

## Unit 6: Evolution

### Biology

11 Class Meetings

*Rev. June 2019*

#### Essential Questions

- How do natural processes create and shape life's unity and diversity?

#### Enduring Understandings with Unit Goals

**EU 1:** Biological evolution can occur through mutation, migration, genetic drift, and natural selection.

- Describe the ways in which mutation, migration, genetic drift, and natural selection influence evolution.
- Describe the concept of natural selection and recognize that there are different patterns of selection.
- Describe patterns of evolution: convergent, divergent, parallel evolution, co-evolution, and the speed of evolutionary change.

**EU 2:** Two processes, speciation and extinction, combine to produce the diversity of life on Earth.

- Describe geographic barriers and biological isolating mechanisms that prevent gene flow and lead to speciation.
- Describe the ways in which extinction and mass extinctions influence biodiversity.

#### Standards

##### Next Generation Science Standards:

- **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

- **CCSS.ELA-Literacy.RST.9-10.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- **CCSS.ELA-Literacy.RST.9-10.3** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- **CCSS.ELA-Literacy.RST.9-10.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.
- **CCSS.ELA-Literacy.RST.9-10.7** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- **CCSS.ELA-Literacy.RST.9-10.8** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- **CCSS.ELA-Literacy.RST.9-10.9** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- **CCSS.Math.Content.HSN.Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **CCSS.Math.Content.HSS.IC.B.6** Evaluate reports based on data.

#### **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:** Student Ownership and Civic responsibility

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#### Unit Content Overview

- Unit Phenomena (such as, “How whales used to have legs”)
- Natural selection
- Micro versus Macro Evolution
- The Fossil record
- Structural and behavioral adaptation
- Adaptations and evolution specific to marine organisms
- Mutations
- Migration
- Homologous Structures
- Analogous Structures
- Genetic drift, founder effect, bottleneck effect
- Derived traits and ancestral traits
- Speciation
- Extinction
- Historical mass extinctions

#### Interdisciplinary Connections

- Algebra I – statistics
- Marine Studies I – biodiversity of fish

#### Daily Learning Objectives with *TWPS Activities*

##### Students will be able to...

- Design a model that explains the unit phenomena
  - *Why would ancestors of modern whales go live in the ocean?*
- Describe the tenants of Darwin’s theory of natural selection, descent with modification, fitness, and adaptation.
  - *For the past 10 to 25 years, farmers have planted crop seeds that have been genetically modified to withstand treatment with a common weed killer called Roundup®. This allows the farmers to spray their fields to get rid of weeds without harming their crops. Recently, more and more farmers have discovered that their fields have Roundup-resistant pigweed growing along with their crop. Provide an explanation of Darwin’s theory of natural selection explains how the populations Roundup-resistant pigweed have increased.*
  - *Provide an example of natural selection. The explanation needs to include: descent with modification, fitness and adaptations.*
- Identify patterns of evolution: convergent, divergent, parallel evolution, co-evolution, and the speed of evolutionary change.

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- *Ostriches (birds) and giraffes (mammals) are both native to the savannahs of Africa. They eat food that is high off the ground and share the same characteristic of an elongated neck. Explain (in detail) whether this would be divergent, convergent or co-evolution.*
- Evaluate evidence to determine common ancestry between organisms.
  - *Compare the two strands of DNA between the right whale, sperm whale and porpoise. Explain which two species are the most closely related. Why?*
- Describe geographic barriers and biological isolating mechanisms that prevent gene flow and lead to speciation.
  - *Describe a situation that could lead to the reproductive isolation between a species.*
- Analyze diagrams and charts of the following and describe how they are used as evidence of evolution:
  - Structural adaptations
  - Biochemical comparisons
  - Geological strata and the fossil record
  - Embryological comparisons
    - *Explain how a bat and dog have a similar forelimb structure, but both species have completely different uses.*
    - *A bird and butterfly both have wings. Explain whether they have a common ancestor or not.*
    - *How are DNA and comparative anatomy used to show relatedness?*
    - *Describe a situation where a species can become fossilized.*
    - *What information can scientists get from a fossil?*
    - *Compare and contrast the embryos of the species in the provided picture. Explain how these embryos can share a common ancestor.*
- Explain the impact of genetic drift, founder effect, and bottleneck effect on population.
  - *Antibiotic resistance occurs when certain bacteria with a mutation that allows them to survive exposure to antibiotic chemicals live on and reproduce. Quickly, a fully resistant generation develops. Explain how this is an example of bottleneck effect on the population.*
  - *When Christopher Columbus came to the Americas, he randomly chose 3 chickens from Spain to bring along. These 3 chickens were the only chickens to breed in the Americas for hundreds of years. Explain how this is an example of founder effect.*
- Evaluate the roles of speciation and extinction in biodiversity.
  - *The climate has been rapidly increasing for many years. Describe what will happen to various species over time.*
- Explain how a changing environment can lead to the evolution of populations.
  - *After discussing the change in populations of the peppered moths during the industrial revolution, how would the moths populations change with the passing of various Clean Air Acts?*

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#### Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Entrance slips/activities
- Lecture with notes
- Close reading with annotations
- Accountable Talk discussions
- Graphic organizers
- Foldables
- Self-assessments
- Student reflection
- Think-pair-share
- Individual response board
- Exit slips
- Laboratory exercises
- Guided notes
- Providing students with completed notes and outlines
- Rephrasing information for students
- Student choice
- Strategic grouping
- Flash cards for vocabulary
- Shortened/modified reading assignments

#### Assessments

##### **FORMATIVE ASSESSMENTS:**

- Whales in Transition Lab
  - MSMHS Rubric 4: Scientific Research
- The Future is Wild Project
  - MSMHS Rubric 3: Problem Solving
- Warm Up activities
- Daily check-ins with students
- Daily Think-Write-Pair-Share (TWPS)
- Entrance and Exit Slips
- Written Homework Assignments
- Guided notes

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- Oral Questioning

**SUMMATIVE ASSESSMENTS:**

- Quiz on EU 1
- Whales in Transition Lab Packet
- The Future is Wild Project
- Unit Test

**Unit Task**

**Unit Task Name:** The Future is Wild Project

**Description:** Students will design an animal of the future and discuss the adaptations it will develop as Earth's environment changes. They will project the evolution of the animal for one major climate change. Students will use their knowledge of the mechanisms and evidence of evolution (EU 1) and speciation/extinction (EU 2). The final product will be a poster presentation.

**Evaluation:** MSMHS Rubric 3: Problem Solving

**Unit Resources**

- Large format poster printer
- Selected Readings
- POGIL: Evidence for Evolution
- POGIL: Evolution and Selection
- Videos
- Internet databases
- Laptops