

**Glencoe’s Response to *The Discovery Institute’s Preliminary Analysis of the Treatment of Evolution in Biology Textbooks Currently Being Considered for Adoption by the Texas State Board of Education***

**TOPIC I: The 1953 Miller-Urey Experiment**

- a. This book includes a drawing of the Miller-Urey apparatus (on p.382) accompanied by a misleading caption that claims “Miller and Urey’s experiment showed that under the proposed conditions on early Earth, small organic molecules, such as amino acids, could form.”
- b. The accompanying text fails to inform students of the problems with the experiment.
- c. Because of its factual errors and lack of information, the text does not enable students to “analyze, review, and critique” this scientific explanation as to its “strengths and weaknesses using scientific evidence and information” (TEKS 112.43c(3)A).

**Glencoe’s response:**

Glencoe agrees that the conditions used by Miller and Urey were not those of early Earth. The text lists the gases currently proposed to be in the atmosphere (page 382, column 1) and then lists different gases for the experiment (page 382, column 2). Still, Miller and Urey’s experiment is used as a starting point in most studies investigating the formation of the first organic molecules. The currently proposed atmosphere for early Earth does yield amino acids, as has been shown in multiple studies, some of which are listed in Rode (1999). Although some of the chemicals listed by the reviewers are toxic to modern life, they are proposed precursors to many of the organic molecules found in these experiments. They would not be toxic to non-living organic molecules. The

Miller-Urey experiment is not only a key study in the origin of life, but also a clear example of hypothesis-testing and the scientific method. Thus, Glencoe feels that it is appropriate to include it in the text.

***Glencoe suggests that the following be added to the end of the caption for Figure 14.12:***

“While the gases used in the experiment are no longer believed to represent the atmosphere of early Earth, later work using a more accurate composition of gases produced similar results.”

***Glencoe suggests that the following be added to the last paragraph on page 382:***

“Current research does not support the atmospheric conditions used in Miller and Urey’s experiments. However, organic compounds have been produced in other simulations of Earth’s early atmosphere.”

## **TOPIC II: Darwin’s Tree of Life & The Cambrian Explosion**

- a. This book mentions the Cambrian explosion and explains that “the fossil record shows an enormous increase in the diversity of life forms during this time” (on p. 377).
- b. The book fails to point out, however, that the Cambrian explosion poses a challenge to Darwin’s theory. Thus the book does not enable students to “analyze, review, and critique” the theory that all animals are descended from a common ancestor as to its “strengths and weaknesses using scientific evidence and information” (TEKS 112.43c(3)A).

### **Glencoe’s response:**

Punctuated equilibrium was developed not to explain evolution, but to account for the apparently fast pace of evolution as seen in the fossil record (Futuyma 1982, Freeman and Herron 1998). Because Darwin suggested that natural selection is a gradual process, events like the Cambrian explosion, clearly a case of change in populations, and thus evolution, might not be understandable with natural selection as the mechanism for evolution.

Since then, researchers have found that evolutionary change through natural selection can be quite fast. The Grants have shown this dramatically in the Galápagos finches (Grant 1999). Further, the fossil record has examples of both punctuated equilibrium patterns and gradual patterns. Thus natural selection can explain the evolution seen in the fossil record.

When the Cambrian explosion is defined on page 377, the students have not been introduced to concepts related to evolution. Thus, they are not prepared to analyze the implications of this part of the fossil record. Glencoe will add the following in a later chapter.

#### ***Glencoe suggests that the following be added to page 412:***

**“Reading Check** Analyze and critique the strengths and weaknesses of gradualism and punctuated equilibrium.”

#### ***Glencoe suggests the following revision to question 24 on page 419:***

**“24. Open Ended** Analyze, review, and critique how Darwin’s idea of gradualism and Eldredge and Gould’s idea of punctuated equilibrium could both be valid. Use the Cambrian explosion (p. 377) as an example.”

### **TOPIC III: Vertebrate Embryos & Haeckel’s Drawings**

- a. This book contains a modified version of Haeckel’s drawings (on p. 402) that exaggerates the similarities among fish, reptile, bird and human embryos.
- b. The accompanying text misleadingly identifies these as “the earliest stage of growth and development” and claims that “it is the shared features in the young embryos that suggest evolution from a common ancestor.” Yet the drawings omit earlier stages in which embryos are less similar.
- c. There is no indication in the text that the earlier stages of vertebrate embryos are actually quite different, or that early differences do not fit the pattern predicted by Darwin’s theory.
- d. Because of its factual errors and lack of information, the text does not enable students to “analyze, review, and critique” the embryological evidence for evolution as to its “strengths and weaknesses using scientific evidence and information” (TEKS 112.43c(3)A).

#### **Glencoe’s response:**

Figure 15.9 is drawn from photographs of actual embryos rather than from Haeckel’s drawings. Haeckel is not mentioned in the text. And, modern embryology does not support “ontogeny recapitulates phylogeny,” which suggests that on its way to becoming a mammal, a mouse embryo will go through stages resembling a fish, then an amphibian, and finally a reptile. Because Haeckel did indeed “massage” his data to support this false idea, *Biology: The Dynamics of Life* does not present this information.

To clarify the contribution of embryology as the line of evidence for evolution, Glencoe agrees to change the definition of embryo to “an early stage of growth and development of both plants and animals.”

#### ***Glencoe suggests the following revision to the caption for Figure 15.9:***

“In other stages of development, these embryos look different from each other. However, in this early stage they are similar. *Hypothesize the strengths and weaknesses of embryology as evidence for evolution.*”

### **TOPIC IV: Peppered Moths**

- a. This book includes a photograph of light- and dark-colored peppered moths on a tree trunk (on p. 397), without informing students either that peppered moths do not normally rest on tree trunks or that the photograph has been staged.
- b. The accompanying text fails to inform students about any of the problems with the classical peppered moth story.
- c. Because of its factual errors and lack of information, the text does not enable students to “analyze, review, and critique” the classical peppered moth hypothesis as to its “strengths and weaknesses using scientific evidence and information” (TEKS 112.43c(3)A).

### **Glencoe's response:**

Glencoe agrees with the reviewers. The rewrite of the lab will state the appropriate points more clearly. In the rewrite below, the text mentions nothing of tree trunks. Thus, the illustration of the moths has only the scientific name as a caption.

It is not unusual to use staged photos in science literature. For example, electron microscope images involve using material fixed in resin, coated in platinum, placed in a vacuum, and sliced into razor-thin sections. These photos allow visualization of science concepts in a case where direct observation would be impossible.

The exercise below makes the point that although natural selection as a mechanism for the evolution of peppered moths cannot yet be easily shown, there is no doubt that evolution has taken place. (Coyne 1998)

### ***Glencoe suggests the following revision to the introduction of Problem-Solving Lab 15.1 on page 397:***

**“Can natural selection explain evolution?”** In some organisms with short life cycles, biologists have observed evolution. In the mid-1800s, scientists noticed that populations of the peppered moth, *Biston betularia*, were changing from mostly light-colored to mostly dark-colored forms. The change to mostly dark-colored forms coincided with increased pollution from coal-burning. Populations in many of these same areas have shifted back towards light forms after the implementation of clean air regulations. Scientists have hypothesized that the evolution of these moths can be explained by natural selection, perhaps because forms not matching the level of soot are more vulnerable to birds.”

### ***Glencoe suggests the following revision to the text below “Solve the Problem”:***

**“Interpret Data** Calculate . . . in each experiment. Discuss how these results may or may not support a natural selection explanation based on birds eating moths.”

### ***Glencoe suggests the following revision to the TWE:***

“Survival was greater in the cleaner air outside the city than for light moths living in the city. There is much inferential evidence, however, that birds are involved. Point out to students that birds have been shown to preferentially eat conspicuous moths, but other studies have failed to completely duplicate Kettlewell’s results. Discuss the implications for natural selection and for evolution. The population changes, so evolution occurs, but the natural selection explanation remains open.

Kettlewell conducted his experiment during daylight hours. The moths are nocturnal. Ask students to critique Kettlewell’s results given this information.”

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