NGSS Grade 8: Unit 3 Sequencing

Evolution explains life's unity and diversity.

Sequence Developed by TUSD Teachers, May 2016

PEs Assessed: MS-ESS1-4, MS-LS3-1, MS-LS4-1,MS LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5, MS-LS4-6

DCIs

Intro with Dinosaur Extinction and Other Examples of Extinctions Over Time

Can bring in ESS3-1 Uneven distribution of Natural resources: Loss of habitat is currently leading cause of extinction

ESS1.C: The History of Planet Earth
The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1- 4)

LS4.A: Evidence of Common Ancestry and Diversity
The collection of fossils and their placement in chronological order (e. g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)

LS4.A: Evidence of Common Ancestry and Diversity
Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)

LS4.A: Evidence of Common Ancestry and Diversity Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

LS1.B: Growth and Development of Organisms
Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MSLS3-2)

LS3.A: Inheritance of Traits
Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)

LS3.B: Variation of Traits
-In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits
In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

LS4.C: Adaptation
Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

LS4.B: Natural Selection
Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)

LS4.B: Natural Selection
In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5)

Additional Concepts

-relative ages / dating rocks
-rock formations
-fossils
-geologic time scale
-rock stata
-landforms
-mountains
-ocean basins

-chronological order
-fossil record
-diversity
-extinction
-changes in life forms over time
-evolution

-anatomical structures
-evolutionary relationships
-relationships between organisms
-fossil record
-branching tree diagrams

-embryological developments across multiple species
-evidence of evolution

-meiosis
-DNA
-genetics
-inheritance

-chromosomes
-genes
-alleles
-proteins
-physical traits
-phenotype vs. genotype

-gene mutations
-positive changes, neutral changes, detrimental changes
-inheritance
-haploid vs. diploid cells

-genetic variation contributes to survival and reproduction
-phenotype vs. genotype
-behavior also contributes to survival and reproduction
-nature vs. nurture?

-changes in populations over time, changes in species over time
-survival of the fittest
-natural selection
-Charles Darwin

-mathematical models supporting natural selection
-probability

-artificial selection
-gene therapy
-selective breeding
-humans influence on inheritance of specific traits
-genetic modification
-animal husbandry
-GMOs

SEPs

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
-Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1- 4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3) Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)

Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4- 1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas to construct an explanation for realworld phenomena, examples, or events. (MS-LS4-2)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)

Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

Constructing Explanations and Designing Solutions - Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)

CCCs

Scale, Proportion, and Quantity
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4)

Patterns
Graphs, charts, and images can be used to identify -patterns in data. (MS-LS4-1)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1),(MS-LS4-2)

Patterns
-Patterns can be used to identify cause and effect relationships. (MS-LS4-2)

Patterns
Graphs, charts, and images can be used to identify -patterns in data. (MS-LS4- 3)

Structure and Function
Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Cause and Effect
Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)

Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)
Interdependence of Science, Engineering, and Technology
Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)

PEs (boundaries of PE)

Performance Task: Evidence of Earth's History

MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]

Activity Brainstorm
- Students are provided with graphs and charts related to the GTS
- Students find patterns and create a media product to explain their understanding of how rock strata and fossils provide evidence of Earth's history and how past extinctions and other changes in species over time
- **Assessment:** Students write an essay explaining the patterns they found and how this helps us understand the future of life on this planet

Comparative Anatomy Stations Lab

MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]

Activity Brainstorm:
- Students visit stations (real artifacts/fossils, microscopes, and digital samples) surrounding the topics of embryology and anatomy
- Students compare modern organisms to fossil organisms to find similarities and differences
- Students compare embryonic stages of different organisms and to the fully developed organisms to find similarities and differences
- **Assessment**: Students evaluate their observations and create a media product to present the relationships found among the species investigated. Students will rate the strength of common ancestry of each relationship presented supported by evidence from their observations.
- Rate Scale 1-10
  - 1= no evidence of a relationship shown between species
  - 10= extremely strong evidence in support of a common ancestor

DNA Mutations Model

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

Activity Brainstorm
- Students create a model (poster, stop start animation or whiteboard app) to show how genes mutate and the effects of the mutation on a protein
- Students must provide and example of a harmful, beneficial and neutral effect of a mutation within the same species within the model
- **Assessment:** Students present their findings to the class in person or via digital method to explain their model and WHY changes to a protein affects organisms. They must also include how this helps us understand the future of life on this planet.

Design a Beak Adaptation Simulation

MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

Activity Brainstorm:
- Intro with Who Wants to Survive a Million Years
- Framework adaptation lab- Design a Beak Adaptation Simulation
- Students use data from lab to create mathematical representations of changes in populations over time
- **Assessment:** Students write a conclusion paragraph using evidence from lab of how genetic variations in a population increase chances of a species surviving in a specific environment

Artificial Selection Debate

MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

Activity Brainstorm:
- Groups of students research different types of artificial selection: selective breeding, genetically modified foods, animal husbandry, gene therapy
- Students present findings to the class using a Google Slide Show and share the impacts (positive and negative) this technology will or may have on society
- **Assessment**: Students debate which technology had or will have the largest impact on society