**Coventry Public Schools - NGSS Aligned Science Curriculum 2015**
**Grade 6 Life Science**
**Unit 6: Change Over Time (Evolution)**
**Teacher Resource Folder**

## *UNIT DESCRIPTION:*

***In this unit of study, students will analyze qualitative and quantitative data for patterns in the fossil record, anatomical similarities and differences, and similarities in embryological development to construct an explanation of changes in population over time. Emphasis is on using the evidence to explain evolutionary relationships among organisms.***

## *UNIT ESSENTIAL UNDERSTANDING(S):*

**Populations change over time to fit their environment.**

## *PERFORMANCE EXPECTATIONS:*

**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.]**

**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.]**

## *UNIT CORE IDEAS:*

**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)

## *UNIT ENGINEERING PRACTICES:*

**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)

**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)

**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)

## *UNIT CROSSCUTTING CONCEPTS:*

**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)

**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),(MS-LS4-2)

## STEM CAREER CONNECTION(S)

This section identifies careers in field of science, technology, engineering and mathematics that relate to the unit.

http://stemcareer.com/topcareers/
http://www.sciencebuddies.org/science-engineering-careers

## *STUDENTS' PRIOR AND FUTURE LEARNING:*

### Disciplinary Core Ideas

| Primary School (Grades K-2) | Elementary School (Grades 3-5) | Middle School (Grades 6-8) | High School (Grades 9-12) |
|---|---|---|---|
| **LS4.A: Evidence of Common Ancestry and Diversity** | | | |
| | Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: moved from K-2) (3-LS4-1)<br><br>Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1) | 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)<br><br>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)<br><br>Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy (MS-LS4-3) | 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. (HS-LS4-1) |

## Science and Engineering Practices

| Primary School (Grades K-2) | Elementary School (Grades 3-5) | Middle School (Grades 6-8) | High School (Grades 9-12) |
|---|---|---|---|
| **Analyzing and Interpreting Data** | | | |
| Analyze data from tests of an object or tool to determine if it works as intended. | Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.<br><br>Analyze data to refine a problem statement or the design of a proposed object, tool, or process.<br><br>Use data to evaluate and refine design solutions. | Analyze displays of data to identify linear and nonlinear relationships.<br><br>Analyze and interpret data to determine similarities and differences in findings. | Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.<br><br>Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.<br><br>Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. |
| **Constructing Explanations and Designing Solutions** | | | |
| Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.<br><br>Generate and/or compare multiple solutions to a problem. | Apply scientific ideas to solve design problems.<br><br>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. | Apply scientific ideas to construct an explanation for real-word phenomena, examples, or events. | Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge,student-generated sources of evidence, prioritized criteria, and tradeoff considerations. |

## Crosscutting Concepts

| Primary School (Grades K-2) | Elementary School (Grades 3-5) | Middle School (Grades 6-8) | High School (Grades 9-12) |
|---|---|---|---|
| **Patterns** | | | |
| Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. | Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.<br><br>Patterns of change can be used to make predictions.<br><br>Patterns can be used as evidence to support an explanation. | Patterns can be used to identify cause and effect relationships.<br><br>Graphs, charts, and images can be used to identify patterns in data. | Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.<br><br>Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced; thus requiring improved investigations and experiments.<br><br>Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.<br><br>Mathematical representations are needed to identify some patterns.<br><br>Empirical evidence is needed to identify patterns. |

## UNIT SUMMATIVE ASSESSMENT

## *Unit 6 Lesson 1*

### *Essential Question*

Open-ended questions that provoke inquiry/engagement and prompt intellectual exploration of the core ideas that impact the phenomenon addressed in the unit.

***What do patterns in fossil records tell us about the history of life on Earth?***

### *Lesson Performance Expectations*

**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.]**

***Practice:***
**Analyze and interpret data to determine similarities and differences in findings.**

***Crosscutting Concepts:***
**Graphs, charts, and images can be used to identify patterns in data.**

***Disciplinary Core Ideas:***
**The collection of fossils and their placement in chronological order 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.**

### *Learning Objectives: What will students KNOW, UNDERSTAND and DO?*

***Know:***

- ***The collection of fossils and their placement in chronological order is known as the fossil record.***

***Understand:***

- ***Fossil Record documents existence of diversity, extinction and change of life forms throughout history.***

***Do:***

- ***Analyze and interpret data from patterns in fossil record.***

### *LEARNING TARGETS*

***I will understand that fossil records give us a timeline of how life has evolved on the planet.***

### *5E Instructional Model*

***Engage:*** (Elicits prior knowledge & promotes curiosity)

- **Story in a Sandwich** (Teacher Guide) (Student Sheet)

***Explore:*** (Students work in collaborative teams to explore questions)

- **The Dating Game** (Teacher Guide) - The students analyze and interpret Pictorial Representation of fossils comparing rock layers (stratigraphy)and radiometric evidence to determine a timeline for evolution of organisms. Make Copies for each group of the following. Determining Fossil Ages: Student Reference Sheet, Regional Analysis Cards
  - **Pre-Activity Discussion**
    1. How does the stratigraphy method work for dating fossils?
    2. How does the radiometric method work for dating fossils?
    3. How would using the stratigraphy and radiometric methods together help scientists create a time scale using evidence from the fossil record?
  - **Procedure 1-2 on Student Sheet**

***Explain:*** (Opportunity to explain their current knowledge & compare to new explanations)

- **The Dating Game Continued**
  - **Procedure 3-4**

***Elaborate:*** (Instruction must add breadth and depth to current understanding)

- **The Dating Game Continued**
  - **Procedure 5**

***Evaluate:*** (Helps both learner & instructor assess understanding of the concept)

- **The Dating Game Question 5 Rubric KEY**

| ***Academic Vocabulary*** |
|---|
| stratigraphy, radiometric, fossils, extinction |
| **Real World Connection:**<br>This section identifies the complex question, global issue, or real world problem addressed in the lesson. Provide an explanation. |
| |
| ***Instructional Strategies to include Struggling Learners, English Language Learners and Advanced Learners*** |

**ELL STRATEGIES:**

**Vocabulary: chronological order, document, existence, diversity, pattern, timeline, evolve, imprint**
**STEMscope Picture Vocabulary:** *(Print out cards and hang in room)*
Fossil Record

**Engage: Support handout for Story in a Sandwich**

**This video on Fossils could help to provide background info**
**https://www.youtube.com/watch?v=3rkGu0BItKM**

**This is another video for support on exploring fossil records and how fossils are formed**
**https://www.youtube.com/watch?v=sPFiwW8J3sY**

**Explore, Elaborate, Explain: The Dating Game student response may need to be done with a partner depending on proficiency level. The ELL teacher could also be the partner; this way she can break down each step specifically. Also, showing students a model response would be beneficial. Teacher may need to create final timeline chart in student notebook as well.**

**Evaluate: Rubric needs to be reviewed with ELL teacher to ensure clear understanding.**

**STRATEGIES FOR STRUGGLING LEARNERS:**

**STRATEGIES FOR ADVANCED LEARNERS:**

| *Formative/Summative Assessments/Performance Task* |
|---|
| **The Dating Game Question 5 Rubric KEY** |
| ***Resources/Technology/Materials*** |
| ***Shells (or other small objects to use as a fossil) - 1 per group***<br>***Plastic Bag - 1 per group***<br>***Set of Books (to act as weights)***<br>***Slices of bread (soft) - 4 slices per group***<br><br>***Colored Pencils***<br>***Colored Copies of Fossil Analysis Cards (if not shared digitally)*** |
| ***CCSS Connections*** |
| ***XXXX*** |

| *Unit 6 Lesson 2* |
|---|
| ***Essential Question***<br>Open-ended questions that provoke inquiry/engagement and prompt intellectual exploration of the core ideas that impact the phenomenon addressed in the unit. |
| ***How do similarities and differences in anatomical structures explain evolutionary relationships?*** |

## *Lesson Performance Expectations*

**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.]**

***Practice:***
Apply scientific ideas to construct an explanation for real-word phenomena, examples, or events.

***Crosscutting Concepts:***
Patterns can be used to identify cause and effect relationships.

***Disciplinary Core Ideas:***
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.

## *Learning Objectives: What will students KNOW, UNDERSTAND and DO?*

***Know:***
- ***Organism with similar (Homologous) structures are related.***

***Understand:***
- ***Anatomical similarities and differences among organisms can be used to infer evolutionary relationships.***

***Do:***
- ***Construct an explanation of evolutionary relationship using evidence of homologous structure among organisms.***

## *LEARNING TARGETS*

***I will compare similarities and differences between rat and elephant skeleton to see if they share a common ancestor.***

## *5E Instructional Model*

***Engage:*** (Elicits prior knowledge & promotes curiosity)
- **Students compare several mammal limb and observe their function.**
- Animal Limbs: The Same or Different?
  - **(Teacher Guide)**
  - **(Student Handout)**
  - **Animal Movement Video Clips**

***Explore:*** (Students work in collaborative teams to explore questions)
- **Rat and the Elephant Activity (Teacher Guide)**
  - **Pre-Activity Questions**
  - **Rats and Elephant Student Handout Procedure 1 to 3.**

***Explain/Elaborate:*** (Opportunity to explain their current knowledge & compare to new explanations)

- **Rats and Elephant Student handout Procedure 4.**

***Evaluate:*** (Helps both learner & instructor assess understanding of the concept)

- **Post Activity Questions 4 -** Could you infer that the elephant and rat once had a common ancestor based on their skeletons? Why or why not?

***Academic Vocabulary***

*Homologous Structures, Ancestor, Speciation*

**Real World Connection:**

This section identifies the complex question, global issue, or real world problem addressed in the lesson. Provide an explanation.

***Instructional Strategies to include Struggling Learners, English Language Learners and Advanced Learners***

**ELL STRATEGIES:**

**Additional vocabulary:** rat, elephant, common ancestor, limb, vertebrate, mammal, reptile, bird

**STRATEGIES FOR STRUGGLING LEARNERS:**

**STRATEGIES FOR ADVANCED LEARNERS:**

(Instruction must add breadth and depth to current understanding)

- Skeleton Sort **(Teacher Guide)**
  - **Student Handout**
  - **Teacher Printout Dog Card**
  - **Teacher Printable Horse Card**

***Formative/Summative Assessments/Performance Task***

***Unit 4 Lesson 2 Evaluation Student sheet***
***Evaluation Response Sample***

***Resources/Technology/Materials***

***Printed Material***
***1 Student Handout: Rats and Elephants: Similar or Different? (per student, group, or class)***
***Student Reference Sheet: None***
***1 Teacher Printout: Rat and Elephant Skeletons (per student)***
***Reusable***
***1 Pencil, colored, set (per group)***

***1 Scissors (per group)***
***1 Glue, stick (per group)***

## *CCSS Connections*

***XXXX***

## *Unit 6 Lesson 3*

### *Essential Question*

Open-ended questions that provoke inquiry/engagement and prompt intellectual exploration of the core ideas that impact the phenomenon addressed in the unit.

***How do similar patterns in embryological development explain evolutionary relationships?***

## *Lesson Performance Expectations*

**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.]**

## *Learning Objectives: What will students KNOW, UNDERSTAND and DO?*

***Know:***

- ***Organism with similar embryological development are related.***

***Understand:***

- ***Embryological similarities can be analyzed to infer and evolutionary relationships.***

***Do:***

- ***Analyze pictorial data to compare patterns in embryological development as evidence of evolutionary relationships.***

## *LEARNING TARGETS*

***I will identify patterns in data by viewing and sorting images of embryonic development in different species.***
***I will construct, analyze, and interpret data in a cladogram to identify relationships.***

## *5E Instructional Model*

***Engage:*** (Elicits prior knowledge & promotes curiosity)

- From Embryos to Chick

***Explore:*** (Students work in collaborative teams to explore questions)

- When looking at a variety of adult animals, clear differences stand out. Even among rodents, for example, a squirrel can easily be identified from a beaver. In their early stages of growth, however, animals can look very similar. As development continues, the embryonic traits become more and more different. That is, we ultimately diverge into distinct species.
- Analyze sets of cards that show different stages in embryonic development of different types of animals.
    - **Student Handout Procedure 1-2**
    - **Printable Cards**

***Elaborate:*** (Instruction must add breadth and depth to current understanding)

- Use the clues provided in the cards to create a cladogram that shows at what point divergence in the characteristics occurs.
    - Student Handout Procedure 3-5

***Explain:*** (Opportunity to explain their current knowledge & compare to new explanations)

**Post-Activity Discussion**

1. What does the cladogram infer about the relationships between those five organisms?
2. Based on your findings, which two organisms would you conclude have the closest relationship out of the five you studied? Explain.
3. Even after one organism branched off from the group, that divergent organism may have later shown similar growth characteristics to the others. Why do you think that is the case?

***Evaluate:*** (Helps both learner & instructor assess understanding of the concept)

- Consider just one of the animals featured in the Embryonic Development Cards. What is another organism that seems like a closer relative to your chosen animal compared to the other four animals included in this activity? If you could follow the complete cycle of development for those two close cousins, what characteristics would be initially shared in their branch off from the original card group? What characteristics would you look for that indicated divergence between the two cousins?
- Have students respond to the questions on Padlet.

***Academic Vocabulary***

**Real World Connection:**

This section identifies the complex question, global issue, or real world problem addressed in the lesson. Provide an explanation.

***Instructional Strategies to include Struggling Learners, English Language Learners and Advanced Learners***

**ELL STRATEGIES:**

| |
|---|
| **STRATEGIES FOR STRUGGLING LEARNERS:**<br><br>**STRATEGIES FOR ADVANCED LEARNERS:** |
| ***Formative/Summative Assessments/Performance Task*** |
| ***Data table***<br>***Cladogram*** |
| ***Resources/Technology/Materials*** |
| |
| ***CCSS Connections*** |
| ***XXXX*** |