# 2020 Unit 07: Natural Selection

Content Area: **Science**
Course(s): **Advanced Placement Biology**
Time Period: **March**
Length: **4 weeks**
Status: **Published**

## Unit Overview

The concepts in Unit 7 build on foundational content from previous units as students discover natural selection, a mechanism of evolution—the theory that populations that are better adapted to their environment will survive and reproduce. Thus, the evolution of a species involves a change in its genetic makeup over time. In this unit, students study the evidence for and mechanisms of evolutionary change. Students also learn what happens when a species does not adapt to a changing or volatile environment and about the Hardy-Weinberg equilibrium as a model for describing and predicting allele frequencies in nonevolving populations. Students will learn to calculate and draw conclusions about the evolution, or lack thereof, of a population from data related to allele frequencies. Biological principles studied here and in previous units will culminate in Unit 8, which covers ecology

## Enduring Understandings

- Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
- Life continues to evolve within a changing environment.
- Natural Selection can lead to the formation of new species
- Natural Selection is a driving force behind evolutionary change.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
- Organisms are linked by lines of descent from common ancestry

## Essential Questions

- How can natural selection contribute to the formation of new species?
- How does natural selection lead to evolutionary changes in species?
- How does species interaction encourage or slow changes in species?
- What conditions in a population make it more or less likely to evolve?

## Standards / Indicators / Student Learning Objectives (SLOs)

- 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)
- Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes.
- Describe the conditions under which allele and genotype frequencies will change in populations.
- Describe the conditions under which new species may arise.
- Describe the rate of evolution and speciation under different ecological conditions.
- Describe the scientific evidence that provides support for models of the origin of life on Earth.
- Describe the types of evidence that can be used to infer an evolutionary relationship.
- 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)
- Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time.
- Explain how natural selection affects populations.
- Explain the relationship between changes in the environment and evolutionary changes in the population.
- Make predictions about the effects of artificial selection on the genetic makeup of a population over time. (LS4.C)

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| 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-LS4-5 | 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-LS4-2 | 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-LS4-1 | Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. |

## Science & Engineering Practices

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| 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

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| 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

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| 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. |

## Lesson Titles

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

## 21st Century Skills and Career Ready Practices

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| CRP.K-12.CRP1 | Act as a responsible and contributing citizen and employee. |
| CRP.K-12.CRP2 | Apply appropriate academic and technical skills. |
| CRP.K-12.CRP3 | Attend to personal health and financial well-being. |
| CRP.K-12.CRP4 | Communicate clearly and effectively and with reason. |
| CRP.K-12.CRP5 | Consider the environmental, social and economic impacts of decisions. |
| CRP.K-12.CRP6 | Demonstrate creativity and innovation. |
| CRP.K-12.CRP7 | Employ valid and reliable research strategies. |
| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP9 | Model integrity, ethical leadership and effective management. |
| CRP.K-12.CRP10 | Plan education and career paths aligned to personal goals. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| CRP.K-12.CRP12 | Work productively in teams while using cultural global competence. |

## Interdisciplinary Connections:

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| LA.RH.11-12.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem. |
| LA.RH.11-12.9 | Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources. |
| LA.RST.11-12.1 | Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. |
| LA.RST.11-12.2 | Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. |
| LA.RST.11-12.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. |
| LA.RST.11-12.4 | Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. |
| LA.RST.11-12.5 | Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. |

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| LA.RST.11-12.6 | Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. |
| LA.RST.11-12.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. |
| LA.RST.11-12.8 | Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. |
| LA.RST.11-12.9 | Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. |
| LA.RST.11-12.10 | By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. |
| LA.WHST.11-12.1 | Write arguments focused on discipline-specific content. |
| LA.WHST.11-12.1.A | Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. |
| LA.WHST.11-12.1.B | Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. |
| LA.WHST.11-12.1.C | Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. |
| LA.WHST.11-12.1.E | Provide a concluding paragraph or section that supports the argument presented. |
| LA.WHST.11-12.7 | 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.11-12.8 | Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source 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

- additional help during tutoring/Delsea One
- 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

- alternative assessment
- benchmark assessment / marking period assessment
- evolution test
- natural selection quiz
- natural selection test
- origin of life quiz
- speciation quiz

## Resources and Materials

- AP Classroom
- 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

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| 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. |