8th Grade Unit 1 - Natural Selection and Evolution

Content Area: **Science**
Course(s): **Science Grade 8**
Time Period: **MP1**
Length: **45 days**
Status: **Published**

NJSLS - Science

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.
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.
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.
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.
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.
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
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.

Science and Engineering Practices

Developing and Using Models

Develop and use a model to describe phenomena. (MS-LS3-1)

Analyzing and Interpreting Data

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)

Using Mathematics and Computational Thinking

Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

Constructing Explanations and Designing Solutions

Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)

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

Obtaining, Evaluating, and Communicating Information

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)

Disciplinary Core Ideas

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 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.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)

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)

Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

LS4.B: Natural Selection

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

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)

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)

Crosscutting Concepts

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)

Patterns

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

Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1, MS-LS4-3)

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)

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)

Scientific Knowledge is Based on Empirical Evidence

Science knowledge is based upon logical and conceptual connections between evidence and explanations. (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)

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)

Rationale and Transfer Goals

In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. Students then construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. Finally, students develop and use models to describe how gene mutations and sexual reproduction contribute to genetic variation. Students understand how genetic factors determine the growth of an individual organism. The crosscutting concepts of cause and effect, patterns, structure and function, constructing explanations, obtaining, evaluating, and communicating information, and using mathematical and computational thinking

are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing graphical displays and gathering, reading, and communicating information. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Enduring Understandings

The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.

Similarities and differences exist in the gross anatomical structures of modern organisms.

Relationships between embryos of different species show similarities in their development.

Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment.

Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions.

In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding.

Each distinct gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual.

In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations.

Essential Questions

How do we know when an organism (fossil) was alive?

How do we know that birds and dinosaurs are related?

Other than bones and structures being similar, what other evidence is there that birds and dinosaurs are related?

How can changes to the genetic code increase or decrease an individual's chances of survival?

How can the environment affect natural selection?

Are Genetically Modified Organisms (GMO) safe to eat?

How do structural changes to genes (mutations) located on chromosomes affect proteins or affect the structure and function of an organism?

Content - What will students know?

- The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
- The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record.
- Relative fossil dating is achieved by examining the fossil's relative position in sedimentary rock layers.
- Objects and events in the fossil record occur in consistent patterns that are understandable through measurement and observation.
- Patterns exist in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers.
- Patterns can occur within one species of organism or across many species.

- Similarities and differences exist in the gross anatomical structures of modern organisms.
- There are anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms.
- Similarities and differences exist in the gross anatomical structures of modern organisms and their fossil relatives.
- Similarities and differences in the gross anatomical structures of modern organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.
- Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships.
- Science assumes that objects and events in evolutionary history occur in consistent patterns that are understandable through measurement and observation.
- Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment.
- Natural selection leads to the predominance of certain traits in a population and the suppression of others.
- Natural selection may have more than one cause, and some cause and effect relationships within natural selection can only be described using probability.
- Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions.
- The distribution of traits in a population changes.
- Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common.
- Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
- In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding.
- In artificial selection, humans choose desirable, genetically determined traits to pass on to offspring.
- Phenomena, such as genetic outcomes in artificial selection, may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.
- Technologies have changed the way humans influence the inheritance of desired traits in organisms.
- Engineering advances have led to important discoveries in the field of selective breeding.
- Engineering advances in the field of selective breeding have led to the development of entire industries and engineered systems.

- Scientific discoveries have led to the development of entire industries and engineered systems.
- Relationships between embryos of different species show similarities in their development.
- General patterns of relatedness among embryos of different organisms can be inferred by comparing the macroscopic appearance of diagrams or pictures.
- Pictorial data can be used to identify patterns of similarities in embryological development across multiple species.
- Similarities in embryological development across multiple species show relationships that are not evident in the fully formed organisms.
- Complex and microscopic structures and systems, such as genes located on chromosomes, can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among the parts of the system; therefore, complex natural structures/systems can be analyzed to determine how they function.
- 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 affect the traits of the individual.
- In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations.
- Some changes to genetic material are beneficial, others harmful, and some neutral to the organism.
- Changes in genetic material may result in the production of different proteins.
- Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- 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.
- Though rare, mutations may result in changes to the structure and function of proteins.

Skills - What will students be able to do?

- Use graphs, charts, and images to identify patterns within the fossil record.
- Analyze and interpret data within the fossil record to determine similarities and differences in findings.
- Make logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on

Earth.

- Apply scientific ideas to construct explanations for evolutionary relationships.
- Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of evolutionary relationships.
- Apply scientific ideas about evolutionary history to construct an explanation for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures.
- Construct an explanation that includes probability statements regarding variables and proportional reasoning of how genetic variations of traits in a population increase some individuals' probability surviving and reproducing in a specific environment.
- Use probability to describe some cause-and-effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment.
- Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time.
- Use mathematical representations to support conclusions about how natural selection may lead to increases and decreases of genetic traits in populations over time.
- Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) from multiple appropriate sources.
- Describe how information from publications about technologies and methods that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) used are supported or not supported by evidence.
- Assess the credibility, accuracy, and possible bias of publications and the methods they used when gathering information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection).
- Use diagrams or pictures to identify patterns in embryological development across multiple species.
- Analyze displays of pictorial data to identify where the embryological development is related linearly and where that linear nature ends.
- Infer general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.
- 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.

Activities - How will we teach the content and skills?

- Inspire Science Life Science Unit 4 Module 1: Lesson 1 How Traits Change
- Inspire Science Life Science Unit 4 Module 1: Lesson 2 The Theory of Evolution by Natural Selection
- Inspire Science Life Science Unit 4 Module 1: Lesson 3 Artificial Selection
- Inspire Science Life Science Unit 4 Module 2: Lesson 1 Fossil Evidence of Evolution
- Inspire Science Life Science Unit 4 Module 2: Lesson 2 Biological Evidence of Evolution
- MS-LS3-1 Lesson Examples
- MS-LS4-1 Lesson Examples
- MS-LS4-2 Lesson Examples
- MS-LS4-3 Lesson Examples
- MS-LS4-4 Lesson Examples
- MS-LS4-5 Lesson Examples
- MS-LS4-6 Lesson Examples

Evidence/Assessments - How will we know what students have learned?

- Inspire Science Labs
- Inspire Science STEM Module Projects
- Inspire Science Life Science Unit 4 Module 1 Assessment
- Inspire Science Life Science Unit 4 Module 2 Assessment
- Daily Warm Up
- Daily Exit Ticket
- Grade 8 Science Unit 1 Benchmark

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• The fossil record documents the existence,	By the end of Grade 5, students	3-LS3-1 Activities

diversity, extinction, and change of many life forms throughout the history of life on Earth. • The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record. • Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment.	understand that: Some kinds of plants and animals that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. Different organisms vary in how they look and function because they have different inherited information. The environment also affects the traits that an organism develops. Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. Different organisms vary in how they look and function because they have different inherited information.	3-LS4-1 Activities

Key Resources

Inspire Science

NOVA: Judgment Day

The Day the Mesozoic Died

National Science Digital Library

99.99% Antibacterial Products and Natural Selection

Making Sense of Natural Selection

Bug Hunt

Color Variation over Time in Rock Pocket Mouse Populations

21st Century Life and Careers

9.2.8.CAP.8	Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.

Career Readiness, Life Literacies, & Key Skills

9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

9.4.8.CT.3	Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
9.4.8.IML.3	Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
9.4.8.IML.4	Ask insightful questions to organize different types of data and create meaningful visualizations.
9.4.8.IML.5	Analyze and interpret local or public data sets to summarize and effectively communicate the data.
9.4.8.TL.1	Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).

Interdisciplinary Connections/Companion Standards

NJSLS ELA

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5)

RST.6-8.4 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 6–8 texts and topics. (MS-LS3-1)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1, , MS-LS4-1, MS-LS4-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3, MS-LS4-4)

WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS4-2, MS-LS4-4)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-

2, MS-LS4-4)

SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2, MS-LS4-4)

SL.8.4 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. (MS-LS4-2, MS-LS4-4)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1)

NJSLS Mathematics

MP.4 Model with mathematics. (MS-LS4-6)

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4, MS-LS4-6)

6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS4-4, MS-LS4-6)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-1, MS-LS4-2)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-4, MS-LS4-6)