

## Unit 6: Natural Selection

### Theme: Biological Evolution

**Big Idea:** Living things are found in certain environments because they have traits that enable them to survive specifically within those environments. Adaptations come about because of traits that help the organism survive, reproduce, and get passed on during reproduction. Biological evolution occurs through the process of natural selection, and there are multiple sources of evidence in support of this process.

#### Essential Questions for this Unit:

1. What components of natural selection can lead to speciation?
2. How does natural selection allow organisms to adapt to new environments with some modifications?

AZ Standard	Core Ideas	Student-Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Essential HS.L4U1.28</b> Gather, evaluate, and communicate multiple lines of empirical evidence to explain the mechanisms of biological evolution.</p> <p><b>Plus HS+B.L4U1.14</b> Construct an explanation based on scientific evidence that the process of natural selection can lead to adaptation.</p>	<p><b>L4: The unity and diversity of organisms, living and extinct, is the result of evolution.</b></p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● 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 have the trait.</li> <li>● Adaptation also means that the distribution of traits in a population can change when conditions change.</li> <li>● 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.</li> <li>● The traits that positively affect survival are more likely to be reproduced and thus are more common in the population.</li> <li>● Natural selection is the result of four factors:               <ol style="list-style-type: none"> <li>(1) the potential for a species to increase in number,</li> <li>(2) the genetic variation of individuals in a species due to mutation and sexual reproduction,</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>● I can investigate and draw conclusions about how a species grows in number, competition for limited resources can arise causing individuals in a species to develop genetic variation (through mutations and sexual reproduction) in response that is passed on to their offspring.</li> <li>● I can explain how individuals with traits that give competitive advantages can survive and reproduce at higher rates than individuals without the traits because of the competition for limited resources.</li> <li>● I can evaluate and provide rationale explanations about individuals that survive and reproduce at a higher rate which provide their specific genetic variations to a greater proportion of individuals in the next generation, and over many generations, groups of individuals can evolve into a different species.</li> <li>● I can construct an explanation based on evidence that identify patterns about the cause and effect relationship between natural selection and adaptation including:               <ol style="list-style-type: none"> <li>(a) changes in a population when some feature of the environment changes.</li> <li>(b) the fact that individuals in a species have genetic variation (through mutations and sexual reproduction) that is passed on to their offspring.</li> </ol> </li> <li>● I can plan and carry out an investigation that models:               <ol style="list-style-type: none"> <li>(1) the change of trait frequency in gene pools over multiple generations, including:</li> </ol> </li> </ul>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p>Research Report:</p> <ul style="list-style-type: none"> <li>● research and orally present the following:               <ol style="list-style-type: none"> <li>1. Describe the line of evidence</li> <li>2. Describe the claim made by the Theory of Natural Selection and the reasoning that links the claim and evidence.</li> <li>3. Evaluate the pros and cons of the line of evidence</li> <li>4. Summarize (make sense of) the meaning of the line of evidence on its own.</li> <li>5. Extension: articulate three questions that the team would like to know more about with regard to the line of evidence.</li> </ol> </li> </ul> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p> <p><b>Short Performance Assessment:</b> Simulating Kettlewell’s Famous Peppered Moth Activity: review the predator-prey relationship against a changing background that shifts the camouflage adaptation from one paper type to the other. Reinforces basic graphing skills. Students prepare a PPT of data</p>	<ul style="list-style-type: none"> <li>● <b>APEX</b> Lesson Assignments</li> <li>● <b>CANVAS:</b> students will complete all prompts with provided figures, ws and videos:               <ul style="list-style-type: none"> <li>- <b>The History of Life on Earth</b> <a href="https://youtu.be/pN7VQas4OaQ">https://youtu.be/pN7VQas4OaQ</a> Create timeline of Major Events</li> <li>-<b>The Making of a Theory: Darwin, Wallace, and Natural Selection</b> <a href="https://youtu.be/XOiUZ3ycZwU">https://youtu.be/XOiUZ3ycZwU</a> -Charles Darwin -Lamarck’s Theory -Hutton and Lyell</li> <li>-<b>PBS Evolution Website(Videos)</b> 1: <i>Isn’t Evolution Just a Theory?</i> 2: <i>Who Was Charles Darwin?</i> 3: <i>How do we know Evolution happens?</i> 4: <i>How Does Evolution Really Work?</i> 5: <i>Why does Evolution Matter Now?</i> WS: <i>Evolving Ideas worksheet to accompany the 5-part videos.</i></li> <li>-<b>The Day the Mesozoic Died</b> <a href="https://youtu.be/tRPu5u_Pizk">https://youtu.be/tRPu5u_Pizk</a></li> <li>-<b>Story of the Peppered Moth</b> <a href="https://youtu.be/jD8w3SOIYok">https://youtu.be/jD8w3SOIYok</a></li> </ul> </li> <li>● <b>LABSTER: Simulated Lessons</b></li> </ul>	<p>Biological Evolution Natural Selection Reproduction Genetic variation Selection Speciation Genetic variation Mutation SexualReproduction Variation in Fitness Limited Resources Adaptation Case and Effect Scientific Theory Genetics Evolution Anatomical Embryological Variation Mutation Predator Prey Camouflage</p>

	<p>(3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and          (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.</p> <ul style="list-style-type: none"> <li>• Genetic information, like the fossil record, also provides evidence of evolution.</li> <li>• DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descents can be inferred by comparing the DNA sequences of different organisms.</li> <li>• Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.</li> </ul>	<p>(a) information derived from DNA sequences, which vary among species but have many similarities between species.          (b) similarities and differences of patterns of amino acid sequences among species.          (c) patterns in the fossil record (e.g., presence, location, and inferences possible in lines of evolutionary descent for multiple specimens).          (d) the pattern of anatomical and embryological similarities.</p>	<p>analysis and findings though oral presentation.</p>	<p>Analyze various models:  <b>Virtual Lab: Evolution Simulation -Simulating Natural Selection</b>  <a href="https://youtu.be/OZGbIKd0XrM">https://youtu.be/OZGbIKd0XrM</a></p>	
<b>Crosscutting Concepts</b>			<b>Science and Engineering Practices</b>		
<p><b>Patterns:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><b>Stability and Change:</b></p> <ul style="list-style-type: none"> <li>• Much of science deals with constructing explanations of how things change and how they remain stable.</li> <li>• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</li> </ul> <p><b>Cause and Effect:</b></p> <ul style="list-style-type: none"> <li>• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</li> <li>• Changes in systems may have various causes that may not have equal effects.</li> </ul>			<p><b>Obtaining, Evaluating, and Communicating Information:</b></p> <ul style="list-style-type: none"> <li>• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</li> <li>• Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem.</li> </ul> <p><b>Constructing Explanations and Designing Solutions:</b></p> <ul style="list-style-type: none"> <li>• Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review.</li> <li>• Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.</li> </ul>		
<b>Anchoring Phenomenon</b>			<b>Investigative Phenomenon</b>		
<p><b>Evolution Story in a Minute: Tusklessness</b>  <a href="https://youtu.be/LI24Ts5zVV0">https://youtu.be/LI24Ts5zVV0</a>  <a href="http://www.biointeractive.org">The Genetics of Tusklessness in Elephants (biointeractive.org)</a></p>			<p><b>Galapagos Finch Evolution</b>  <a href="https://youtu.be/mcM23M-CCoq">https://youtu.be/mcM23M-CCoq</a></p>		

## Unit 6: Natural Selection

### Theme: Evolution of Populations

**Big Idea:** Distribution of traits in a population can change when conditions change. Over time, these changes can accumulate to the point where the survivors can no longer reproduce with some members of the population and have become a different species, or they can decline to the point of extinction of a species. Organisms in a population with advantageous heritable traits survive and reproduce better, leading 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.

#### Essential Questions for this Unit:

1. How do changes to the distribution of traits in a population by the physical environment lead to speciation or extinction?

AZ Standard	Core Ideas	Student-Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Essential HS.L4U1.27</b> Obtain, evaluate, and communicate evidence that describes how changes in frequency of inherited traits in a population can lead to biological diversity.</p> <p><b>Plus HS+B.L4U1.13</b> Obtain, evaluate, and communicate multiple lines of empirical evidence to explain the change in genetic composition of a population over successive generations.</p>	<p><b>L4: The unity and diversity of organisms, living and extinct, is the result of evolution.</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>If members cannot adjust to change that is too fast or too drastic; the opportunity for the species' evolution is lost.</li> <li>Adaptation also means that the distribution of traits in a population can change when conditions change.</li> <li>Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. Species become extinct because they can no longer survive and reproduce in their altered environment.</li> </ul>	<ul style="list-style-type: none"> <li>I can use mathematical analysis with data (e.g., using tables, graphs and charts) to show the distribution of genetic traits over time.</li> <li>I can investigate and draw conclusions about the changes to the distribution of traits in a population (stabilizing, disruptive, and directional) by the physical environment (natural or human) can lead to speciation (divergent evolution) or extinction if the organisms cannot adjust quickly enough.</li> <li>I can obtain, evaluate, and communicate scientific information on the positive or negative effects on survival and reproduction of individuals as relating to their expression of a variable trait in a population, and natural selection as the cause of increases and decreases in heritable traits over time in a population, but only if it affects reproductive success.</li> </ul>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p>Research Report:  <ul style="list-style-type: none"> <li>Write a research report on the positive or negative effects on survival and reproduction of individuals as relating to their expression of a variable trait in a population, and natural selection as the cause of increases and decreases in heritable traits over time in a population, but only if it affects reproductive success.(using scientific information and empirical evidence that uses at least two different formats e.g., oral, graphical, textual and mathematical). Students cite the origin of the information as appropriate.</li> </ul> </p> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p>	<ul style="list-style-type: none"> <li><b>APEX</b> Lesson Assignments</li> <li><b>CANVAS:</b> students will complete all prompts &amp; q's (ws / videos):</li> <li><b>-Hardy-Weinberg Equilibrium</b> <a href="https://youtu.be/G00JxJSG7WQ">https://youtu.be/G00JxJSG7WQ</a> <a href="https://youtu.be/7S4WMwesMts">https://youtu.be/7S4WMwesMts</a></li> <li><b>-Types of Natural Selection</b> <a href="https://youtu.be/64JUJdZdDQo">https://youtu.be/64JUJdZdDQo</a></li> <li><b>-Natural Selection</b> <a href="https://youtu.be/vCHdT9MWIaA">https://youtu.be/vCHdT9MWIaA</a></li> <li><b>-Beaks of Finches</b> <a href="https://youtu.be/mcM23M-CCoq">https://youtu.be/mcM23M-CCoq</a></li> <li><b>-Necks of the Tortoises</b> <a href="https://youtu.be/nTswxH4R8IA">https://youtu.be/nTswxH4R8IA</a></li> <li><b>-Natural Selection &amp; the Rock Pocket Mouse</b> <a href="https://youtu.be/sjeSEnaKGrq">https://youtu.be/sjeSEnaKGrq</a></li> <li><b>-Peacock Dance Display</b> <a href="https://youtu.be/qDvFdi-pFMc">https://youtu.be/qDvFdi-pFMc</a> Q: Not all male peacocks had large bright tails...adjustment or adaptation?</li> <li><b>-Different Colored Skin</b> <a href="https://youtu.be/r4c2NT4naQ">https://youtu.be/r4c2NT4naQ</a></li> <li><b>-Himalayan Rabbits turn Black in Ice</b></li> <li><b>-Nile crocodile/temp/se of offspring</b></li> <li><b>-What are Adaptations of a Lobster?</b></li> </ul> <ul style="list-style-type: none"> <li><b>LABSTER: Simulated Lessons</b> Analyze various models: <b>Birds on the Islands – Bio Labs Online</b> <b>Moth Population - Bio Labs Online</b> <b>Hawks, Birds &amp; Insects - Bio Labs Online</b> <b>STEM Case - Evolution</b></li> </ul>	<p>Biodiversity Diversity Speciation Divergent Evolution Extinction Ancestral Biological Evolution Directional Stabilizing Disruptive Population Variation Genetic Drift Gene Flow Mutation Trait Genotype Phenotype Frequency Allele Mimic Camouflage Behavior New Species Hardy-Weinberg Equilibrium</p>

Crosscutting Concepts	Science and Engineering Practices
<p><b>Stability and Change:</b></p> <ul style="list-style-type: none"> <li>● Much of science deals with constructing explanations of how things change and how they remain stable.</li> <li>● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. Adaptation – Teacher Video: <a href="#">LS4.C: Adaptation — The Wonder of Science</a></li> </ul> <p><b>Cause and Effect:</b></p> <ul style="list-style-type: none"> <li>● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</li> <li>● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</li> <li>● Systems can be designed to cause a desired effect.</li> <li>● Changes in systems may have various causes that may not have equal effects. Cause &amp; Effect – Teacher Video: <a href="#">CCC2: Cause and Effect — The Wonder of Science</a></li> </ul>	<p><b>Using Mathematics and Computational Thinking:</b></p> <ul style="list-style-type: none"> <li>● Use mathematical or algorithmic representations of phenomena or design solutions to describe and support claims and explanations, and create computational models or simulations.</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information:</b></p> <ul style="list-style-type: none"> <li>● Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</li> <li>● Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a Problem.</li> </ul>
Anchoring Phenomenon	Investigative Phenomenon
<p>-Why are Neanderthals Extinct?  <a href="https://youtu.be/bWRjtyiqHfA">https://youtu.be/bWRjtyiqHfA</a></p> <p>-The Origins of Neanderthals  <a href="https://youtu.be/T7pQEDg9WRY">https://youtu.be/T7pQEDg9WRY</a></p>	<p>-The Rise and Fall of the Tallest Mammal  <a href="https://youtu.be/SDk1Ft50bsI">https://youtu.be/SDk1Ft50bsI</a></p>

## Unit 7: Inheritable Traits

### Theme: Meiosis

**Big Ideas:** Sperm and egg cells are specialized cells, each of which has one of the two versions of each gene carried by the parent, selected at random. The sorting of genetic material, along with mutations in the DNA and the recombining of the DNA at fusion, results in genetic variation.

#### Essential Questions for this Unit:

1. How does biological information pass from one generation to another?
2. What happens during each phase of meiosis?

AZ Standard	Core Ideas	Student-Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Essential HS.L3U1.24</b> Construct an explanation of how the process of sexual reproduction contributes to genetic variation.</p>	<p><b>L3: Genetic information is passed down from one generation of organisms to another.</b></p> <ul style="list-style-type: none"> <li>● In sexual reproduction, a specialized type of cell division called meiosis occurs and results in the production of sex cells, such as gametes (sperm and eggs) or spores, which contain only one member from each chromosome pair in the parent cell.</li> <li>● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.</li> </ul>	<p>-I can identify and describe the inputs and outputs of meiosis. -I can make a claim that inheritable genetic variations may result from new genetic combinations through meiosis and mutations caused by environmental factors. -I can develop a model that shows the patterns of genetic variation through sexual reproduction (meiosis), errors in DNA replication, and environmental factors, including gametes, crossing over, and gene recombination.</p>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p><b>Research Report:</b> ● Construct a flip-book and develop a detailed explanation of how the process of meiosis is responsible for creating new genetic variations- student must explain why they are not identical to their siblings. Includes a peer review.</p> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p> <p><b>Short Performance Assessment:</b> -Construct models that show the “crossing-over” of chromosomes at each stage of Meiosis. Students will provide an oral detailed explanation for each stage.</p>	<ul style="list-style-type: none"> <li>● APEX Lesson Assignments</li> <li>● CANVAS: students will complete prompts w/provided figures ws and videos:</li> <li>-<b>Vocabulary reinforcement:</b> sentence and illustration</li> <li>-<b>Meiosis – Made Super Easy</b> <a href="https://youtu.be/nMEyeKQClqI">https://youtu.be/nMEyeKQClqI</a></li> <li>-<b>Difference between Meiosis &amp; Mitosis</b> <a href="https://youtu.be/yRLQKZzFb68">https://youtu.be/yRLQKZzFb68</a></li> <li>-<b>Meiosis and Crossing Over</b> <a href="https://youtu.be/id3H0pqVCr8">https://youtu.be/id3H0pqVCr8</a></li> <li>● LABSTER: Simulated Lessons</li> <li>-Analyze various stages of Meiosis</li> </ul>	<p>Meiosis      Cell division Gamete      Zygote Diploid      Haploid Sister      Non-sister Somatic cell DNA replication Crossing over Gene recombination chromosome Homologous Spermatogenesis Oogenesis Sexual reproduction Fertilization Heredity Genes Genotype Phenotype Mutation Genetic variation</p>
<b>Crosscutting Concepts</b>			<b>Science and Engineering Practices</b>		
<p><b>Patterns:</b></p> <ul style="list-style-type: none"> <li>● Empirical evidence is needed to identify patterns.</li> <li>● 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.</li> </ul> <p><b>Cause and Effect:</b></p> <ul style="list-style-type: none"> <li>● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</li> </ul>			<p><b>Constructing Explanations and Designing Solutions:</b></p> <ul style="list-style-type: none"> <li>● Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review.</li> <li>● Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.</li> </ul> <p><b>Developing and Using Models:</b></p> <ul style="list-style-type: none"> <li>● Develop, revise, and use models to predict and support explanations of relationships between systems or between components of a system.</li> <li>● Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems.</li> </ul>		
<b>Anchoring Phenomenon</b>			<b>Investigative Phenomenon</b>		
<p><b>Why does Down Syndrome Occur?</b> <a href="https://youtu.be/mdu439J-Q54">https://youtu.be/mdu439J-Q54</a></p>			<p><b>Chromosome 21 – How Accidental Inheritance can lead to Down’s Syndrome</b> <a href="https://youtu.be/wtebnV_QFQU">https://youtu.be/wtebnV_QFQU</a></p>		

## Unit 7: Inheritable Traits

### Theme: Punnett Squares and Probability

**Big Ideas:** Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Therefore, the variation and distribution of traits observed depend on both genetic and environmental factors.

**Essential Questions for this Unit:**

1. How are different forms of a gene passed to offspring?
2. How can we use probability to predict traits?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Plus HS+B.L3U1.10</b> Use mathematics and computational thinking to explain the variation that occurs through meiosis and calculate the distribution of expressed traits in a population.</p>	<p><b>L3: Genetic information is passed down from one generation of organisms to another.</b></p> <ul style="list-style-type: none"> <li>• Environmental factors can also cause mutations in genes, and viable mutations are inherited.</li> <li>• Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population.</li> <li>• Thus the variation and distribution of traits observed depend on both genetic and environmental factors.</li> </ul>	<ul style="list-style-type: none"> <li>-I can predict traits of individual organisms.</li> <li>-I can use mathematical representations and patterns to predict the probability of expressed traits by given data by the frequency, distribution, and variation of expressed traits in the population.</li> <li>-I can analyze and explain the reasons why predictions (Punnett squares) may not correspond with occurrences in a population (environmental mutations or environmental causes for on/off genes)</li> </ul>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p>Research Report: • Explain Mendel’s studies and conclusions about inheritance using the key terms. Partner will peer edit suggesting at least two more words (synonyms) and give the definition.</p> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p> <p><b>Short Performance Assessment:</b> Student work collaboratively to create Punnett Squares for Bear Fur Color: Brown Fur BB, Brown Fur Bb, Black Fur bb. Select genotype, phenotype, Punnett square, cross allele in PS, calculate genotypic &amp; phenotypic ratios and provide an outcome statement (Conclusion).</p>	<ul style="list-style-type: none"> <li>• APEX Lesson Assignments</li> <li>• CANVAS: students will complete all prompts with provided figures ws and videos:</li> <li>-<b>ARTICLE: The Blue People of Troublesome Creek</b> <a href="https://www.abcnews.com/News/News/2019/07/20/blue-people-of-troublesome-creek-abc-news/">Fugates of Kentucky: Skin Bluer than Lake Louise - ABC News (go.com)</a></li> <li>-<b>Genetic Variation</b> <a href="https://youtu.be/jUHokSPkzT8">https://youtu.be/jUHokSPkzT8</a></li> <li>-<b>Punnett Squares</b> <a href="https://youtu.be/qOPTpnXHIIY">https://youtu.be/qOPTpnXHIIY</a></li> <li>-<b>How to Draw a Punnett Square</b> <a href="https://youtu.be/prkHKjUmMs">https://youtu.be/prkHKjUmMs</a></li> <li><b>Practice Problem Sets:</b> -Punnett Squares -Genotypic ratio -Phenotypic Ratio -Mono-hybrid cross -Di-hybrid cross -Punnett Square w/multiple Alleles</li> <li>-<b>Blood Types and Punnett Squares</b> <a href="https://youtu.be/WFjIPemOmFY">https://youtu.be/WFjIPemOmFY</a></li> <li>-<b>PTC Taste Test Activity</b></li> <li>•<b>LABSTER: Simulated Lessons</b> Analyze various models: <b>Gregor Mendel</b> <b>Mono-hybrid cross</b> <b>Di-hybrid cross</b></li> </ul>	<p>Gregor Mendel Mendel’s Principles Segregation Principle of Independent Assortment Genetics Fertilization Trait Gene Allele Principle of dominance Allele Dominant Recessive Homozygous Heterozygous Punnett Squares Probability Di-hybrid cross Mono-hybrid cross One Factor Cross Two factor Cross P, F1, F2</p>
<b>Crosscutting Concepts</b>			<b>Science and Engineering Practices</b>		
<p><b>Patterns:</b></p> <ul style="list-style-type: none"> <li>• Mathematical representations are needed to identify some patterns.</li> <li>• Empirical evidence is needed to identify patterns.</li> </ul>			<p><b>Using Mathematics and Computational Thinking:</b></p> <ul style="list-style-type: none"> <li>• Use mathematical or algorithmic representations of phenomena or design solutions to describe and support claims and explanations, and create computational models or simulations.</li> <li>• Apply techniques of algebra and functions to represent and solve scientific and engineering problems.</li> </ul>		

	<b>Obtaining, Evaluating, and Communicating Information:</b> <ul style="list-style-type: none"><li>● Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</li><li>● Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or the process of development and the design and performance of a proposed process or system.</li></ul>
<b>Anchoring Phenomenon</b>	<b>Investigative Phenomenon</b>
What is an Allele? <a href="https://youtu.be/rdJzAbRMC2o">https://youtu.be/rdJzAbRMC2o</a>	<b>Mendelian Genetics and Punnett Squares</b> <a href="https://youtu.be/3f_eisNPpnc">https://youtu.be/3f_eisNPpnc</a>

## Unit 7: Inheritable Traits

### Theme: Protein Synthesis

**Big Ideas:** A gene is a length of DNA, and hundreds or thousands of genes are carried on a single chromosome. Each distinct gene chiefly controls the production of a specific protein by specific organelles, which in turn affects the traits of the individual.

#### Essential Questions for this Unit:

1. How does the structure of DNA determine the function of protein, and what is the function of proteins?
2. What are the similarities and differences between DNA and RNA?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Plus HS+B.L3U1.11</b> Construct an explanation for how the structure of DNA and RNA determine the structure of proteins that perform essential life functions.</p> <p><b>Plus HS+B.L1U1.5</b> Analyze and interpret data that demonstrates the relationship between cellular function and the diversity of protein functions.</p> <p><b>Plus HS+B.L1U1.4</b> Develop and use models to explain the interdependency and interactions between cellular organelles. Note: Relevant organelles (Golgi apparatus, endoplasmic reticulum, and cytoskeleton) should be taught to understand cellular transport.</p>	<p><b>L3: Genetic information is passed down from one generation of organisms to another.</b></p> <ul style="list-style-type: none"> <li>• The information passed from parents to offspring is coded in DNA molecules that form the chromosomes.</li> <li>• Genes are regions in the DNA that contain the instructions that code for the formation of proteins.</li> </ul> <p><b>L1: Organisms are organized on a cellular basis and have a finite life span.</b></p> <ul style="list-style-type: none"> <li>• Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids.</li> <li>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.</li> </ul>	<p>-I can illustrate the process of protein synthesis and structure including the nucleus, ribosome, endoplasmic reticulum, and Golgi apparatus.</p> <p>-I can analyze and interpret data that explains how cells contain genetic information in the form of DNA molecules and includes</p> <ol style="list-style-type: none"> <li>a. genes are regions in the DNA that contain the instructions that code for the formation of proteins.</li> <li>b. several organelles (i.e., nucleus, ribosome) along with DNA work together in the formation of proteins.</li> </ol> <p>-I can construct an explanation in the form of a claim on how protein synthesis and transport utilizes various organelles: Golgi apparatus, endoplasmic reticulum, ribosome and the cytoskeleton.</p> <p>-I can explain the cause and effect relationships between DNA, the proteins it codes for, and the resulting traits observed in an organism (DNA&gt;RNA&gt;Proteins&gt;Trait).</p>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p>Research Report: •Construct and explain for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</p> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p> <p><b>Short Performance Assessment:</b> Protein Synthesis Lab <i>pdf</i> Students will follow the steps of protein synthesis; translate the genetic code for specific amino acids while using paper models to simulate protein synthesis.</p>	<ul style="list-style-type: none"> <li>• APEX Lesson Assignments</li> <li>• CANVAS: students will complete all prompts with provided figures ws and videos:</li> </ul> <p><b>-DNA Structure and Function:</b> <a href="https://youtu.be/_POdWsii7AI">https://youtu.be/_POdWsii7AI</a></p> <p><b>-The Structure of DNA:</b> <a href="https://youtu.be/o_-6JXLYS-k">https://youtu.be/o_-6JXLYS-k</a></p> <p><b>-DNA Structure:</b> <a href="https://youtu.be/C1CRrtkWwu0">https://youtu.be/C1CRrtkWwu0</a></p> <p><b>-DNA Replication:</b> <a href="https://youtu.be/5qSrmeiWsuc">https://youtu.be/5qSrmeiWsuc</a></p> <p><b>-DNA Structure and Replication:</b> <a href="https://youtu.be/8kK2zpwRVOM">https://youtu.be/8kK2zpwRVOM</a></p> <p><b>-DNA Replication:</b> <a href="https://youtu.be/NZeGUt8b0EO">https://youtu.be/NZeGUt8b0EO</a></p> <p><b>-Why RNA is just as cool as DNA?</b> <a href="https://youtu.be/OElo-zX1k8M">https://youtu.be/OElo-zX1k8M</a></p> <p><b>-Protein Synthesis and Ribosome</b> <a href="https://youtu.be/h5mJbP23Buo">https://youtu.be/h5mJbP23Buo</a></p> <p><b>-Mutations: Power of Small Change</b> <a href="https://youtu.be/GieZ3pk9YVo">https://youtu.be/GieZ3pk9YVo</a></p> <p><b>-DNA and Longest Word</b> <a href="https://youtu.be/itsb2SqR-R0">https://youtu.be/itsb2SqR-R0</a></p> <p><b>-What is DNA and How does it Work?</b> <a href="https://youtu.be/zwibqNGe4aY">https://youtu.be/zwibqNGe4aY</a></p> <p><b>-Genes, DNA and Chromosomes</b> <a href="https://youtu.be/hywRdDVR76A">https://youtu.be/hywRdDVR76A</a></p> <ul style="list-style-type: none"> <li>•LABSTER: Simulated Lessons Analyze various models: -Examine the structure of DNA -Analyze the steps in which DNA Replication occurs. -Transcription, Translation</li> </ul>	<p>DNA RNA Protein Genes Chromosome Protein synthesis Polypeptide Lipids Carbohydrates Replication Reverse Transcription Transcription Initiation Elongation termination mRNA ribosomes anticodon Complementary Base Pair Peptide tRNA Translation coding codon guanine adenine uracil thymine promoter splicing amino acid</p>

Crosscutting Concepts	Science and Engineering Practices
<p><b>Structure and Function:</b></p> <ul style="list-style-type: none"> <li>The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.</li> </ul> <p><b>Cause and Effect:</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.</li> </ul>	<p><b>Developing and Using Models:</b></p> <ul style="list-style-type: none"> <li>Use models (including mathematical and computational) to generate data to support explanations and predict phenomena, analyze systems, and solve problems.</li> <li>Evaluate merits and limitations of two different models of the same proposed tool, process, or system in order to select or revise a model that best fits the evidence or design criteria.</li> </ul> <p><b>Analyzing and Interpreting Data:</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p><b>Constructing Explanations and Designing Solutions:</b></p> <ul style="list-style-type: none"> <li>Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.</li> <li>Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review.</li> <li>Base causal explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future.</li> </ul>
Anchoring Phenomenon	Investigative Phenomenon
<p><b>Protein Synthesis Animation</b>  <a href="https://youtu.be/NDIjexTT9j0">https://youtu.be/NDIjexTT9j0</a></p>	<p><b>Transcription (DNA to mRNA)</b>  <a href="https://youtu.be/Zyb8bpGMRO">https://youtu.be/Zyb8bpGMRO</a></p>

## Unit 7: Inheritable Traits

### Theme: Genetic Engineering

**Big Ideas:** Mutations to genes can result in changes to DNA and traits, which can affect the structures and functions of the organism. These changes can accumulate to the point of affecting the variety of the population. When sequences of genes are known, genetic material can be artificially changed to give organisms certain features. In gene therapy, special techniques are used to deliver into human cells genes that are beginning to help in curing disease. Decisions about whether certain actions should be taken will require ethical and moral judgments which are not provided by knowledge of science.

#### Essential Questions for this Unit:

1. What environmental factors cause mutations in the DNA molecule?
2. How have mechanisms of meiosis and random fertilization lead to genetic variation?
3. How has the understanding of the DNA molecule led to modern advanced biotechnology?

AZ Standard	Core Ideas	Student Friendly Objectives	Assessment	Resources	Vocabulary
<p><b>Essential HS.L3U1.25</b> Obtain, evaluate, and communicate information about the causes and implications of DNA mutation.</p> <p><b>Plus HS+B.L3U1.12</b> Analyze and interpret data on how mutations can lead to increased genetic variation in a population.</p> <p><b>Essential HS.L3U3.26</b> Engage in argument from evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology.</p>	<p><b>L3: Genetic information is passed down from one generation of organisms to another.</b></p> <ul style="list-style-type: none"> <li>● Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation.</li> <li>● Environmental factors can also cause mutations in genes, and viable mutations are inherited.</li> <li>● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.</li> <li>● The overall sequence of genes of an organism is known as its genome.</li> <li>● More is being learned all the time about genetic information by mapping the genomes of different kinds of organisms.</li> <li>● When sequences of genes are known genetic material can be artificially changed to give organisms certain features.</li> <li>● In gene therapy special techniques are used to deliver into human cells genes that are beginning to help in curing disease</li> </ul>	<p>-I can ask questions to make connections of how genetic mutations produce genetic variations that can be inherited.</p> <p>-I can investigate and draw conclusions about the various sources of genetic variation: meiosis (crossing-over), DNA replication (mutations) and environmental factors.</p> <p>-I can construct an explanation on how genetic mutations can occur due to errors during replication; and/or environmental factors.</p> <p>-I can evaluate and provide an explanation of the causes and implications of mutation in which they may not have equal effects</p> <p>-I can engage in argument and counterarguments based on evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology to include genomes, gene therapy, gene mapping and curing diseases.</p>	<p><b>Summative Assessments:</b> CANVAS Benchmark Tests APEX UNIT Tests</p> <p>Research Report:</p> <ul style="list-style-type: none"> <li>• Develop a logical argument based on evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology to include genomes, gene therapy, gene mapping and curing diseases. Students will present and cite evidence to support claim. Paper must include one complete peer review used to improve overall report.</li> </ul> <p><b>Formative Assessments:</b> APEX Lesson Quizzes WS Questions during lectures Labster - WS Questions</p> <p><b>Short Performance Assessment:</b></p>	<ul style="list-style-type: none"> <li>• APEX Lesson Assignments</li> <li>• CANVAS: students will complete all prompts with provided figures ws and videos:</li> <li>-Genetic Variation &amp; Mutation <a href="https://youtu.be/bLP8udGGfHU">https://youtu.be/bLP8udGGfHU</a></li> <li>-Genetic Variation, gene flow, and new species <a href="https://youtu.be/11iYk0Yrx3q">https://youtu.be/11iYk0Yrx3q</a></li> <li>- Gene Editing <a href="https://youtu.be/IS_2c52OPFw">https://youtu.be/IS_2c52OPFw</a></li> <li>-What is Genetic Engineering? <a href="https://youtu.be/3IsQ92KiBwM">https://youtu.be/3IsQ92KiBwM</a></li> <li>-Genetic Engineering <a href="https://youtu.be/BK12dQq4sJw">https://youtu.be/BK12dQq4sJw</a></li> <li>-Gene Therapy <a href="https://youtu.be/19fSG4Skvws">https://youtu.be/19fSG4Skvws</a></li> <li>-Genetically Modified Organisms <a href="https://youtu.be/bmi45JLJOqU">https://youtu.be/bmi45JLJOqU</a></li> <li>-Are GMO's Good or Bad? <a href="https://youtu.be/7TmcXYp8xu4">https://youtu.be/7TmcXYp8xu4</a></li> <li>-Dark Side of Genetic Engineering <a href="https://youtu.be/o4aKPhbyZM4">https://youtu.be/o4aKPhbyZM4</a></li> <li>•LABSTER: Simulated Lessons</li> </ul>	<p>DNA Organism DNA mutation Genetic variation Meiosis DNA replication Gene Therapy Genetic combination Gene Editing Genetic Engineering Gene Splicing Recombinant DNA Genetic Modification GMO</p>

				<p>Analyze various models:  <b>Genetic Mutation</b>  <b>Genetic Engineering</b>  <b>Gene Therapy</b></p>	
<b>Crosscutting Concepts</b>			<b>Science and Engineering Practices</b>		
<p><b>Stability and Change:</b></p> <ul style="list-style-type: none"> <li>• Much of science deals with constructing explanations of how things change and how they remain stable.</li> </ul> <p><b>Cause and Effect:</b></p> <ul style="list-style-type: none"> <li>• Changes in systems may have various causes that may not have equal effects.</li> </ul>			<p><b>Asking Questions and Defining Problems:</b></p> <ul style="list-style-type: none"> <li>• Ask questions that require relevant empirical evidence to answer.</li> <li>• Ask and evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information:</b></p> <ul style="list-style-type: none"> <li>• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</li> <li>• Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible.</li> </ul> <p><b>Constructing Explanations and Designing Solutions:</b></p> <ul style="list-style-type: none"> <li>• Base causal explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future.</li> <li>• Apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion.</li> <li>• Construct and revise explanations based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories, simulations) and peer review.</li> </ul> <p><b>Engaging in Argument from Evidence:</b></p> <ul style="list-style-type: none"> <li>• Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.</li> <li>• Construct a counter-argument that is based on data and evidence that challenges another proposed argument.</li> <li>• Evaluate a claim for a design solution to a real-world problem based on scientific knowledge, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations)</li> </ul>		
<b>Anchoring Phenomenon</b>			<b>Investigative Phenomenon</b>		
<p><b>Genetic Engineering Will Change Everything Forever</b>  <a href="https://youtu.be/iAhjPd4uNFY">https://youtu.be/iAhjPd4uNFY</a></p>			<p><b>Heredity and Genetics (Investigative Phenomena) (nsta.org)</b>  <a href="https://www.nytimes.com/2018/01/26/us/health/biracial-twins.html">Meet the biracial twins no one believes are sisters (nypost.com)</a></p>		