Unit 6 Overview

SAMPLE Unit of Study: Biology

Natural Selection and Evolution

Overview

Unit Description

In this unit, students explore evolutionary theory and its importance to living organisms. Students begin by examining the various observations that led to the historical development of Darwin's theory. They then identify the main points of natural selection and analyze how natural selection acts as a mechanism for evolution. Students then apply their knowledge and understanding of the concepts of natural selection to a laboratory investigation in which they evaluate how the availability of varying food sources affects bird beak frequency.

After establishing a firm understanding of the process of natural selection and its effects on organisms, students then develop an understanding of more complex mechanisms of evolution, including how the processes of genetic drift and gene flow impact populations. Students also examine how new species or species variations originate via evolutionary mechanisms, and differentiate between the roles of directional, disruptive, and stabilizing selection in altering the biological diversity of populations. Students then compare and contrast reproductive, geographic, and biogeographic isolation and analyze the relationship of these processes to speciation and the theory of evolution.

Finally, students examine the various types of scientific evidence that support the theory of evolution, including fossils, comparative anatomies, and evolutionary relationships. They assess comparative anatomies seen among varied organisms and describe how the evidence found in the fossil record demonstrates common ancestry between organisms. Students end the unit by interpreting the evolutionary relationships displayed between organisms on a cladogram and explain how understanding evolutionary history impacts the classification of organisms.

Big Ideas

- The processes of natural selection and evolution provide the means by which organisms adapt to differing environments and new species form on the Earth.
- Evolution of organisms is affected by multiple complex factors, including genetics, common and uncommon traits within populations, and isolation of species.

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- Evidence of the evolution of living organisms that has occurred throughout Earth's history can be seen within the fossil record, comparative anatomical structures, and additional structural and behavioral characteristics that are shared by related organisms.

Essential Questions

- What is Darwin's Theory?
- How does the process of natural selection occur? How is it different from evolution?
- How does genetic variation affect natural selection? How does genetic variation over multiple generations impact evolution?
- How does the environment impact natural selection and biodiversity of organisms? Why does isolating organisms not always cause them to become extinct?
- What kinds of evidence, past and present, support the theory of evolution?

Key Standards

The following focus standards are intended to guide teachers to be purposeful and strategic in both what to include and what to exclude when teaching this unit. Although each unit emphasizes certain standards, students are exposed to a number of key ideas in each unit, and as with every rich classroom learning experience, these standards are revisited throughout the course to ensure that students master the concepts with an ever-increasing level of rigor.

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	HS-LS3-3.
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	HS-LS34-1.
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.	HS-LS4-2.
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.	HS-LS4-3.
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	HS-LS4-4.

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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.	HS-LS4-5.

Recommended Structures

The Unit Outline included in this document provides a framework for weekly instruction, practice, and assessment. Each week of instruction includes digital lessons that students will complete independently, as well as opportunities for whole-group and small-group teacher-led instruction.
The Unit Outline will use the following icons.

Preparation for Weekly Instruction

- Learning Goals
- Edgenuity Digital Lessons

Modifications for Special Populations

- Supporting English Learners
- Work for Early Finishers

Additional Instructional Support

- Science & Engineering Practices
- Cross-Cutting Concepts
- Real-World Connections
- Common Misconceptions & Reteaching Strategies
- Social Emotional Learning Connections

Unit 6 Outline

Week 1 – *Natural Selection & Genetics* Unit 6: Natural Selection and Evolution

Learning Goals

This week, students will examine the concepts that constitute Darwin's Theory of natural selection, as well as explore how these concepts are demonstrated in real-world populations.

- Identify the major concepts of natural selection. (HS-LS4-2)
- Analyze the relationship between natural selection and evolution. (HS-LS4-4)
- Use statistics and probability to examine the effects of natural selection on populations, including the adaptation of specific organisms. (HS-LS3-3, HS-LS4-3)

Edgenuity Digital Lessons

- Darwin's Theory
- Lab: Natural Selection

Week at a Glance

Day 1	Build background knowledge and introduce the unit. Students will work together in small groups to draw five factors affecting an environment/organism at random from a hat or by number (factors could include type of climate in the environment, type of terrain in the environment, predators of the organism, food the organism eats, an environmental change that is taking place in its habitat, etc.) and use the five specific factors they select to develop an imaginary organism that would be able to survive in those conditions. After creating their organisms, each group will present their creature to the class and discuss why the characteristics that the animal has would help them survive in the conditions selected. Students will also discuss why the different organisms that were created would not be able to survive in other environments and why. The instructor will then explain how the adaptation of organisms due to environmental conditions is the basis of Darwin's Theory and natural selection.				

	Students will then watch a short video with a brief overview of Charles Darwin and the Origin of Species, such as the example videos below: • Lower Level: https://www.youtube.com/watch?v=urSNtaQKOAk • Higher Level: https://www.youtube.com/watch?v=mcY0fOWhwB8				
Day 2	Students will work independently on the digital lesson: "Darwin's Theory." Monitor students who are struggling and provide individual attention as needed.				
Day 3	Open the class period with a discussion question. • *What are some ways that natural selection and evolution affect us in our daily lives? How do you know?* Encourage students to discuss applications of natural selection and evolution in the real world and evaluate the claims of others during the discussion. Have students then review several of Darwin's journal excerpts from his travels in the Galapagos Islands (such as the Galapagos Islands, Ecuador entries in this pdf: https://www-tc.pbs.org/wgbh/evolution/educators/teachstuds/pdf/darwins_excerpts.pdf and select five of the most significant observations that they think Darwin made. Divide the students into small groups and have them discuss their individual selections in order to come up with a group consensus of the five most significant observations overall. Each group will then present their observations and why they believe these are the most significant to the development of Darwin's Theory. Students will then work on the project portion of the lesson: "Darwin's Theory." Monitor students who are struggling and provide individual attention as needed. **Science and Engineering Practices** Students will be applying mathematical and critical thinking skills when completing the project "Analyzing the Effects of the Environment on Traits" in the lesson "Darwin's Theory." Prior to beginning				

	this project, help students to review the methods used for calculating percentages, as well as how to read and interpret bar graphs. **Cross-Cutting Concepts** Within the project for the lesson "Darwin's Theory," students will be analyzing evidence presented in multiple bar graphs to determine how various environmental factors affect the distribution of traits in sample populations. Prior to beginning the project, help students to review the differences between cause and correlation, and how data is used to determine causes of change vs. correlations between changes.				
Day 4	Use the data to identify students who did not pass the quiz from "Darwin's Theory." These students will be Group A. Students who passed the quiz will be Group B. During the first part of the class period, pull Group A together for re-teaching while Group B students work on finishing the project portion of "Darwin's Theory" and moving on to the next digital lesson ("Lab: Natural Selection"). For the remaining time, work with students individually or in small groups as needed.				
Day 5	Students will work independently to finish the "Lab: Natural Selection" lesson and any other unfinished digital lessons and/or activities from the week. Refer to the work for early finishers for those that have already completed the required lessons. **Science and Engineering Practices** Within the lesson "Lab: Natural Selection," students will complete a laboratory report detailing the procedures followed and results seen in the laboratory investigation. Prior to beginning the experiment, help students to review the guidelines for developing a concise, accurate lab report to share their discoveries. Emphasize the importance of creating and sharing a clearly written, thorough procedure for the investigation so that others could repeat the investigation and confirm or refute the results. In addition, review the differences between independent and dependent variables with the				

	students to ensure that they are able to accurately predict and explain their results after the investigation is complete. **Cross-Cutting Concepts** Within the laboratory investigation in the lesson "Lab: Natural Selection," students simulate three flocks of birds with different shaped beaks to predict how the flocks will change size and adapt over time to the available food sources. After completing the investigation, discuss with students the various patterns that they saw in how the bird populations changed, and how these changes provide evidence of the correlation between available food sources and the types of bird beaks seen in an environment.				

Modifications for Special Populations

	Low Proficiency	High Proficiency
Supporting English Learners	To build background knowledge, have students watch a summary video about "The Theory of Natural Selection." Lead a discussion with students about traits that would be beneficial for survival in various environments. Video Options: https://www.youtube.com/watch?v=vnktXHBvE8s https://www.youtube.com/watch?v=s64Y8sVYfFY	Sentence frames are given to students to help them structure their thoughts in English. Each frame is made of a mostly completed sentence and one or more blank spaces. Students need to fill in the blanks with their own ideas. Pair students and ask them to describe Darwin's Theory using a Sentence Frame. Ask students to read their final sentence(s) aloud.
Work for Early Finishers	Allow early finishers to read a brief biography of Darwin's life such as the one found here: https://www.biography.com/people/charles-darwin-9266433 and create an illustrated comic strip depicting the highlights of the biography. These can then be displayed within the classroom if desired.	

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Science & Engineering Practices	• Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3), (HS-LS4-3) • Construct an explanation based on valid and reliable sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS4-2),(HS-LS4-4)
Cross-Cutting Concepts	• Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-LS3-3) • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2),(HS-LS4-4) • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-3)
Real-World Connections	Discuss how natural selection can be impacted by human factors. Point out examples such as the development of antibiotic-resistant bacteria and pesticide-resistant insects, and have students brainstorm how natural selection may have impacted the development of these organisms.
Social Emotional Learning Connections	Have students individually reflect on their beliefs and values regarding evolution. Ask students to reflect on why they believe what they do (e.g., family belief, faith belief, scientific belief). Lead a discussion about respecting the opinions and backgrounds of others in this topic. Ask questions including why is this topic controversial? Do you think that was the intention of Charles Darwin? How can we respect the different opinions while still expressing our understanding of the topic?

Week 2 – *Natural Selection & Biodiversity*

Unit 6: Natural Selection and Evolution

Learning Goals

This week, students will explore the importance of genetics and environmental factors in the processes of natural selection and evolution. Students will also differentiate between types of environmental processes that affect species biodiversity.

- Examine the role of genetics in evolution. (HS-LS4-2)
- Describe how the environment affects genetics and natural selection. (HS-LS3-2, HS-LS4-5)
- Compare and contrast the effects of selection models on biodiversity of populations. (HS-LS4-2, HS-LS4-3)
- Explain how new species or traits originate through natural selection. (HS-LS4-5)

Edgenuity Digital Lessons

- Factors Affecting Genetic Variation
- Factors Affecting Biological Diversity

Week at a Glance

Day 1	Use data to identify students who struggled with the following learning objectives: • Summarize the main points of Darwin's Theory. • Explain how natural selection acts as a mechanism of evolution. Group students in pairs or triads such that each grouping has at least one student who did not struggle with these objectives and at least one student who did. Have students work in groups to create posters, worksheets, or other activities that could teach younger students the main concepts that make up Darwin's Theory, as well as what the major differences are between natural selection and evolution.				

Common Misconceptions & Reteaching Strategies

Many students may confuse natural selection for evolution or use the terms interchangeably. It is important for teachers to clarify for students that natural selection is only one of the mechanisms that contributes to the evolution of organisms. Other mechanisms that contribute to evolution include genetic drift, gene flow, and genetic mutations. Use the following activity to help students better conceptualize the relationship between natural selection and evolution:

- Fill a large dish with a variety of different candies. Make sure to include some candies that are going to be popular with students and some that will not be popular. Examples of unpopular candies could include items like black jelly beans, circus peanuts, peppermints, etc. Try to include candies of different sizes, shapes, and colors. Allow each student in the class to pick two candies from the bowl.
- After students have selected their candies, start a class discussion regarding the variations that can be seen within different organisms and why these variations are important.
- Show students the remaining candies in the bowl and work together as a class to make a list of the candy varieties that were both originally available and those that were not selected by the students. Have the students also work together as a class to describe the various traits of the candies that were most popular, such as type of candy (i.e., chocolate, fruit-flavored), size of candy, brand, etc., as well as the traits for the unpopular candies.
- Explain how having “unpopular” traits allowed certain candies to “survive” being selected by the students, and that this is an example of how natural selection works within populations - certain traits contribute to survival, and other traits lead to extinction.
- Continue the explanation by adding more candies into the bowl in proportion to the ones that are left (i.e., add in more unpopular candies and little to none of the popular candies). Then allow students to select one more candy from the bowl and discuss what they think would happen if the teacher repeated this process with the students a few more times.

	• Explain how the addition of more unpopular candies to the bowl is similar to how the reproduction of certain traits accumulates over time in new generations, causing evolution. **Science and Engineering Practices:** After completing the lesson "Darwin's Theory," some students may still have questions regarding the supporting evidence for "Darwin's Theory" and/or evolution in general, and some students may interpret evolution as not being a proven phenomenon because it is only a "theory." Review with students the process involved in forming a scientific theory and emphasize the importance of having thorough accumulated scientific evidence before a theory is presented and/or accepted. Brainstorm additional examples of scientific theories and some of the evidence that exists to support them (such as the atomic theory, plate tectonic theory, etc.).				
Day 2	Students will work independently on the digital lesson: "Factors Affecting Genetic Variation." Refer to the work for early finishers for those that have completed the required lessons. Work with individual students as needed. **Science and Engineering Practices:** Students will be applying mathematical and critical thinking skills to examine and interpret genetic data and graphs in the lesson "Factors Affecting Genetic Variation." Prior to beginning this project, help students to review how to determine direct and indirect relationships from data, as well as the structure of a T-chart and how they are created. **Cross-Cutting Concepts** Within the lesson "Factors Affecting Genetic Variation," students will be examining scientific data to determine the effects of factors such as mutations, population growth, toxins, and other environmental phenomena on the genetic variation seen in populations. Review with students how to differentiate between direct and indirect causes and how evidence is used to support claims regarding cause and effect relationships.				

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Day 3	Begin the class with the following discussion question: • *What is the difference between genetic drift and gene flow? When might a population experience genetic drift? When might a population experience gene flow?* Encourage students to discuss real world scenarios in which each of these evolutionary mechanisms would occur and evaluate the claims of others during the discussion. Have students each obtain a fun-size bag of small candies (such as M&Ms or Skittles) and complete a hands-on activity to further examine the process of genetic drift within a population (an example activity can be found here: https://www.gulfcoast.edu/current-students/academic-divisions/natural-sciences/biology-project/evolution/documents/genetic-drift-activity-m-ms.pdf). Divide students into groups of three or four after completing the activity to discuss and analyze their results and how these results demonstrate the concept of genetic drift. Then have students work on finishing "Factors Affecting Genetic Variation" and moving on to "Factors Affecting Biological Diversity" for the remainder of the class period. For the remaining time, work with students individually or in small groups as needed. **Science and Engineering Practices:** Students will be applying critical thinking skills to examine and interpret distribution graphs in the lesson "Factors Affecting Biological Diversity." Prior to beginning this project, review the concept of standard deviation with students and how standard deviation is used to analyze the common characteristics seen in a population. (Note: Students do not need to know methods for calculating standard deviation, just have a general understanding of the concept.)				
Day 4	Begin the class with the following discussion question: • *How might human activities impact the development of new species? How might human activities impact the development of varied species?*				

	Encourage students to discuss real world scenarios in which new species or varied species may develop due to human interactions with the environment and evaluate the claims of others during the discussion. Students will then work independently on finishing the digital lesson: "Factors Affecting Biological Diversity." Refer to the work for early finishers for those that have completed the required lessons. Work with individual students as needed. **Science and Engineering Practices / Cross-Cutting Concepts** Within the lesson "Factors Affecting Biological Diversity," students will be examining how factors such as isolation of organisms can lead to the creation of new species and higher biodiversity of populations. Brainstorm with students some of the ways that organisms may become isolated from each other by natural or human-induced means (such as through natural disasters, urbanization, etc.), and the effects that it might have on populations, natural selection, and evolution. Encourage students to try to provide additional support for their claims by having them provide real-world examples if possible.				
Day 5	Some students will need this day to finish the week's required digital lessons and/or activities. Other students will be finished with the required digital lessons and activities. Refer to the work for early finishers for those that have completed the required lessons.				

Modifications for Special Populations

	Low Proficiency	High Proficiency
Supporting English Learners	Front-load needed vocabulary before students begin the lesson on Day 2. Vocabulary needs will vary with each student population, but consider including *variation, genetics, gene flow, genetic drift, allele, adaptation, mutations, toxins, distribution,*	Have students complete a Venn Diagram comparing and contrasting *genetic drift* and *genetic flow*. Encourage students to include examples of both.
Work for Early Finishers	Allow early finishers to read the following article discussing the long-term impacts of the BP oil spill on wildlife in the Gulf of Mexico.	

	https://www.theguardian.com/environment/2014/apr/09/wildlife-gulf-of-mexico-bp-oil-spill Have the students write a short summary discussing how the effects of the oil spill have affected genetic variation and biodiversity in the region, including describing if this event caused genetic drift or gene flow, as well as what type of environmental selection was demonstrated in the event. Have students support their assertions with evidence from the lesson.
Science & Engineering Practices	• Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2) • 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 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. (HS-LS4-2) • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS4-3) • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)
Cross-Cutting Concepts	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-2), (HS-LS4-2), (HS-LS4-5) • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-3)
Real-World Connections	Discuss how artificial factors can impact the overall biodiversity seen in a specific environment. Point out examples such as the import of invasive species to specific regions for use in pest control (such as the introduction of cane toads in Hawaii and Florida to control pests targeting sugarcane fields), and discuss the impacts that these invasive species can have on native species in an environment. Have students brainstorm solutions that could be implemented to address the problems that invasive species create for native organisms.
Social Emotional Learning Connections	Lead a discussion about diversity asking questions including why is biodiversity important in nature, how do we see diversity in the human species, why is human diversity important, what are some benefits of human diversity, what are challenges with highly diverse areas, and how can we overcome those challenges?

Week 3 – *Natural Selection & Geologic Time*

Unit 6: Natural Selection and Evolution

Learning Goals

This week, students will examine how the isolation of organisms impacts natural selection, as well as how evidence from extinct populations can be used to verify the theory of evolution and demonstrate relationships between past and present organisms.

- Explain the relationship between types of isolation and natural selection. (HS-LS3-2, HS-LS4-4)
- Evaluate evidence in the fossil record that supports evolutionary theory. (HS-LS4-1)
- Describe how comparative anatomies are used to determine organismal relationships. (HS-LS4-1)

Edgenuity Digital Lessons

- Biogeographic Isolation
- Biological Evidence and the Fossil Record

Week at a Glance

Day 1	Use data to identify students who struggled with the following learning objectives: • Describe genetic drift and gene flow as mechanisms of evolution. • Examine how directional, disruptive, and stabilizing selection affect biological diversity. Group students in pairs or triads such that each grouping has at least one student who did not struggle with these objectives and at least one student who did. Have students work in groups to create posters, worksheets, or other activities that could teach younger students the differences between gene flow and genetic drift, as well as what the major differences are between directional, disruptive, and stabilizing selection in populations. **Common Misconceptions & Reteaching Strategies** Many students may have difficulty understanding the differences between genetic drift and gene flow. It is important for teachers to clarify for students that gene flow occurs when genes move between populations of organisms due to reproduction, while genetic drift occurs within a single				

	population of organisms and is a random process. Many videos (such as the example here on genetic drift: https://www.youtube.com/watch?v=W0TM4LQmoZY) are available online to provide students with a more interactive visualization of how these phenomena work. **Cross-Cutting Concepts** Within the lesson "Factors Affecting Biological Diversity," students will be examining the differences between directional, disruptive, and stabilizing selection. Brainstorm with students some real-world situations that might contribute to these selection types, and the overall effects each selection type would have on the overall biodiversity of an ecosystem. Ask students to think critically about which types of selection might be most common in healthy and/or unhealthy ecosystems, and why that might be (i.e., do you see directional and/or disruptive selection in healthy ecosystems? Do you see stabilizing selection in unhealthy ecosystems? How do you know? etc.). Encourage students to try to support their claims with real-world examples.				
Day 2	Students will work independently on the digital lesson: "Biogeographic Isolation." Refer to the work for early finishers for those that have completed the required lessons. Work with individual students as needed.				
Day 3	Use data to identify students who did not pass the quiz from "Factors Affecting Biological Diversity." These students will be Group A. Students who passed the quiz will be Group B. During the first part of the class period, pull Group A together for re-teaching while Group B students work on the project for "Biogeographic Isolation." For the remaining time, work with students individually or in small groups as needed. Refer to the work for early finishers for those that have completed the required lessons. Work with individual students as needed. **Science and Engineering Practices** Within the lesson "Biogeographic Isolation," students will be analyzing evidence of speciation within the finches of the Galapagos Islands using scientific resources. Prior to beginning the project, help students to review the differences between reliable and unreliable research sources, and how to				

determine article bias. Review the importance of using multiple resources to provide support for scientific explanations, as well as how to cite sources used.

Common Misconceptions & Reteaching Strategies

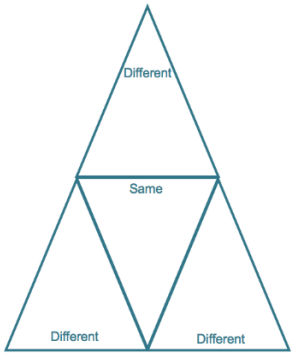
Many students may have difficulty understanding the differences between directional selection and disruptive selection. It is important for teachers to clarify for students that directional selection will favor one extreme trait of a population, while disruptive selection favors both extreme traits in a population. Use the following activity to help students better conceptualize the differences between directional and disruptive selection:

- For the first part of the activity, have students work individually or in pairs to create a variety of "creatures" using materials such as cotton balls and pipe cleaners. The "creatures" will need to have variations in their characteristics, such as some having larger "bodies" or longer "legs." Each creature will need to have a small tag (such as a piece of masking tape) attached and a score assigned to the creature. Larger creatures or creatures with longer legs should have a larger score, while smaller creatures or creatures with shorter legs should have a smaller score. (To save time, you can create the creatures before class so that the students do not have to.)
- Work with the class to calculate the average body size score for the creature population. After this value is calculated, have half of the students hide the creatures throughout the classroom while the other half is not watching.
- After the creatures are hidden, have the students in the half of the class that was not hiding the creatures each collect one of the hidden creatures (one that is the most obvious to them).
- Work with the class to calculate the average body size score for the creatures that were not collected. Discuss how the average body size shifted toward the smaller creatures and how this provides an example of directional selection.

	• For the second part of the activity, staple or tape brown and green construction paper in various areas throughout the classroom to represent “bark” and “leaves.” Make sure that there are more areas of “bark” than “leaves.” • Have students cut out a variety of “beetles” from brown and green construction paper. Students should put green stripes on some of the brown beetles and/or brown stripes on some of the green beetles, so that there are some that are solid colored and some that are striped. (To save time, you can create the beetles before class so that the students do not have to.) Each type of beetle will need to have a score assigned to it. Solid brown beetles should have a smaller score, green beetles should have a larger score, and striped beetles should have an intermediate score. • Work with the class to calculate the average score for the creature population. After this value is calculated, have students put double-sided tape on the back of the beetles, and inform the students that these beetles like to live on either “bark” or “leaves.” Have half of the students hide the beetles on the “bark” and “leaves” while the other half is not watching. • After the beetles are hidden, have the students in the half of the class that was not hiding the beetles each collect one of the hidden beetles (one that is the most obvious to them). • Work with the class to calculate the average score for the beetles that were not collected. Discuss how the average score shifted and how the change in the population to favor mainly the brown and green beetles provides an example of disruptive selection.				
Day 4	Begin the class with the following discussion question: • *Lemurs are a unique species of primitive primate that are related to monkeys and apes. There are over 100 species of lemur found in the world that are only native to Madagascar and the neighboring Comoro Islands. Does this example demonstrate speciation by isolation? Why or why not? If it does, what type of isolation does this scenario depict?* Encourage students to discuss the differences between reproductive isolation, geographic isolation, and biogeographic isolation and evaluate the claims of others during the discussion. Students will then work				

	independently on finishing the “Biogeographic Isolation” project and moving on to “Biological Evidence and the Fossil Record.”				
Day 5	Some students will need this day to finish the week’s required digital lessons. Other students will be finished with the required digital lessons. Refer to the work for early finishers for those that have completed the required lessons.				

Modifications for Special Populations

	Low Proficiency	High Proficiency
Supporting English Learners	Have students create a picture dictionary of important vocabulary words in lesson which may include *directional selection, disruptive selection, stabilizing selection, reproductive isolation, geographic isolation and biogeographic isolation.*	Have students complete two triangle diagrams (see below). Ask students to use the first to compare and contrast directional selection, disruptive selection and stabilizing selecting including examples of each. Ask them to use the second to compare and contrast reproductive isolation, geographic isolation and biogeographic isolation. 
Work for Early Finishers	Allow early finishers to conduct research on some of the unique organisms that have evolved throughout the world as a result of biogeographic isolation (such as the platypus, Tasmanian devil, and wombats of Australia).	

	Have the students select one organism of interest and write a short summary discussing the unique characteristics of their organism, and how those characteristics enable the organism to survive in its native habitat.
Science & Engineering Practices	• Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2) • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1) • 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 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. (HS-LS4-4)
Cross-Cutting Concepts	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-2), (HS-LS4-4) • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1)
Real-World Connections	Have students read and discuss the following article highlighting the use of new technologies such as 3-D printing, virtual modeling, and x-ray topography in modern study of the fossil record: https://www.smithsonianmag.com/innovation/new--tech-ancient-fossils-180951647/. Work together as a class to brainstorm additional technologies that could be of benefit in studying ancient organisms and how they could be used, additional issues that scientists may encounter in using these technologies, and possible solutions to address some of these issues.
Social Emotional Learning Connections	Students learned about the impact of isolation on various organisms. Lead a discussion on how isolation can impact human's mental, emotional, physical, and social health. Ask questions including how does being isolated from your friends make you feel? How does being isolated from your family make you feel? Is there any value in being isolated temporarily? How can we cope with feelings of isolation?

Unit 6 Outline

Week 4 – *Natural Selection & Evolution*	Unit 4: Systems of Equations and Inequalities
Learning Goals	This week, students will finish their examination of the evolutionary connections between past and present organisms and complete the Unit Review and Unit Test. • Describe the relationship between classification and evolution. (HS-LS4-1) • Explain how cladograms are used to determine the evolutionary relationships between organisms. (HS-LS4-1)
Edgenuity Digital Lessons	• Evolutionary Relationships • Unit Review • Unit Test

Week at a Glance

Day 1	Use data to identify students who did not pass the quiz from "Biogeographic Isolation." These students will be Group A. Students who passed the quiz will be Group B. During the first part of the class period, pull Group A together for re-teaching while Group B students work on finishing "Biological Evidence and the Fossil Record" and moving on to "Evolutionary Relationships." For the remaining time, work with students individually or in small groups as needed.				
Day 2	Students will work independently on finishing "Evolutionary Relationships" and moving on to the Unit Review. Refer to the work for early finishers for those that have completed the required lessons. Work with individual students as needed.				

	Science and Engineering Practices / Cross-Cutting Concepts Within the lesson "Evolutionary Relationships," students will examine the ways in which the shared characteristics of organisms are used to classify them, including applying cladograms/phylogenetic trees to determining evolutionary relationships. Review with students how this method could be applied to other situations, such as in the development of a family tree or a pedigree chart. Have students brainstorm characteristics they share with other members of their family, and how these characteristics are able to show that all family members come from common ancestry. If desired, students could develop a family tree as an extension to the lesson.				
Day 3	Use data to identify students who struggled with the following learning objectives: • Distinguish scientific evidence that supports the theory of evolution. • Analyze the relationships among organisms based on a variety of shared characteristics. Group students in pairs or triads such that each grouping has at least one student who did not struggle with these objectives and at least one student who did. Have students work in groups to create posters, worksheets, or other activities that could teach younger students the types of evidence in the fossil record that support evolutionary theory, as well as how to determine if organisms are related based on shared traits. **Common Misconceptions & Reteaching Strategies** Many students may have difficulty interpreting the information about evolutionary relationships that can be obtained by reading cladograms. One of the most common misconceptions about cladograms is that the highest-level organism is that which is farthest away from the outgroup, and other organisms in the cladogram are sidetracks on the way to that goal. In actuality, there are not any organisms that are "higher" or "more evolved" than other organisms, there are just differences in how evolution has occurred within organisms. Another common mistake that students make when interpreting cladograms is to read only the tips of the cladogram, rather than the nodes. This can lead				

	to students inaccurately interpreting how closely related individual organisms are. Finally, students often mistake the similarity in structures or characteristics of individual organisms on a cladogram as indicative of how closely related two species are. There are multiple instances of organisms that are more closely related to dissimilar organisms than similar organisms (for example, crocodiles are more closely related to birds than to lizards or turtles). An example activity that can be done in class to help students better understand how to build cladograms and interpret evolutionary relationships shown in cladograms can be found at the site below. http://www.tamdistrict.org/cms/lib/CA01000875/Centricity/Domain/540/Building%20a%20Cladogram%20Practice.docx				
Day 4	Have any students that have yet to complete Unit Review activity do so at the start of the class period. Ask the remaining students to work in small groups to identify three real-world scenarios that could have an effect on the natural selection of specific organisms (examples could include pollution, urbanization, desertification, oil spills, forest fires, etc.) and what kinds of future impacts these situations could have on the evolution of larger populations. As students complete the Unit Review, have them join this activity.				
Day 5	Have all students take the Unit Test.				

Modifications for Special Populations

Supporting English Learners	**Low Proficiency** Have students create and complete the table below. This will serve as their personal reference for all the important vocabulary from the unit. Have students use this document as a review tool.	**High Proficiency** Have students create their own review game using an online study tool like https://kahoot.it/ and https://quizlet.com/. Have other students play the various games created.

Unit 6 Outline

Word	Definition	Sentence	Source (dictionary/ glossary)	Re-write the Word

Work for Early Finishers	If students complete the Unit Test before the entire class is done, encourage them to journal or discuss the questions below with other students: • *Do organisms evolve randomly? Why or why not?* • *Do humans have an influence on the evolution of organisms? Why or why not?* • *After a species has become a species, does it stop evolving? Why or why not?*
Science & Engineering Practices	• Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1)
Cross-Cutting Concepts	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1)
Real-World Connections	Discuss how humans utilize artificial means to "naturally select" for characteristics that they find to be most beneficial in organisms. Point out examples such as the breeding of cattle for increased milk or meat yields, or the cross-breeding of different grapevines to create fruit such as the cotton candy grape. Have students brainstorm the benefits and disadvantages artificial selection could have to naturally occurring evolution.
Social Emotional Learning Connections	Have students complete a self-assessment of their understanding of the content, their work ethic, and their pacing and organization throughout the unit. Complete a reflection with students answering the questions what am I academically proud of in this unit of study, what character traits I am proud of during this unit of study, what academic challenges did I have, what character challenges did I have, and what is a goal I can strive for during the next unit of study?