### Living Environment Unit 5 – Evolution

**Unit Overview:** Evolution is fundamental to the study of biology, combining areas such as genetics, molecular biology, reproduction, anatomy and classification. In this unit, students will learn about the history of the theories of evolution as well as the process of natural selection and how it is the basis for evolution. They will outline events in the evolution of life on Earth and learn what evidence has led to our understanding of how life evolved and how new evidence is changing our view of the relatedness of organisms.

#### Essential Questions:
- How do organisms and species change over time?
- What is the historical context of evolution?
- How does the mechanism of natural selection explain how evolution occurred?
- What are sources of genetic variation in species?
- What is mutation?
- How do new species arise?
- What is meant by reproductive, behavioral, geographic and temporal isolation?
- How are evolutionary changes like the growth of a bush?
- What evidence supports evolution?
- What is extinction and when can it occur?

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### MST Standard 1 - Science

**Key Idea 1:** The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process

### MST Standard 4 - Science

**Key Idea 3:** Individual organisms and species change over time.

### New York State P-12 Science Learning Expectations

#### New York State Science Learning 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.

**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.
### Scientific Observation Provides Insights into Evolution:
Describe fossil evidence, differences in species, and anatomical evidence for evolution.

### Theory of Natural Selection:
Compare artificial to natural selection, summarize the four principles of natural selection, and describe how variations can lead to resistance to antibiotics and pesticides.

### Genetic Evidence Supports Evolution:
Describe the significance of genetic variation within a population and identify its sources.

### New Species can arise through speciation

#### Isolation:
Explain how isolation occurs and the types of isolation identified.

#### Patterns in Evolution:
Describe how adaptive traits lead to evolution or extinction as the environment changes. Use an evolutionary diagram to trace common ancestry.

### MST Standard 1 Science

#### 1.1 - Elaborate on basic scientific and personal explanations of natural phenomena and develop extended visual models and mathematical formulations to represent one’s thinking.
1.1a – Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
1.1b – Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.
3.2 – Apply statistical analysis techniques when appropriate to test if chance alone explains the results.

### MST Standard 4 Science

#### 3.1 – Explain the mechanisms and patterns of evolution.
3.1a – The basic theory of biological evolution states that the Earth’s present-day species developed from earlier, distinctly different species.
3.1b – New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.
3.1c – Mutations and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.
3.1d – Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be

#### Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
#### 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.
#### The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.
#### Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an expected equilibrium, and (4) the effects of natural selection.

### Resources

#### Castle Learning - Access through Clever

#### BPS Science Department Recommended Virtual Labs
– must be logged into BPS google document account through BPS Gmail account to access

#### McDougal-Littell Biology Living Environment Chapters 10, 11, 12, 17

#### BPS Science K-12 Schoology Folder 9-12 Resources → Living Environment Resources

#### Required NYS Lab - Beaks of Finches

#### Peppered Moth Game
- From Arizona State University, this simulation allows participants to watch natural selection in action.

#### Evolution of Whales Animation
- This animation is from the National Museum of Natural History and the Smithsonian institution.

### Content Vocabulary

- **Evolution**
- **Species**
- **Fossil**
- **Variation**
- **Adaptation**
- **Artificial selection**
- **Natural selection**
- **Population**
- **Fitness**
- **Biogeography**
- **Homologous structure**
- **Analogous structure**
- **Vestigial structure**
- **Paleontology**
- **Gene pool**
- **Allele frequency**
- **Gene flow**
- **Genetic drift**
- **Hardy-Weinberg equilibrium**
- **Reproductive isolation**
- **Speciation**
- **Behavioral isolation**
- **Geographic isolation**
- **Temporal isolation**
- **Convergent evolution**
- **Divergent evolution**
- **Coevolution**
- **Extinction**
- **Punctuated equilibrium**
- **Relative dating**
- **Isotope**
- **Half-life**

### Measurement of Student Learning

- **Ticket Out**
- **Think-Pair-Share**
- **Formative Assessment**
- **Weekly Quiz**
- **Unit Test**
- **Homework**
- **Review Questions**
- **DDI process using data from Edocrina & Castle learning to generate data**

### Higher Order Questions from LE Regents Exams
LE Regents Exams are hyperlinked for ease of access to questions
passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

3.1e – Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life-forms, as well as for the molecular and structural similarities observed among the diverse species of living organisms.

3.1f – Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

3.1g – Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

3.1h – The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions.

3.1i – Behaviors have evolved through natural selection. The broad patterns of behavior exhibited by organisms are those that have resulted in greater reproductive success.

3.1j – Billions of years ago, life on Earth is through by many scientists to have begun as simple, single-celled organisms. About a billion years ago, increasingly complex multicellular organisms began to evolve.

3.1k – Evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the 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.

• 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. That is, 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.

• Adaptation also means that the distribution of traits in a population can change when conditions change.

• 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
growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms.

3.11 - Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on Earth no longer exist.

| the decline–and sometimes the extinction–of some species. |
| • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ evolution is lost. |
## BPS Science Department Living Environment – Unit 5

### Resources
- **http://ngss.nsta.org/Classroom-Resources.aspx** - Searchable NYSSLS/NGSS aligned resources curated by NSTA
- **Buffalo Public Schools Science Department LE Webpage** – BPS Living Environment curriculum resource hub
- **BPS Science Department Recommended Virtual Labs** – Virtual lab resources with embedded links to virtual labs and student sheets. Must be logged into BPS google document account through BPS Gmail account to access.
- **NYS Regents Living Environment Exams 2010-2020** NYSED’s Office of State Assessment webpage for released Regents Living Environment Examinations
- **NYS MST Science Learning Standards Living Environment** Current NYS Living Environment Standards
- **NYS P-12 Science Learning Standards (HS)** – NYSSLS High School Standards for Living Environment
- **NYSED Bilingual Glossaries** – NYS Statewide Language Regional Bilingual Education Resource for NYSED approved bilingual glossaries.

### English Language Learners (ELL) Enhancements
- To access [hyperlinked](http://ngss.nsta.org/Classroom-Resources.aspx) material, you must be logged into your BPS Google Drive

### Instructional Accommodations (depending on the student’s needs)
- **Extended time** for tests in class, projects and assignments
- **Directions read**. Broken down as necessary
- **Model** how to complete the activity in the lesson
- **Oral simplification** of directions or questions
- **Translated version** of test when available. Student may have both version English and native language version

### Listening
- **Translanguaging** - Use of their entire linguistic repertoire. Have things translated into their language (if student can read in their home language)
- **Build background knowledge**
- **Visuals** - GIFs, pictures - will assist students in understanding what they are listening to
- **Video to review or introduce a topic** - use [closed captioning](http://ngss.nsta.org/Classroom-Resources.aspx) to help students see the words and pronunciations while they listen to the content
- **Word stretching / Vowel stretching** when instructing allows student to listen closely to the pronunciation of the word

### Speaking
- **Sentence Frames** - to begin a sentence such as Evolution is… or I think that evolution is…
- **Academic Conversation Starters**: Have a visual of a list of academic sentence starters that students can refer to in a discussion. Examples include: “I expect ___ to happen.” or “My data shows that…”
- **Choral Reading** - To build fluency, self-confidence and motivation with reading/speaking
- **Create movement** to go with the word. Movement can be a motivating factor, as well as a kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning

### Reading
- **Supplementary Text** to help reinforce concepts. If necessarily, use lower Lexile levels to ensure comprehension.
- **Visual Aids** - Pictures or models to support vocabulary words and concepts
- **Video to review or introduce a topic** - use [closed captioning](http://ngss.nsta.org/Classroom-Resources.aspx) to help students read along while they listen to the content
- **4 Square / Frayer models** to help students gain a deeper understanding of vocabulary.
- **Highlighting** important text to assist students in answering questions after the reading.
- **Chunking** - Break reading of text into chunks or paragraphs

### Writing
- **Sentence Frames** - to begin a sentence such as Biodiversity is… or An example of competition is…
- **Close passages** with word banks
- **Word banks**
- **Graphic Organizers** to help break down the writing process and organize thoughts
- **Standards-based sentence stems**

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BPS Science Department Living Environment Unit 5
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#### Special Education Modifications
- Special Education students must have accommodations as per Individual Educational Plan (IEP)

#### Instructional
- **Pre-teach** vocabulary
- **Use picture vocabulary**
- **Scaffold** Depth of Knowledge questions
- **Provide** copy of notes/notes in “close” form
- **Use of Think, Pair, and Share** strategy to help process information
- **Scaffold** written assignments with the use of **graphic organizers**
- Allow for **multiple ways to respond** (verbal, written, response board)
- **Provide model of performance task**
- **Modify informational text** to fit the needs of the students
- **Provide a digital or paper interactive notebook**
- **Present complex tasks in multiple ways**
- **Provide mnemonic strategies** for Living Environment concepts

#### Technology:
- **Audio** reading of text
- **Text to type** functions
- **Videos** to clarify/visualize Living Environment concepts
- **Record class lecture/discussions** and make accessible to student
- **Nearpod** - interactive presentations of notes
- **Playposit** - show a video clip about the topic and add your own questions for them to answer as they watch
- Allow students to type answers in chat on **Teams**

#### In Class Assessments
- **Provide review packet or review sheet** of concepts covered on the test
- **Practice similar questions prior to the test**
- **Provide multiple options** for projects
- **Give a timeline** of when things are due and remind them of the process often.
- **Use of timer** in class
- **Break all complex tasks into chunks**

#### Step Up to Writing
- **Step Up to Writing** materials can be found in BPS Science K-12 Schoology Folder → 9-12 Resources → Living Environment → Resources → Curriculum Materials

#### SUTW Strategies
- **Transitions for Different Purposes**
- **Four Step Summary Paragraph**
- **Meaningful Sentences**
- **Planning Paragraphs with Informal Outline**
- **Stretching Paragraphs in Essays and Reports**
- **Traffic Light Colors for Informative Explanatory Writing**