Big Idea 1: Evolution

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Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Big Idea 1

"The process of evolution drives the diversity and unity of life."

A.P. Biology

Belleville Board of Education

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Unit Overview

"Evolution is a change in the genetic makeup of a population over time, with natural selection its major driving mechanism. Darwin's theory, which is supported by evidence from many scientific disciplines, states that inheritable variations occur in individuals in a population. Due to competition for limited resources, individuals with more favorable variations or phenotypes are more likely to survive and produce more offspring, thus passing traits to future generations."

NGSS

	The basic modeling cycle is summarized in the diagram. It involves (1) identifying variables in the situation and selecting those that represent essential features, (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables, (3) analyzing and performing operations on these relationships to draw conclusions, (4) interpreting the results of the mathematics in terms of the original situation, (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable, (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.
SCI.HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
SCI.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.
SCI.HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
SCI.HS	Natural Selection and Evolution
SCI.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.
SCI.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.

Exit Skills

By the end of Unit 1 A.P. Biology Students should be able to:

- The student is able to convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change.
- The student is able to evaluate evidence provided by data to qualitatively and/or quantitatively investigate the role of natural selection in evolution.
- The student is able to apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future.
- The student is able create a phylogenetic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set.
- The student is able to analyze data related to questions of speciation and extinction throughout the Earth's history.
- The student is able to design a plan for collecting data to investigate the scientific claim that speciation and extinction have occurred throughout the Earth's history.
- The student is able to use data from a real or simulated population(s), based on graphs or models of types of selection, to predict what will happen to the population in the future.
- The student is able to justify the selection of data that address questions related to reproductive isolation and speciation.
- The student is able to evaluate given data sets that illustrate evolution as an ongoing process.

Enduring Understanding

Enduring understanding 1.A: Change in the genetic makeup of a population over time is evolution.

Enduring understanding 1.B: Organisms are linked by lines of descent from common ancestry.

Enduring understanding 1.C: Life continues to evolve within a changing environment.

Enduring understanding 1.D: The origin of living systems is explained by natural processes.

Essential Questions

Essential knowledge 1.A.1: How is Natural selection is a major mechanism of evolution?

Essential knowledge 1.A.2: How does Natural selection acts on phenotypic variations in populations?

Essential knowledge 1.A.3: How is Evolutionary change is also driven by random processes?

Essential knowledge 1.A.4: Why is Biological evolution is supported by scientific evidence from many

disciplines, including mathematics?

Essential knowledge 1.B.1: Why do Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today?

Essential knowledge 1.B.2: How are Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested?

Essential knowledge 1.C.1: How have Speciation and extinction have occurred throughout the Earth's history?

Essential knowledge 1.C.2: How can Speciation occur when two populations become reproductively isolated from each other?

Essential knowledge 1.C.3: How do Populations of organisms continue to evolve?

Essential knowledge 1.D.1: What are the several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence?

Essential knowledge 1.D.2: How does Scientific evidence from many different disciplines supports models of the origin of life?

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Learning Objectives

- The student is able to convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change.
- The student is able to evaluate evidence provided by data to qualitatively and/or quantitatively investigate the role of natural selection in evolution.
- The student is able to apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future.
- The student is able to evaluate data-based evidence that describes evolutionary changes in the genetic makeup of a population over time.
- The student is able to connect evolutionary changes in a population over time to a change in the environment.
- The student is able to use data from mathematical models based on the Hardy- Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of specific populations.
- The student is able to justify the selection of data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and the effects of selection in the evolution of specific populations.
- The student is able to make predictions about the effects of genetic drift, migration and artificial selection on the genetic makeup of a population.
- The student is able to evaluate evidence provided by data from many scientific disciplines that support biological evolution.
- The student is able to refine evidence based on data from many scientific disciplines that support biological evolution.
- The student is able to design a plan to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry and geology.
- The student is able to connect scientific evidence from many scientific disciplines to support the modern concept of

evolution.

- The student is able to construct and/or justify mathematical models, diagrams or simulations that represent processes of biological evolution.
- The student is able to pose scientific questions that correctly identify essential properties of shared, core life processes that provide insights into the history of life on Earth.
- The student is able to describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these shared, conserved core processes and features support the concept of common ancestry for all organisms.
- The student is able to justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- The student is able to pose scientific questions about a group of organisms whose relatedness is described by a phylogenetic tree or cladogram in order to (1) identify shared characteristics, (2) make inferences about the evolutionary history of the group, and (3) identify character data that could extend or improve the phylogenetic tree.
- The student is able to evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a simple cladogram to determine evolutionary history and speciation.
- The student is able create a phylogenetic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set.
- The student is able to analyze data related to questions of speciation and extinction throughout the Earth's history.
- The student is able to design a plan for collecting data to investigate the scientific claim that speciation and extinction have occurred throughout the Earth's history.
- The student is able to use data from a real or simulated population(s), based on graphs or models of types of selection, to predict what will happen to the population in the future.
- The student is able to justify the selection of data that address questions related to reproductive isolation and speciation.
- The student is able to describe speciation in an isolated population and connect it to change in gene frequency, change in environment, natural selection and/or genetic drift.
- The student is able to describe a model that represents evolution within a population.
- The student is able to evaluate given data sets that illustrate evolution as an ongoing process.
- The student is able to describe a scientific hypothesis about the origin of life on Earth.
- The student is able to evaluate scientific questions based on hypotheses about the origin of life on Earth.
- The student is able to describe the reasons for revisions of scientific hypotheses of the origin of life on Earth.
- The student is able to evaluate scientific hypotheses about the origin of life on Earth.
- The student is able to evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth.
- The student is able to justify the selection of geological, physical, and chemical data that reveal early Earth conditions.

Interdisciplinary Connections

LA.11-12.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.9-12.N-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.
TECH.8.1.12	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

MA.9-12.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.9-12.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.11-12.WHST.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
LA.11-12.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.11-12.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LA.11-12.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.11-12.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
HPE.2.1.12	All students will acquire health promotion concepts and skills to support a healthy, active lifestyle.
HPE.2.4.12	All students will acquire knowledge about the physical, emotional, and social aspects of human relationships and sexuality and apply these concepts to support a healthy, active lifestyle.

Alignment to 21st Century Skills & Technology

Key SUBJECTS AND 21st CENTURY THEMES

Mastery of key subjects and 21st century themes is essential for all students in the 21stcentury.

Key subjects include:

- English, reading or language arts
- World languages
- Arts
- Mathematics
- Economics
- Science
- Geography
- History
- Government and Civics

21st Century/Interdisciplinary Themes

- Environmental Literacy
- Global Awareness

- Health Literacy

21st Century Skills

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

Technology Infusion

- MS Powerpoint
- Google Drive
- Prezi
- Khan Academy
- Ted Talks
- Ted- ED
- Bozeman Science (Youtube)
- Windows Movie Maker
- Time Lapse
- Online Flow Chart maker
- MS Excel: graphs, charts, calculations, equations

Differentiation

As a Reminder:

The basis of good differentiation in a lesson lies in differentiating by content, process, and/or product.

Resources:

- NJDOE: Instructional Supports and Scaffolds for Success in Implementing the Common Core State Standards http://www.state.nj.us/education/modelcurriculum/success/math/k2/

Special Education

- assistive technology

- computer or electronic device utilizes
- multi-sensory presentation
- preferential seating

ELL

- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing students to correct errors (looking for understanding)
- providing study guides

Intervention Strategies

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- providing study guides
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using videos, illustrations, pictures, and drawings to explain or clarify

Evidence of Student Learning-CFU's

- Common benchmarks: Actual AP Test Questions, released by College Board
- Create a Multimedia Presentation
- Evaluation rubrics
- Outline
- Quizzes
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Top 10 List
- Unit tests

Primary Resources

Pearson: AP Biology, 8th ed.

Campbell, N.A. and Reece, J.B. - California - Pearson, San Francisco - 2008

Pearson: Test Prep Series for AP Biology

Holtzclaw, F.W. , Holtclaw, T.K. - New Jersey - Pearson, Upper Saddle River - 2014

College Board: AP Biology Investigative Labs: An inquiry based approach

The College Board, New York, N.Y. - 2012

Ancillary Resources

- PearsonEasyBridge.com worksheets for review
- Chrome Book Projects/ Research/ Analysis
- Google Classroom
- Barron's Review Flash Cards