Georgia Performance Standards Framework for Biology 9-12

Unit: Organization
General Task

Are They Similar or Not?

Overview: Biological evolution accounts for diversity of all life over long periods of time. Through billions of years of evolution, life forms have continued to diversify in a branching pattern, from single-celled ancestors to the diversity of life on Earth today. There is a fit between organisms and their environments, though not always a perfect fit. Not every feature of an organism is an adaptation, but features often reflect their evolutionary history. In this internet task, students will learn and be able to explain various forms of evidence among living organisms thus using biological data to analyze similarities among organisms and leading to the support for common ancestry.

Standards:

SB5. Students will evaluate the role of natural selection in the development of the theory of evolution.
   b. Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution.
   c. Explain how fossil and biochemical evidence support the theory.
   d. Relate natural selection to changes in organisms.

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
   a. Exhibit the above traits in their own scientific activities.
   b. Recognize that different explanations often can be given for the same evidence.
   c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.
SCSh3. **Students will identify and investigate problems scientifically.**
   a. Suggest reasonable hypotheses for identified problems.
   b. Develop procedures for solving scientific problems.
   c. Collect, organize and record appropriate data.
   d. Graphically compare and analyze data points and/or summary statistics.
   e. Develop reasonable conclusions based on data collected.
   f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh 4. **Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.**
   a. Develop and use systematic procedures for recording and organizing information.
   b. Use technology to produce tables and graphs.
   c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh7. **Students analyze how scientific knowledge is developed.**
   Students recognize that:
   a. The universe is a vast single system in which the basic principles are the same everywhere.
   b. Universal principles are discovered through observation and experimental verification.
   c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.
   d. Hypotheses often cause scientists to develop new experiments that produce additional data.
   e. Testing, revising, and occasionally rejecting new and old theories never ends.

**Enduring Understandings:**
- Species evolve over time.
- The millions of different species of plants, animals and microorganisms that live on earth today are related by descent from common ancestors.
Evolution explains the number of different life forms we see, similarities in anatomy and chemistry and sequence of changes in fossils formed over more than a billion years. 
Natural selection is a primary factor in evolutionary change.

**Essential Questions:**

1. How does comparative structure evidence support evolution?
2. Why is evolution by natural selection considered to be a mechanism for how life changes overtime?
3. How can common ancestry be analyzed through observation of similarities and differences among anatomy, biochemistry, and fossil changes in a diversity of organisms?

**ADMINISTRATION PROCEDURES**

**Pre-Assessment:**

[http://www.exploratorium.edu/exhibits/embryo/embryoflash.html](http://www.exploratorium.edu/exhibits/embryo/embryoflash.html)

*TEACHER NOTES: This site provides a series of embryos in which the students have to guess which embryo is human based on certain embryological characteristics. This site can be projected to stimulate curiosity and bring in other aspects of biology to help students understand the vocabulary to link this evidence to support evolution. If internet connection is not available, the teacher could use a similar picture such as the one below. Be sure to mark out the names of the embryos.*
Outcome / Performance Expectations: Students will explain the types of scientific evidence that support the theory of evolution. Students will relate natural selection to changes in organisms.

General Teacher Instructions: Contextual language must be an emphasis prior to the activity and reemphasize after closing of activity and extension in order to help with conceptualizing evolutionary phenomenon.

- **Primary language** *(minimal vocabulary that must be addressed in the activity)*: homology, analogy, common ancestry, natural selection, selective pressures

- **Secondary language** *(scaffolding vocabulary which leads to mastery of concept)*: convergent evolution, and divergent evolution.

Recommendation: The teacher should use the extension activity at the end of the template to further relate other areas of scientific evidence in order to help students learn how to build a case using scientific data to support the phenomenon of evolution.
### Georgia Performance Standards Framework for Biology 9-12

<table>
<thead>
<tr>
<th>Materials Needed:</th>
<th>Internet, possible LCD projector, printed copies of directions</th>
</tr>
</thead>
</table>

### Task with Student Directions:

- Use the website to navigate through web lesson questions.
- Go to this website: [http://evolution.berkeley.edu/evolibrary](http://evolution.berkeley.edu/evolibrary)
- Navigate to "What is the Evidence for Evolution"
- Then navigate' to Similarities and differences: Understanding homology and analogy

1. Research the words homology and analogy,

In the picture above, state whether the organisms in the picture describes analogy or homology in terms of evolution?
2. The picture below are pictures of tetrapods. Based on your observations, what is a tetrapod?

3. What are the six bones found in all tetrapod legs?

4. Identify these limbs (to what animal do they belong)?

5. **Wild Goose Chase Moment**: What did the common ancestor of all modern tetrapods appear to look like? Create a phylogenetic chart of the four organisms identified. Research and explain the accuracy of your chart. **Why does homology of structures support common ancestry?**

6. **Wild Goose Chase Moment**: *Pick the word highlighted in bold*: What characteristics of anatomy tend to be (analogous or homologous) among these animals? Why? Are a bird and a crocodile homologous to each other? Explain.

7. Similar structures that evolved independently are called ____________________.
|   | 8. a) Predict the selective pressure causing differences between a marsupial and a placental mammal?  
|   | b) Research what is Smilodon?  
|   | c) Research what is Thylacosmilus?  
|   | d) From reading the research about the descent of the Smilodon and Thyacosmilus, what characteristic of these to species would make them evolutionarily related?  
|   | 9. Describe how two unrelated organisms such as flowers could evolve to have a similar appearance?  
|   | 10. Are similarities between dolphins and sharks homologous or analogous?  
|   | 11. Research criteria that could be used to determine whether something has homology or analogy when compared to other organisms?  
|   | 12. Fill in the blanks of the primate tree. Why are humans considered to be primates? Is your answer based on homology or analogy? |
14. Considering all of the evidence, are the "wings" (actually flaps of skin stretched between the legs) of sugar gliders and flying squirrels homologous or analogous structures? Explain why you would come to this answer.

15. **Wild goose chase moment**: See more examples of homology and examples of analogy.

a) Are a Venus fly trap and the pitcher plant homologous or analogous? Explain the reason for your answer.

b) How are barnacles and limpets similar? How can these similarities be explained?
Resources: Adapted from biologycorner.com which was further adapted from [http://evolution.berkeley.edu/evolibrary](http://evolution.berkeley.edu/evolibrary) [http://www.exploratorium.edu/exhibits/embryo/embryoflash.html](http://www.exploratorium.edu/exhibits/embryo/embryoflash.html) [http://www.indiana.edu/~ensiweb/lessons/mol.bio.html](http://www.indiana.edu/~ensiweb/lessons/mol.bio.html)

Homework / Extension: EXTENTION: Wild Goose Chase Moment: Extension Activity. Research the Cytochrome C proteins of the organisms identified in the picture of question 1. How many differences in amino acid sequences are among the identified organisms? You may want to create a small data table.

<table>
<thead>
<tr>
<th>Identified organism</th>
<th>Number of amino acid differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organism 1</td>
<td></td>
</tr>
<tr>
<td>Organism 2</td>
<td></td>
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<tr>
<td>Organism 3</td>
<td></td>
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<tr>
<td>Organism 4</td>
<td></td>
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</tbody>
</table>

Using the data table, justify why these organisms share a common ancestor?

*Teacher Note: Extension Resources: If students have trouble finding organisms to include in their data try using some organisms from the following resources from this evolution lesson:*
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| Instructional Task Accommodations for ELL Students: | • Check for comprehension of expectations, instructions and relevant vocabulary  
• Include illustrations with the word wall  
• Modify language requirements for written assessments  
• Pair with more advanced native language speaking partner (allow for translation in native language for comprehension) as needed  
• Provide paragraph summary template (fill in the blank format) and graphic organizer  
• Provide bilingual support materials when possible |
| --- | --- |

**Molecular Biology and Phylogeny:**

http://www.indiana.edu/~ensiweb/lessons/mol.bio.html

This resource could be used as a follow-up lesson as an option to make more connections to the standards.

| Instructional Task Accommodations for Students with Specific Disabilities: | • **Review and Implement IEP accommodations for specific student needs**  
Other Accommodations may include  
• Create a word wall for new vocabulary; word wall can be an interactive whereby students use yarn to make connections with key vocabulary  
• Include illustrations with the word wall  
• Use KIM vocabulary strategy (Key word, Illustration, and Meaning student in students own words)  
• Word banks for written assessments such as essays  
• Pair with “buddies” with strong written and verbal skills  
• Provide templates and graphic organizers  
• Provide check lists for step by step directions  
• Allow for extended time. |
| --- | --- |

| Instructional Task Accommodations for Gifted Students: | • Create a game board to review the concepts of how species evolve over time.  
• Ask students to bring in pictures of comparable organisms to class and classify them based on homology or analogy. Then students must be able to explain how the uniformity and similarity of organisms support the phenomenon of evolution. |
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