Grade 8 Science, Unit 1

Evidence of Common Ancestry

Overview

Unit abstract

By the completion of this unit of study, students will understand how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students will examine evidence to support their understanding of patterns in the fossil record and how those patterns show relationships between modern organisms and their common ancestors.

Students will use the practices of analyzing graphical displays and gathering, reading, and communicating information. The crosscutting concepts of cause and effect, patterns, and structure and function will support understanding across this unit of study.

Essential question

- How do organisms change over time?

Bristol–Warren, Central Falls, Cranston, Segue Institute for Learning, Tiverton, and Woonsocket, with process support from The Charles A. Dana Center at the University of Texas at Austin

Written Curriculum

Next Generation Science Standards[1]

MS. Natural Selection and Adaptations

Students who demonstrate understanding can:

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.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 and interpret data to determine similarities and differences in findings. (MS-LS4-1) **----------** ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)	**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)	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1) **----------** ***Connections to Nature of Science*** **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)

Connections to other DCIs in this grade-band: **MS.ESS1.C** (MS-LS4-1); **MS.ESS2.B** (MS-LS4-1)

Articulation across grade-bands: **3.LS4.A** (MS-LS4-1); **HS.LS4.A** (MS-LS4-1); **HS.ESS1.C** (MS-LS4-1)

Common Core State Standards Connections:

ELA/Literacy –

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)*

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-LS4-1)

Mathematics –

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)*

[1] Next Generation Science Standards is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product.

MS. Natural Selection and Adaptations

Students who demonstrate understanding can:
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.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices

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 real-world phenomena, examples, or events. (MS-LS4-2)

Disciplinary Core Ideas

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)

Crosscutting Concepts

Patterns

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

Connections to Nature of Science

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-LS4-2)

Connections to other DCIs in this grade-band: **MS.LS3.A** (MS-LS4-2); **MS.LS3.B** (MS-LS4-2); **MS.ESS1.C** (MS-LS4-2)

Articulation across grade-bands: **3.LS4.A** (MS-LS4-2); **HS.LS4.A** (MS-LS4-2); **HS.ESS1.C** (MS-LS4-2)

Common Core State Standards Connections:

ELA/Literacy –

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-LS4-2)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2)
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)*
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)*

Mathematics –

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-LS4-2)*

MS. Natural Selection and Adaptations

Students who demonstrate understanding can:

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.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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)	**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)	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-3)

Connections to other DCIs in this grade-band: N/A

Articulation across grade-bands: **HS.LS4.A** (MS-LS4-3)

Common Core State Standards Connections:

ELA/Literacy –

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-LS4-3)*

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-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)*

Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study.

By the end of Grade 5, students know 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.

Progression of current learning

Driving question 1
How can the analysis and interpretation of data be used to identify 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?

Concepts

- 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.

Practices

- 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.

Driving question 2
How do scientific ideas construct explanations for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships?

Concepts

- 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 decent.
- 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.

Practices

- 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.

Driving question 3
How can patterns of similarities in the embryological development across multiple species be used to identify relationships not evident in the fully formed anatomy?

Concepts	Practices
• 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.	• 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.

Integration of content, practices, and crosscutting concepts

Prior to middle school, students know that some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago. In this unit of study, students will build on this knowledge by examining how the fossil record documents the existence, diversity, extinction, and change of many life forms through Earth's history. The fossil record and comparisons of anatomical similarities between organisms and their embryos enable the inference of lines of evolutionary descent.

- Students analyze images or data to identify patterns in the locations of fossils in layers of sedimentary rock. They can use their understanding of these patterns to place fossils in chronological order. Students may make connections between their studies of plate movement in grade 7 and the possible shifting of layers of sedimentary rock to explain inconsistencies in the relative chronological order of the fossil record as it is seen today.
- Students can analyze data on the chronology of the fossil record based on radioactive dating. An explanation of radioactive dating can be provided to students along with data, but students are not expected to complete any calculations. Information can be provided in the form of data tables correlating fossil age with half-life. This information could also be presented in the form of a graph.
- Students may analyze images from the fossil record to identify patterns of change in the complexity of the anatomical structures in organisms. For example, students can observe pictures of fossilized organisms with similar evolutionary histories in order to compare and contrast changes in their anatomical structures over time. Students may be placed in groups, with each group examining changes in anatomical structures over time within one evolutionary lineage (e.g., the whale, the horse, cycads). Once students have identified patterns of change within one evolutionary lineage, they can meet with students from other groups to discuss patterns of change across multiple evolutionary lineages. Students could then present their findings using a variety of media choices (PowerPoint,

poster, short skit or play, comic strip, etc). This activity would provide application of the real-world phenomenon that life on Earth changes over time.

- Students could be provided with multimedia experiences in order to analyze visual displays of the embryological development of different species. They can analyze the linear and nonlinear relationships among the embryological developments of different species. For example, students can analyze data about embryological development to determine whether development across species shares a similar rate, similar size of embryos, or similar characteristics over a period of time. If these characteristics are consistent across species, a linear relationship can be inferred. At the point where the rate, size, or general characteristics of development diverge, the relationship can then be classified as nonlinear.
- Students can integrate the patterns they identified in the fossil record by studying sedimentary rock images and radioactive dating data provided by the teacher and the relationships they discovered through their study of embryological development with evidence from informational texts to develop an explanation of changes in life forms throughout the history of life on Earth. This explanation could be presented in the form of a claim, with students required to cite evidence from their studies of diagrams, images, and texts to explain that life on Earth has changed over time.

Integration of mathematics and/or English Language Arts/literacy

Mathematics

- Use variables to represent numbers and write expressions to represent patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearances in the rock record to 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. Understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specified set.
- Use variables to represent numbers and write expressions showing patterns that can be used to identify cause-and-effect relationships among the anatomical similarities and differences among modern organisms and between modern and fossil organisms. This representation will be used to infer evolutionary relationships. Understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specified set.

English language arts/literacy

- Cite specific textual evidence to support the analysis of patterns found in the fossil record to document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth. Use scientific, precise details in the explanations.
- Integrate quantitative or technical information about the fossil record that is expressed in words into a version of that information expressed visually in the form of a flowchart, diagram, model, graph, or table.
- Attending to the precise details of explanations or descriptions, cite specific textual evidence to support analysis of science texts' information on the relationships between the anatomical similarities and differences among modern organisms and between modern and fossil organisms and their fossil relationships.

- Write informative/explanatory text examining anatomical similarities and differences among modern organisms and between modern and fossil organisms and their fossil relationships. The text should convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Draw evidence from informational texts to support an analysis of, reflection on, and research about anatomical similarities and differences among modern organisms and between modern and fossil organisms used to infer evolutionary relationships.
- Engage in a range of collaborative discussions about the anatomical similarities and differences among modern organisms and between modern and fossil organisms used to infer evolutionary relationships. Discussions must provide opportunities for students to clearly express their own ideas and exchange ideas with others. The discussions may be one on one, in groups, or led by the teacher.
- Present claims and findings to explain the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. Emphasize the important points in a focused, coherent manner with relevant evidence, valid reasoning, and well-chosen details. During the presentation, students must use appropriate eye contact, adequate volume, and clear pronunciation.
- Cite specific textual evidence to support the analysis of pictorial data comparing patterns of similarities in embryological development across multiple species to identify relationships not evident in the fully formed anatomy. Attention must be paid to the precise details of explanation or descriptions.
- Integrate quantitative or technical information about general patterns of relatedness among embryos of different organisms expressed in words in a text with a version expressed in a flowchart, diagram, model, graph, or table.
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with the information gained from reading a text about embryological development across multiple species in order to identify relationships not evident in the fully formed anatomy.

Future learning

Life science

- 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.

Earth and space science

- Continental rocks, which can be more than 4 billion years old, are generally much older than the rocks of the ocean floor, which are less than 200 million years old.
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history.

Number of Instructional Days

Recommended number of instructional days: 15 (1 day = approximately 50 minutes)s

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.