MIDDLE SCHOOL LIFE SCIENCE: FOSSIL RECORD

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-LS-4-1 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. (SEP: 4; DCI: LS4.A; CCC: Patterns) [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.]*

MS-LS-4-2 Apply scientific ideas to construct an explanation for similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. (SEP: 6; DCI: LS4.A; CCC: Patterns) [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.]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

The history of Earth's organisms is documented in chronological order by the fossil record, which is a collection of fossils found in layers of rock around the planet. The fossil record provides information on the existence, diversity, and extinctions of life over time. Anatomical(structural) similarities and differences in species of both living (extant) and extinct organisms may help to infer possible ancestral relationships. Organisms that share a pattern of anatomical structures are likely to be more closely related than organisms that do not share a pattern of anatomical structures.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- Fossilized samples of *Archaeopteryx* show anatomical features of both modern day birds and reptiles.
- Sugar gliders and northern flying squirrels both have a patagium (membrane that stretches from the forelimb to hindlimb on each side of the animal), but are found on different continents (Australia and North America).
- Fossils of *Cynognathus*, a land dwelling reptile, are found on both parts of South America and Africa.
- Mosasaurus is a deep-sea marine lizard which spent all of its time far beneath the water's surface. It's fossils have been found in central South Dakota.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for

student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data ● Analyze and interpret data to determine similarities and differences in findings. **Constructing Explanations and Designing Solutions** ● Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events	**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. ● 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.	**Patterns** ● Graphs, charts, and images can be used to identify patterns in data. ● Patterns can be used to identify cause and effect relationships.

Fossils provide evidence of past life and include mineral replacements, preserved remains, or traces of organisms that lived long ago. The fossil record documents Earth's history by organizing the location and placement of fossils that have been discovered in strata (layers) of sedimentary rock. Fossils found in rock strata are placed in chronological order with older fossils found in bottom layers and newer fossils in upper layers of undisturbed rock. These fossils document the existence, diversity, extinction, and change of many life forms. Due to the specific conditions necessary to preserve organisms, not all types of organisms that existed in the past have left fossils that can be retrieved.

Ancestral relationships between organisms may be explained by comparing anatomical similarities between the fossils of organisms found in sedimentary rock. Anatomical patterns may be found by evaluating the structures of like organisms from different time periods that are thought to be related. Factors that might have caused anatomical changes to occur can then be determined. Patterns might also be detected by studying the type of organisms and their abundance in strata that occurred after catastrophic events (major volcanic eruption, meteor impact, etc.), thus identifying possible cause and effect relationships. A comparison of the anatomical similarities and differences between existing and extinct organisms allows evolutionary relationships to be inferred.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Analyzing and Interpreting Data

- Provide students with data on organisms present throughout different rock strata. Ask students to determine when mass extinctions occurred based on fossil evidence.

SEP Constructing Explanations and Designing Solutions

- Show students skeletons of extinct and living organisms thought to have a recent common ancestor. Ask students to write an explanation of similarities and differences between modern and extinct organisms (such as archaeopteryx and modern birds or fossilized horses and modern horses).

CCC Patterns

- After presenting observational data on organisms prevalent during different periods of time, ask students: What do you predict will happen to species diversity in the future? Use patterns you see in the data to justify your answer.

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Use similarities and differences in** *graphs* **to provide evidence** for when mass extinctions occurred, organisms or types of organisms emerged, went extinct, or evolved, and the long-term increase in the diversity and complexity of organisms on Earth.
- **Construct an explanation based on evidence to identify similarities and differences** in anatomical *patterns* in and between fossilized organisms (e.g., skulls of fossilized crocodiles and fossilized dinosaurs) and living organisms (e.g. skulls of modern crocodiles and skeletons of birds)
- **Apply scientific ideas and principles to explain that** *in a given image* fossils and rock strata are found in order relative to each other (i.e. relative dating) and provide chronological data.
- **Apply scientific reasoning to show evidence** from *images* of the fossil record of the existence, diversity, extinction and change of many life forms throughout history.
- **Construct qualitative explanations based on** *images* of anatomical structures of fossilized and modern organisms to find *anatomical patterns* that show the potential ancestral relationships of organisms.