

Unit 5: Evolution

AP Biology

7 Class Meetings

Revised June 2019

Essential Questions

- How has evolution shaped the diversity of life on Earth?

Enduring Understandings with Unit Goals

EU 1: Sequencing genomes provides scientists with evidence of shared ancestry and evolution.

- Describe the types of information scientists can gather from genomes.
- Compare and contrast genome sequences among various species.

EU 2: Descent with modification by natural selection explains the adaptations of organisms and the unity and diversity of life.

- Assess the evidence provided for Darwin's theory of descent with modification through natural selection.
- Analyze phylogenetic trees and cladograms to determine the relatedness of different species.

EU 3: Genetic variation among populations makes evolution possible.

- Calculate and analyze the evolution of a population using the Hardy-Weinberg equation.
- Describe the process of speciation and the origin of species.
- Describe how gene flow, genetic drift, and natural selection all can influence macroevolution.

Standards

Next Generation Science Standards (NGSS):

- **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.
- **HS-LS4-3.** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- **HS-LS4-4.** Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

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- **HS-LS4-5.** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Common Core State Standards:

- **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- **RST .11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research.
- **SL.11-12.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
- **MP.2** Reason abstractly and quantitatively.
- **MP.4** Model with mathematics.

MSMHS Academic, Civic, and Social Competencies

Competency 1. Read and write effectively for a variety of purposes.

Competency 2. Speak effectively with a variety of audiences in an accountable manner.

Competency 3. Make decisions and solve problems independently and collaboratively.

Competency 4. Apply scientific knowledge and concepts to a variety of investigative tasks.

Competency 5. Contribute to a positive learning environment with respect and responsibility.

Unit Content Overview

- Genomes
- Human Genome Project
- Genomics
- Noncoding DNA
- Mutation
- Evolution
- Comparing genomes

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- Charles Darwin
- Descent with modification
- Natural selection
- Homology
- Phylogeny
- Taxonomy
- Phylogenetic trees
- Cladistics
- Maximum parsimony
- Evolution of populations
- Genetic variation
- Gene pools
- The Hardy-Weinberg Principle
- The Hardy-Weinberg Equation
- Genetic drift
- Gene flow
- Speciation
- The fossil record
- Extinction

Interdisciplinary Connections

- AP Statistics: probability
- ECE Marine Science: plate tectonics, mass extinctions

Daily Learning Objectives with *TWPS Activities*

Students will be able to...

- Compare genomes of various species to analyze their relatedness.
 - *According to the best current estimate, the human genome contains fewer than 21,000 genes. However, there is evidence that human cells produce more than 21,000 different polypeptides. What process might account for this discrepancy?*
 - *Would you expect the genome of a macaque (monkey) to be more similar to the mouse genome or the human genome? Why?*
- Explain how an organism's physical environment is likely to result in evolutionary changes.
 - *How does the concept of descent with modification explain both the unity and diversity of life?*

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- Describe the ways in which genetic information enables scientists to construct phylogenies.
 - *Decide whether each of the following pairs of structures more likely represents analogy or homology, and explain your reasoning: a) a porcupine's quills and a cactus's spines; b) a cat's paw and a human hand; c) an owl's wing and a hornet's wing.*
 - *Explain why phylogenies based on different genes can yield different branching patterns for the tree of all life.*
- Evaluate the effects of natural selection, genetic drift, and gene flow on the allele frequencies within a population.
 - *Of all the mutations that occur in a population, why do only a small fraction become widespread?*
 - *In what sense is natural selection more "predictable" than genetic drift?*
- Calculate equilibrium using The Hardy-Weinberg Equation and describe the meaning of the resulting figures.
 - *Is allopatric speciation more likely to occur on an island close to the mainland or on a more isolated island of the same size? Explain your prediction.*
 - *Speciation can occur rapidly between diverging populations, yet the length of time between speciation events is often more than a million years. Explain this contradiction.*
- Explain the processes involved with speciation and extinction, along with their effect on global biodiversity.
 - *How can the Darwinian concept of descent with modification explain the evolution of such complex structures as the vertebrate eye?*

Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Daily Warm Up Activities
- Power Point Lecture with note-taking
- Flexible grouping
- Foldables
- Exit slips
- Graphic Organizers
- Creating authentic connections for students
- Rephrasing and restatement of information and concepts
- Student use of headphones

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- Independent reading
- Outlining of text
- Reading and Accountable Talk Discussion of Text
- Laboratory exercises

Assessments

FORMATIVE ASSESSMENTS:

- Why Don't Whales Have Legs? Lab Report
 - MSMHS Rubric 4: Scientific Research
- Close reading and interpretation of text
- Outlining of textbook
- Warm Up Activities
- Exit slips
- Oral questioning
- Accountable Talk Discussions
- Daily Think-Write-Pair-Share (TWPS)
- Daily check-ins with students
- Practice FRQs
- Practice MCQs
- Homework/Reading checks

SUMMATIVE ASSESSMENTS:

- Quiz on EU 1
- Quiz on EU 2
- Quiz on EU 3
- Why Don't Whales Have Legs? Lab Report
- Unit Test

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Unit Task

Unit Task Name: Why Don't Whales Have Legs? Lab Report

Description: Students will use information from this unit on genomes and genetic evolution (EU 1), as well as phylogenies and cladistics (EU 2) in order to make predictions about the evolution of populations (EU 3). Students will be given a set of materials and must design and conduct a laboratory investigation to determine why modern whale species have no legs. Students will have to work together on the investigation, but will write individual lab reports following the MSMHS Lab Report Writing Guidelines.

Evaluation: MSMHS Rubric 4: Scientific Research

Unit Resources

- Textbook (Biology in Focus AP Edition. Campbell et al. 2014. Pearson Education, Inc)
- Interactive Science Notebook
- MSMHS School-wide Rubrics
- Lab Supplies
- Graphing calculators
- Internet databases
- Laptops