple literacy strategies
- Repeat, reword, clarify
- Tap prior knowledge
- Use graphic organizer
- Use real objects when possible

IEP & 504 Modifications

- Focus on domain specific vocabulary and keywords providing study guides that don't lead the student to study too much extraneous information (less unnecessary details)/scaffolded study guides
- modeling and showing lots of examples
- non-verbal redirection of behaviors
- rewording questions so that there are not higher level vocabulary within the question (you are testing for understanding of the content not the ability to understand the question)

Gifted and Talented Modifications

- Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning
- Determine where students' interests lie and capitalize on their inquisitiveness. (Is there a specific career they are interested in? How would this apply to their interest?)
- Encourage students to explore concepts in depth and encourage independent studies or investigations

- Evaluation of thesis statements
- Generating and testing hypotheses
- Graph analysis / interpretation
- Journal article analysis

At Risk Modifications

- additional help during tutoring/Delsea One/Academic Enrichment
- hands-on instruction
- modeling and showing lots of examples
- review, restate, reword directions
- testing modifications
- visuals

Alternative Assessments

Performance tasks
Project-based assignments
Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments

Skills-based assessment
Reading response
Writing prompt
Lab practical

Formative Assessment

- exit ticket
- google survey
- Kahoot
- KWL form

- lesson summary
- previous class review
- question of the day
- Think-pair-share

Summative Assessment

- benchmark assessment / marking period assessment
- natural selection quiz
- natural selection test
- speciation quiz

Resources and Materials

- Bunny Population Growth: Students will develop and use models to simulate the growth of a rabbit population in order to support explanations about the role of limiting factors and variation in maintaining or destroying the population. http://phet.colorado.edu/en/contributions/view/3896
- Google Classroom
- HHMI Pocket Mouse Evolution: This activity serves as an extension to the HHMI short film The Making of the Fittest: Natural Selection and Adaptation and a means of reinforcing the concepts of variation and natural selection. Students explain how variation, selection, and time fuel the process of evolution by comparing, integrating, and evaluating sources of information presented in different media or formats. They analyze and organize data, comparing and contrasting various types of data sets (both self-generated and archival). http://www.hhmi.org/biointeractive/color-variation-over-time-rock-pocket-mouse-populations
- textbook

Technology

- chromebooks
- https://phet.colorado.edu/en/simulation/natural-selection
- internet

TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

TECH.8.2.12.C Design: The design process is a systematic approach to solving problems.