Title: Evidence for Evolution

Introduction: In this lesson students read the article “Was Darwin Wrong” published in the Nov 2004 issue of National Geographic Magazine. As students read they will complete a graphic organizer to glean key information from the article. After reading the article the students will write a summary essay to reinforce the important elements that support the theory of evolution.

Learning Outcomes:

1. Students will engage in interaction with science content from informational text contained in a popular magazine.
2. Students will be able to state evidence used to supporting the theory of evolution.
3. Students will gain practice in writing skills and summarizing information.

Curriculum Alignment:

National Standards addressed by this lesson include content standards for grades 9-12 for the Life Sciences. Fundamental concepts include biological evolution and that natural selection and its evolutionary consequences provide a scientific explanation for the fossil record.

North Carolina Standards

Biology

3.05 Examine the development of the theory of evolution by natural selection including:

- Development of the theory
- Fossil and biochemical evidence

English III

2.01 Research and analyze ideas, events, and/or movements related to United States culture by:

- locating facts and details for purposeful elaboration.
- organizing information to create a structure for purpose, audience, and context.
- excluding extraneous information.
- providing accurate documentation.

2.03 Demonstrate the ability to read, listen to and view a variety of increasingly complex print and non-print informational texts appropriate to grade level and course literary focus, by:

- identifying and analyzing text components (such as organizational structures, story elements, organizational features) and evaluating their impact on the text.
- providing textual evidence to support understanding of and reader’s response to text.
- demonstrating comprehension of main idea and supporting details.
- summarizing key events and/or points from text.
- making inferences, predicting, and drawing conclusions based on text.
- identifying and analyzing personal, social, historical or cultural influences, contexts, or biases.
- making connections between works, self and related topics.

3.03 Use argumentation for:
• interpreting researched information effectively.
• establishing and defending a point of view.
• addressing concerns of the opposition.
• using logical strategies (e.g., deductive and inductive reasoning, syllogisms, analogies) and sophisticated techniques (e.g., rhetorical devices, parallelism, irony, concrete images).
• developing a sense of completion.

4.03 Assess the power, validity, and truthfulness in the logic of arguments given in public and political documents by:

• identifying the intent and message of the author or artist.
• recognizing how the author addresses opposing viewpoints.
• articulating a personal response to the message and method of the author or artist.
• evaluating the historical significance of the work.

6.01 Demonstrate an understanding of the conventions of language by:

• decoding vocabulary using knowledge of Anglo-Saxon, Greek, and Latin bases and affixes.
• using vocabulary strategies such as context clues, resources, and structural analysis (roots, prefixes, etc.) to determine meaning of words and phrases.

**Classroom Time Required:** Approximately one 90 min class period with the student completing the essay portion as a homework assignment. The teacher should provide some introduction to any vocabulary that may be unfamiliar to students. Students should be allowed to skim the article for unfamiliar terms and ask questions. Students should be able to read the article and complete the graphic organizer before the end of the class period. Instructor may wish to review the graphic organizer with the students before proceeding with the essay assignment.

**Materials Needed:**

- *Copy of Article “Was Darwin Wrong” by David Quammen. accessible at http://ngm.nationalgeographic.com/ngm/0411/feature1/fulltext.html*
- *Graphic organizer chart for recording information from essay.*
- *KIM chart for new vocabulary (optional)*
- *Handout “Is It a Scientific Theory” (individual copies may be distributed or project one copy to the class for discussion)*

**Technology Resources:**

- *Computer with internet access to acquire article*
- *Computer for word processing essay. (Optional)*

**Pre-Activities/Activities:** The teacher needs to fully assess the needs and ability levels of the students before beginning this lesson. Critical vocabulary is given in the lesson plan; however some students may need additional scaffolding. The teacher should also review the supporting materials thoroughly and determine which students will need the graphic organizer, the outline or in some instances students may be proficient writes and may not need either of these. It may also be wise to discuss putting
information into one’s own words in completing the graphic organizer to reduce instances of plagiarism. This would also be a good time to discuss/review what constitutes plagiarism.

**Engage:** Engage students with a Socratic discussion on what constitutes a scientific theory. Many students dismiss the theory of evolution as “just at theory”. A discussion of this can be found in paragraph one, of the article. At this point allow students to construct their own meaning of a scientific theory. The instructor will assist students in understanding what constitutes a scientific theory in the explain portion of the lesson.

**Explore:** Explore other scientific theories such as relativity, electricity, continental drift which are discussed in the opening of the article. Have students examine their own reaction to these theories. Are they dismissed as easily as the theory of evolution? Again this should be done in a Socratic style.

**Explain:** Using the handout “Is It a Scientific Theory” help students to understand that scientific theories are overarching, unifying explanations developed from extensive observations, experimentation and reflection. Theories are well-supported, time-tested, and substantiated by facts, tested hypothesis, models and principles. A theory is always subject to skepticism and may be modified or replaced as new information is acquired through the scientific process. It should also be explained to students that although Darwin is credited with giving us evolutionary theory that he was influenced strongly by geologic discoveries and that evidence continues to mount in favor of evolutionary theory.

**Elaborate:** Return to the opening discussion and examine all of the evidence both past and present at this point students should read the article and using the graphic organizer fill in the information in the tables as they read the article. Teacher should move about the room examining the statements that students are putting into the graphic organizer for completeness, vocabulary and understanding. The article actually mentions 8 types of evidences that support evolution (biogeography, paleontology, embryology, morphology, population genetics, biochemistry, molecular biology, and genomics. Students should focus on the first four in their graphic organizer as they appear first and are discussed in more detail in the article than the latter. Questions students to determine if they understand what they are noting on their graphic organizer.

**Evaluate:** Evaluate student understanding by having them write a summary paper recapping what they believe provides the strongest evidence for evolution. Students should be provided a copy of the scoring rubric provided before they begin the writing process.

**Assessment:**

> See scoring rubric provided below.

**Modifications:** Modifications of many types can be made depending on the ability level of the students. Students with weaker writing skill may need more prompts and assistance in understanding thesis statements and topic sentences. The instructor may also want to assist students in preparing an outline before they begin the writing process. Use the graphic organizer and/or the outline scaffold to help students in acquiring information from the article and in organizing their thoughts.
Alternative Assessments: none

Supplemental Information: none

Critical Vocabulary: These are the terms with which students seem to have the most difficulty, since the English standard course of study emphasized etymology of word this information is provided where it could be found.

  - **anagenesis** - from the Greek, *genesis* it means “up,” “against,” “generation”, “birth” in Biology the progressive evolution of a species

  - **embryology** - the science dealing with the formation, development, structure, and functional activities of embryos. From the Latin *embryo* derived from Greek. *Embryon*. “a young animal”

  - **vestigial** - from Latin, *vestigium* "footprint, trace,” in Biology, occurring or persisting as a rudimentary or degenerate structure.

  - **genomics** - the study of genomes.

  - **speciation** - the formation of new species as a result of geographic, physiological, anatomical, or behavioral factors that prevent previously interbreeding populations from breeding with each other from the Latin species "kind, sort”.

  - **morphology** - the branch of biology dealing with the form and structure of organisms.

  - **population genetics** - the study of hereditary characteristics and their behavior within a population.

  - **microbial disease** - general term for a disease or condition caused by bacteria or other microscopic organisms.

  - **biogeography** - from the Greek. *geographia* "description of the earth’s surface,” from ge "earth” + -graphia “the study of the geographical distribution of living things.”

  - **progenitor** - from Latin *progenitorem* "ancestor", a biologically related ancestor.

  - **biochemistry** - the science dealing with the chemistry of living matter.

  - **pleontology** – from the Greek. *palaios* "old, ancient" + -ology "study of."

**Homologues-homologous** structure or structures that may appear different but are derived from the same embryonic tissue such as the arm of a human, the flipper of a whale and the leg of a horse.

Comments:

- If at all possible students should be provided their own copy of the essay to allow for annotating and margin notes.
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Is It A Scientific Theory?

Put an X next to the statements you think best apply to scientific theories.

_____ 1. Theories include observations.
_____ 2. Theories are the “hunches” of scientists.
_____ 3. Theories can include personal beliefs, opinions, or religious viewpoints.
_____ 4. Theories are well established and have stood the test of time.
_____ 5. Theories are incomplete, temporary ideas.
_____ 6. A theory never changes.
_____ 7. Theories are inferred explanations, strongly supported by data.
_____ 8. A scientific law has been proven and a theory has not.
_____ 9. Theories are used to make predictions.
_____ 10. Theories eventually “mature” and can become laws.

Examine the statements you have checked off. Describe what a scientific theory means to you.

________________________________________________________________________
________________________________________________________________________
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### “Was Darwin Wrong”

<table>
<thead>
<tr>
<th>Information Organizer</th>
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</thead>
<tbody>
<tr>
<td><strong>What is a theory?</strong></td>
<td></td>
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<tr>
<td><strong>Examples of theories.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Some background information of Darwin.</strong></td>
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</tbody>
</table>

### Four types of evidence that support Darwin’s theory.

<table>
<thead>
<tr>
<th>Supporting details</th>
<th>Supporting details</th>
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<th>Supporting details</th>
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</table>
# Scoring Rubric for Darwin Essay Summary

<table>
<thead>
<tr>
<th></th>
<th>Needs Improvement (redo)</th>
<th>Poor 2</th>
<th>Fair 3</th>
<th>Good 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
<td>Two of five criteria from Good category have been met.</td>
<td>Three of five criteria from Good category have been met.</td>
<td>Four of five criteria from Good category have been met.</td>
<td>Paper is double spaced; Paper includes title page, with Title, Date, Name; Paper contains proper bibliography; Font is #12 Times New Roman or Arial.</td>
</tr>
<tr>
<td><strong>Grammar &amp; Mechanics</strong></td>
<td>One of the four criteria from the good category have been met.</td>
<td>Two of the four criteria from the Good category have been met.</td>
<td>Three of the four criteria from the Good category have been met</td>
<td>Student writes in full sentences with appropriate punctuation; Student makes appropriate use of vocabulary; Student has three or fewer spelling errors; Student has 3 or fewer grammatical errors.</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>Student introduces paper with three or fewer sentences. Thesis is unclear.</td>
<td>Student introduces topic in three or four sentences. Thesis not clearly stated.</td>
<td>Student introduces topic with three or four good sentences ending with a clear thesis statement.</td>
<td>Student fully introduces topic in detail with four or more good sentences ending with a fifth sentence containing a clear thesis statement.</td>
</tr>
<tr>
<td><strong>Body</strong></td>
<td>One of three Criteria from Fair category has been met.</td>
<td>Two of three criteria from Fair category have been met.</td>
<td>Essay contains two body paragraphs. Student provides clear topic sentence with 4+ supporting sentences. Each topic sentence relates back to thesis statement.</td>
<td>Essay contains three body paragraphs. Student provides clear topic sentence with 4+ supporting sentences. Each topic sentence relates back to thesis statement.</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td>One of four criteria from Good category has been met</td>
<td>Two of four criteria from Good category have been met.</td>
<td>Three of four criteria from Good category have been met.</td>
<td>Student clearly restates thesis statement. Student recaps each point presented in body of paper. Student interjects their own comments/feeling. Paper ends with quote, question, or catchy statement.</td>
</tr>
</tbody>
</table>
Outline Template

1. Introduction
   a. Opening sentence
   b. Sentence two
   c. Sentence three
   d. Sentence four
   e. Thesis statement

2. Body Paragraph 1
   a. Topic Sentence
   b. Support for topic
   c. Support for topic
   d. Support for topic
   e. Support for topic

3. Body Paragraph 2
   a. Topic Sentence
   b. Support for topic
   c. Support for topic
   d. Support for topic
   e. Support for topic

4. Body Paragraph 3
   a. Topic Sentence
   b. Support for topic
   c. Support for topic
   d. Support for topic
   e. Support for topic

5. Conclusion
   a. Restatement of thesis
   b. Recap topic sentence 1
   c. Recap topic sentence 2
   d. Recap topic sentence 3
   e. Provide personal insight
   f. Ending quote, question, or catchy statement.