| Title: Unit II: Theory of Evolution | Subject/Course: 9th Grade Science |
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| Topic: Darwin's Theory of Natural Selection, Mechanisms of Evolution, Evidence of Evolution | Grade: 9     Designer(s): Erin Gallagher, Jaclyn Gutterman |

## Stage 1- Desired Results

**Established Goals:**
*Student knowledge & understanding of...*
1. The relationship between genetic inheritance and evolution
2. The relationship between an organism's features and its environment.
3. Types of natural selection
4. Speciation and its contributing factors
5. The manifestation of genetic mutations as changes in a species over time
6. How the environment shapes organisms
7. Various adaptations for survival (mimicry, competitive advantage, camouflage, physical/physiological/behavioral adaptations)

**Anchor Descriptors:**
**BIO.B.3.1** Explain the mechanisms of evolution.
**BIO.B.3.2** Analyze the sources of evidence for biological evolution.
**BIO.B.3.3** Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.

**Eligible Content:**
**BIO.B.3.1.1** Explain how natural selection can impact allele frequencies of a population.
**BIO.B.3.1.2** Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).
**BIO.B.3.1.3** Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
**BIO.B.3.2.1** Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).
**BIO.B.3.2.1** Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).
**BIO.B.3.3.1** Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

**NGSS:**
**HS-LS2:** Ecosystems: Interactions, Energy, and Dynamics
**HS-LS2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
**HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
**HS-LS3:** Heredity: Inheritance and Variation of Traits
**HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
**HS-LS4:** Biological Evolution: Unity and Diversity
**HS-LS4-1.** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

**HS-LS4-2.** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

**Science and Engineering Practices:**
- Constructing Explanations and Designing Solutions (HS-LS2-7, HS-LS4-2)
- Engaging in Argument from Evidence (HS-LS2-8)
- Analyzing & Interpreting Data (HS-LS3-3)
- Obtaining, Evaluating, and Communicating Information (HS-LS4-1)

**Disciplinary Core Ideas:**
**LS2.C:** Ecosystem Dynamics, Functioning and Resilience
**LS2.D:** Social Interactions & Group Behaviors
**LS4.A:** Evidence of Common Ancestry and Diversity
**LS4.B:** Natural Selection
**LS4.C:** Adaptation
**LS4.D:** Biodiversity & Humans

**Crosscutting Concepts**
- Cause & Effect (HS-LS2-8, HS-LS4-2)
- Stability & Change (HS-LS2-7)
- Scale, Proportion, and Quantity (HS-LS3-3)
- Patterns (HS-LS4-2)
- Systems & Systems Models (HS-LS2-5)
- Energy & Matter (HS-LS2-3, HS-LS2-4)

| Transfer: |
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Students will be able to independently use their learning to…

1. Describe Darwin's theory of evolution, supported by his observations and research.
2. Contrast Darwin's scientifically-accepted theory with Lamarck's provably incorrect ideas (Inheritance of Acquired Characteristics).
3. Explain natural selection
4. Compare natural selection to artificial selection.
5. Explain and compare the difference between natural selection and evolution.
6. Explain how natural selection can impact allele frequencies of a population.
7. Describe the factors that can contribute to the development of a new species.
8. Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
9. Describe how the geographic distribution of species today relates to their evolutionary history.
10. Make connections between an organism's adaptation and its environment (driving biotic/abiotic pressures).
11. Interpret evidence supporting the theory of evolution.
12. Explain the basics of classification of living things.
13. Use scientific terms properly in written and oral form.

| Meaning: |
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| Understandings: | Essential Questions: |
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| *Students will understand that…* <br> • The relationship between genetic inheritance and evolution <br> • The relationship between an organism's features and its environment. <br> • Types of natural selection <br> • Speciation and its contributing factors <br> • The manifestation of genetic mutations as changes in a species over time <br> • How the environment shapes organisms <br> • Various adaptations for survival (mimicry, competitive advantage, camouflage, physical/physiological/behavioral adaptations) <br> • Organisms are organized for study by various physical and physiological features. | 1. What evidence convinced Darwin that species could change over time? <br> 2. What are the principles of natural selection? <br> 3. How can natural selection change a population? <br> 4. How do fossils provide evidence for evolution? <br> 5. How does morphology provide evidence of evolution? <br> 6. How does biochemistry provide evidence of evolution? <br> 7. How are living things organized for study? |

## Acquisition:

| *Students will know…* | *Students will be skilled at …* |
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| • Principles of inheritance as they relate to evolution <br> • Natural selection contributing factors <br>     o Variation, Heritability, Overproduction, Reproductive Advantage, Competition <br> • Speciation contributing factors <br>     o Genetic drift, migration, geographic isolation <br> • Evidence of evolution <br>     o Fossil, anatomical, physiological, embryological, biochemical, universal genetic code <br> • Evidence for Darwin's theory/lack of evidence for previously proposed ideas (Lamarck) <br> • Basics of taxonomy and classification. | 1. Cite specific fossil evidence, biochemical evidence and morphology to support organism relatedness due to evolution. <br> 2. Describe the factors which influence evolution. <br> 3. Follow an adaptation from its genetic origin as a mutation to its presence in a whole species based on the environmental pressures. <br> 4. Differentiate between analogous, homologous and vestigial structures. <br> 5. Explain why ideas like Lamarck's are not scientifically relevant. <br> 6. Explain how mechanisms of evolution drive speciation. <br> 7. Use a dichotomous key to understand how and why organisms are categorized for study. |

## Stage 2- Assessment Evidence

| Unit-Based Project | Other Evidence: |
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| Natural selection research project | Chapter quizzes: <br> • Ch 15: Evolution <br> • Ch 17.1: Organizing Life's Diversity <br> Unit Test: Evolution |

## Stage 3- Learning Plan

### Pre-Assessment

| Learning Events | Progress-Monitoring |
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| Vocabulary:<br><u>CH 15</u><br>*Artificial selection, natural selection, evolution, derived trait, ancestral trait, homologous structure, vestigial structure, analogous structure, embryo, biogeography, fitness, camouflage, mimicry, genetic drift, founder effect, bottleneck, stabilizing selection, directional selection, sexual selection, allopatric speciation, sympatric speciation, gradualism, punctuated equilibrium*<br><br><u>CH 17.1, 17.2</u><br>*Classification, taxonomy, binomial nomenclature, taxon, species, genus, family, order, class, phylum, kingdom, domain, phylogeny, character, cladistics, cladogram*<br><br>Vocabulary<br>Lecture presentation/notes/discussion<br>Animations/videos<br>Chapters 15/17.1 Section Assessment Questions<br>**Exercises:**<br><ul><li>Five parts of natural selection graphic organizer</li><li>Explain animal adaptations as Darwin and Lamarck</li><li>Evidence of evolution case studies</li><li>Videos and questions on evolution of specific animals in unique environments (ex: animals in hydrothermal vents)</li><li>Analyze and plot data from peppered moth scenario</li><li>Practice interpreting cladograms</li><li>Model a dichotomous key</li><li>Evolution webquest</li></ul>**Laboratory Activities:**<br><ul><li>Natural selection demonstration using beans/manipulatives</li><li>Use a dichotomous key to classify fictional organisms</li></ul>Guided reading/Review handouts<br>Chapter 15/17.1 Assessment Questions<br>Chapter 15/17.1 Standardized Test Prep | ✓ Do Nows<br>✓ Vocabulary quizzes<br>✓ Classwork/homework check<br>✓ Online activities completion and accuracy check with discussion on results<br>✓ Accuracy of section and chapter review questions, guided reading handouts, chapter reading synopses<br>✓ Lab exercises execution & data analyses<br>✓ Unit project progression monitoring |
| **Technology**<br><ul><li>Laptops and Internet for online activities and project research</li><li>Powerpoint/LCD projector for lecture/discussion</li><li>Laboratory equipment & materials for lab exercises</li><li>Pearson Biology: eBook, online assignments, quizzes, tests, online activities, questions, presentations, animations</li><li>Text companion website: www.pearsonsuccessnet.com</li><li>Discovery Streaming, TeacherTube, various online sources for visuals, etc.</li></ul> | **Pacing Guide**<br>November/December<br>Chapters 15.1,.2,.3,17.1<br>Approx: 4 weeks<br>Review/reteach<br>Unit test / Unit Project due |