June 7, 2011

An Evaluation of Supplementary Biology and Evolution Curricular Materials Submitted for Adoption by the Texas State Board of Education

A Report from Discovery Institute's Center for Science and Culture

Executive Summary

In 2009, the Texas State Board of Education (TSBOE) adopted new Texas Essential Knowledge and Skills (TEKS) that require critical scientific evaluation of the core tenets of Darwinian evolution as well as other scientific theories. For example, they require students to "analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student." Even more specifically, the new TEKS require students to "analyze and evaluate" core tenets of neo-Darwinian evolution, such as common ancestry, mutation, natural selection, and sudden appearance in the fossil record. They also require critical investigation of the chemical origin of life.

The purpose of this report is to evaluate whether supplementary curricula recently submitted for adoption for use in Texas comply with the 2009 TEKS pertaining to biological and chemical evolution. This report *only* evaluates the curricula as regards the evolution-related TEKS and does not evaluate the curricula for compliance with other TEKS.

Most Proposed Supplementary Curricula Fail to Follow 2009 TEKS and/or Contain Glaring Scientific Errors

Fifteen groups have now submitted online curricula for adoption by the TSBOE to comply with the new 2009 TEKS. Ten of those groups have posted sufficient curricula online to allow for analysis. Unfortunately, as regards the TEKS that pertain to biology and evolution, **only one of the proposed curricula (International Databases, LLC) makes any serious attempt to fulfill the call for meaningful critical analysis of biological and chemical evolution. The remaining curricula that were accessible online make no meaningful effort to satisfy the TEKS' requirements that students "analyze and evaluate" neo-Darwinian evolution.** Nor do they require that students critique Darwinian evolution or the chemical origin of life "by using empirical evidence, logical reasoning, and experimental and observational testing." In short, the 2009 TEKS notwithstanding, most of the proposed supplements do *not* examine "all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student." Rather, the proposed curricula promote biological and chemical evolution in a one-sided manner, presenting *only* the evidence supporting evolution and failing to mention any scientific viewpoints or evidence that challenge evolution.

In addition, many of these curricula contain glaring scientific errors based on outdated science. For example, three of the proposed curricula (from Adaptive Curriculum, Holt McDougal, and Rice University) use Haeckel's inaccurate embryo drawings—called fraudulent by multiple evolutionary scientists—to claim that vertebrate embryos are similar in their earliest stages. Clearly inaccurate as well as outdated, Haeckel-derived embryo drawings were previously removed by the TBSOE from textbooks designed for use in Texas during the 2003 biology textbook adoption process; these bogus drawings should not be allowed to re-enter the curriculum.

A number of the curricula promote several other notoriously inaccurate "icons of evolution":

- Some curricula wrongly report that the Miller-Urey experiment produced amino acids under conditions that accurately simulated the early earth (e.g. Apex Learning, Cengage, McGraw Hill, or Technical Lab Systems).

- Some curricula claim that the prevalence of dark moths over light moths is due to moths naturally resting on tree trunks in the wild where they are eaten by birds, failing to report the empirical data questioning this claim.

- Some curricula promote the Galápagos finches as if they provide evidence for adaptive radiation, failing to mention that the finches are highly similar and can even interbreed.

- One curriculum even resuscitates long-debunked claims that the coccyx, appendix, tonsils, and many other functional organs are "vestigial," failing to mention that these organs are now recognized to have important functions (e.g. appendix, coccyx, tonsils, etc.) or are not generally regarded as evolutionary holdovers (e.g. male nipples).

Both because they fail to fulfill the 2009 TEKS and/or because they contain glaring scientific errors, 9 of the 10 proposed curricula which posted enough material online to allow for analysis clearly require significant revisions.

One Curriculum Tries to Follow 2009 TEKS, But Inappropriately Covers Intelligent Design

A single curriculum, submitted by International Databases, LLC, attempts to follow the 2009 TEKS by encouraging critical thinking, analysis, and evaluation of Darwinian evolution and the chemical origin of life, using empirical evidence, logical reasoning, experimental and observational testing, including examining all sides of scientific evidence. **However, this curriculum also includes intelligent design, which is not required by the TEKS, and which Discovery Institute (the leading intelligent design research organization) opposes requiring in public schools.** As Discovery Institute's Science Education Policy page states:

> As a matter of public policy, Discovery Institute opposes any effort to require the teaching of intelligent design by school districts or state boards of education. Attempts to mandate teaching about intelligent design only politicize the theory and will hinder fair and open discussion of the merits of the theory among scholars and within the scientific community. Furthermore, most teachers at the present time do not know enough about intelligent design to teach about it accurately and objectively.
>
> Instead of mandating intelligent design, Discovery Institute seeks to increase the coverage of evolution in textbooks. It believes that evolution should be fully and completely presented to students, and they should learn more about evolutionary theory, including its unresolved issues. In other words, evolution should be taught as a scientific theory that is open to critical scrutiny, not as a sacred dogma that can't be questioned.[1]

The TSBOE clearly did not intend to broach the issue of intelligent design in its 2009 TEKS revision. Therefore, the International Databases proposed curriculum as currently written goes beyond the curriculum standards established by the TSBOE.

[1] Discovery Institute's Science Education Policy, at http://www.discovery.org/a/3164

I. The New 2009 TEKS

In 2009, the TSBOE adopted the following new TEKS pertaining to biology and evolution:

> Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
>
> Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;
>
> Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;
>
> Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;
>
> Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;
>
> Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;
>
> Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and
>
> Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.
>
> Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;
>
> Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.

In April 2011, the TSBOE posted online links to 15 different curricula submitted for adoption to fulfill the new TEKS.[2] This report provides an analysis of those curricula and the extent to which they fulfill the TEKS that relate to biology and evolution.

[2] See http://www.tea.state.tx.us/index4.aspx?id=2147499573

II. Key Scientific Errors and Problems in Submitted Supplementary Curricula

A. Origin of Life—Miller-Urey Experiment

Textbooks commonly claim that in the 1950s, Stanley Miller and Harold Urey performed experiments showing how the "building blocks" of life, such as amino acids, could have arisen on the early Earth. Textbooks typically show a diagram of the glass apparatus used by Miller and Urey to purportedly simulate lightning strikes hitting the earth's early atmosphere. The claim is usually made that the experiments accurately simulated early earth conditions by using the gasses methane and ammonia to represent the earth's early atmosphere.

However, it has been known for decades that the Earth's early atmosphere was not composed of methane or ammonia, and would not have been conducive to Miller-Urey type chemistry. As origin of life theorist David Deamer explains, "This optimistic picture began to change in the late 1970s, when it became increasingly clear that the early atmosphere was probably volcanic in origin and composition, composed largely of carbon dioxide and nitrogen rather than the mixture of reducing gases assumed by the Miller-Urey model. Carbon dioxide does not support the rich array of synthetic pathways leading to possible monomers…"[3] Theorist Jeffrey Bada and other experts have likewise observed that "Geoscientists today doubt that the primitive atmosphere had the highly reducing composition Miller used…"[4]

There are strong reasons to expect that the early earth's atmosphere did not contain significant amounts of methane, ammonia, or high concentrations of other reducing gasses. The earth's early atmosphere is thought to have been produced by outgassing from volcanoes on the early earth, and the composition of those volcanic gasses is related to the chemical properties of the earth's inner mantle. Multiple studies have found that the chemical properties of the earth's mantle **would have been the same in the past** as they are today.[5] But today, volcanic gasses do not contain methane or ammonia, and are not reducing. A paper in *Earth and Planetary Science Letters* found that these chemical properties have been essentially constant over earth's history, leading to the conclusion that "**Life may have found its origins in other environments or by other mechanisms."**[6]

The Miller-Urey experiment is typically cited to lend plausibility to a "primordial soup" hypothesis, and the unguided chemical origins of life. But many leading theorists today have abandoned the Miller-Urey experiment and the "primordial soup" theory it is claimed to support. In February 2010, NPR reported

---

[3] David W. Deamer, "The First Living Systems: a Bioenergetic Perspective," *Microbiology & Molecular Biology Reviews*, Vol. 61:239 (1997).

[4] Adam P. Johnson, H. James Cleaves, Jason P. Dworkin, Daniel P. Glavin, Antonio Lazcano, Jeffrey L. Bada, "The Miller Volcanic Spark Discharge Experiment," *Science*, Vol. 322:404-405 (October 17, 2008).

[5] Kevin Zahnle, Laura Schaefer, and Bruce Fegley, "Earth's Earliest Atmospheres," *Cold Spring Harbor Perspectives in Biology* (2010) ("Geochemical evidence in Earth's oldest igneous rocks indicates that the redox state of the Earth's mantle has not changed over the past 3.8 Gyr") (internal citations omitted).

[6] Dante Canil, "Vanadian in peridotites, mantle redox and tectonic environments: Archean to present," *Earth and Planetary Science Letters* , Vol. 195:75-90 (2002) (internal citation removed) ("Abiotic synthesis of molecules and hydrocarbons that can lead to life in early Archean mantle-derived volcanic gases requires they contain significant H_2 and CO, but such reduced components are not supported by results of this and many other studies, which imply a scenario of Archean mantle redox not unlike that of today. **Life may have found its origins in other environments or by other mechanisms**.") (emphasis added).

that biochemist Nick Lane believes that the primordial soup theory is "past its expiration date."[7] So drastic is the evidence against pre-biotic synthesis of biological monomers that in 1990 the Space Studies Board of the National Research Council recommended that origin of life scientists undertake a "reexamination of biological monomer synthesis under primitive Earthlike environments, as revealed in current models of the early Earth."[8]

Unfortunately, textbooks rarely inform students that the Miller-Urey experiments probably did not accurately model the early earth, or that leading theorists no longer consider the Miller-Urey experiments as a viable explanation for a "primordial soup."

B. Tree of Life

Textbooks typically present universal common ancestry and a great "tree of life" as fact without offering any evidence that challenges that viewpoint. They often claim that there is a consilience of various lines of evidence—including the fossil record, anatomical and molecular (DNA) homology, biogeography, and embryology—that unequivocally supports common ancestry. But in fact within each of these fields there is much data that challenges universal common ancestry and/or conflicts sharply with standard evolutionary accounts of organismal relationships. Textbooks almost universally censor from students evidence that contradicts the arguments presented in favor of common ancestry.

(1) The Fossil Record

Textbooks usually state that the fossil record unwaveringly supports Darwinian evolution and common ancestry. A few isolated examples of "transitional forms" may be emphasized, with no discussion of criticisms of these transitional forms, and no discussion of evidence that contradicts gradual neo-Darwinian change. Students should learn about these transitional forms and understand the arguments for common descent from fossils. But students should also learn that the fossil record shows a pattern of explosions of new life-forms that often contradicts the predictions and expectations of common descent and neo-Darwinian evolution.

Modern evolutionary biology predicts that species evolved, as Darwin put it in *Origin of Species*, through "numerous, successive, slight modifications."[9] But the fossil record often tells a story of abrupt appearance of new life-forms and body plans without similar evolutionary precursors. This is seen most strikingly in the Cambrian explosion, the geologically sudden appearance of numerous new animal body plans about 530 million years ago. As one college-level textbook admits, "Most of the animal phyla that are represented in the fossil record first appear, 'fully formed,' in the Cambrian ... The fossil record is therefore of no help with respect to the origin and early diversification of the various animal phyla."[10]

Unfortunately, textbooks often omit any mention of the Cambrian explosion, even though leading evolutionary paleontologist Robert L. Carroll has said that "The most conspicuous event in metazoan

[7] Deborah Kelley, "Is It Time To Throw Out 'Primordial Soup' Theory?," NPR (February 7, 2010).
[8] National Research Council Space Studies Board, *The Search for Life's Origins* (National Academy Press: Washington D.C., 1990).
[9] Charles Darwin, *Origin of Species* (1859), Chapter 6, available at http://www.literature.org/authors/darwin-charles/the-origin-of-species/chapter-06.html.
[10] R.S.K. Barnes, P. Calow & P.J.W. Olive, *The Invertebrates: A New Synthesis*, pp. 9-10 (3rd ed., Blackwell Sci. Publications, 2001).

evolution was the dramatic origin of major new structures and body plans documented by the Cambrian explosion."[11] According to scientists like Carroll, "The extreme speed of anatomical change and adaptive radiation during this brief time period requires explanations that go beyond those proposed for the evolution of species within the modern biota."[12] Likewise, other authorities have stated that "the major evolutionary transitions in animal evolution still remain to be causally explained ... microevolution does not provide a satisfactory explanation for the extraordinary burst of novelty during the Cambrian Explosion."[13] When textbooks do discuss the Cambrian explosion, these problems are rarely pointed out to students.

Darwin was, of course, well aware even in the nineteenth century of the problem that the abrupt appearance of animal groups presented for his theory. He stated: "The case at present must remain inexplicable; and may be truly urged as a valid argument against the views here entertained." Contrary to Darwin's hope, however, in the 150 years since the publication of the *Origin,* discoveries in paleontology have only made the puzzle of the fossil record and the Cambrian explosion even more acute. Stephen Jay Gould observed that "[t]he absence of fossil evidence for intermediary stages between major transitions in organic design, indeed our inability, even in our imagination, to construct functional intermediates in many cases, has been a persistent and nagging problem for gradualistic accounts of evolution."[14]

The Cambrian explosion is not an isolated event and is in fact one of various "explosions" in the fossil record. Paleontologists have observed explosions of fish species,[15] a plant explosion,[16] a bird explosion,[17] and even a mammal explosion.[18] As one unusually candid textbook acknowledges, "Many species remain virtually unchanged for millions of years, then suddenly disappear to be replaced by a quite different, but related, form. Moreover, most major groups of animals appear abruptly in the fossil record, fully formed, and with no fossils yet discovered that form a transition from their parent group."[19]

Abrupt explosions of mass biological diversity seem to be the rule, not the exception, for the fossil record. Transitions plausibly documented by fossils seem to be the rare exception. However, there are two purported transitional forms which are often discussed in textbooks.

a. Archaeopteryx

Textbooks commonly portray *Archaeopteryx* as an intermediate form between reptiles and birds.

---

[11] Robert L. Carroll, "Towards a new evolutionary synthesis," *Trends in Ecology and Evolution*, Vol. 15(1):27-32 (2000).
[12] *Id.*
[13] Jaume Baguña and Jordi Garcia-Fernández, "Evo-Devo: the Long and Winding Road," *International Journal of Developmental Biology*, Vol. 47:705-713 (2003) (internal citations removed).
[14] Stephen Jay Gould, "Is a new and general theory of evolution emerging?," *Paleobiology*, Vol. 6(1): 119-130 (1980).
[15] Shu *et al.*, "Lower Cambrian vertebrates from south China," *Nature*, Vol. 402:42-46 (Nov 4, 1999); Arthur Strahler, *Science and Earth History -- The Evolution/Creation Controversy*, p. 408 (Prometheus Books, 1987).
[16] Bateman et al., "Early Evolution of Land Plants: Phylogeny, Physiology, and Ecology of the Primary Terrestrial Radiation," *Annual Review of Ecology and Systematics,* Vol. 29:263-292 (1998).
[17] Alan Cooper and Richard Fortey, "Evolutionary explosions and the phylogenetic fuse," *Trends in Ecology and Evolution*, Vol. 13(4):151-156 (April, 1998); Alan Feduccia, "'Big bang' for tertiary birds?," *Trends in Ecology and Evolution*, Vol.18(4):172-176 (April, 2003).
[18] Alan Cooper and Richard Fortey, "Evolutionary explosions and the phylogenetic fuse," *Trends in Ecology and Evolution*, Vol. 13(4):151-156 (April, 1998); Niles Eldredge, *The Monkey Business: A Scientist Looks at Creationism*, p. 65 (New York: Washington Square Press, 1982).
[19] C.P. Hickman, L.S. Roberts, and F.M. Hickman, *Integrated Principles of Zoology*, p. 866 (Times Mirror/Moseby College Publishing, 1988, 8th ed).

Archaeopteryx is generally considered to have been a true bird, capable of flight. But according to vertebrate paleontologist Robert A. Martin, the dinosaurs which supposedly evolved into *Archaeopteryx* "all occur in the fossil record after *Archaeopteryx* and so cannot be directly ancestral."[20] Most evolutionary scientists today doubt that modern birds are even descended from *Archaeopteryx*. Some are even critical of the hypothesis that birds are descended from dinosaurs.[21] Its status as a true transitional form has been called into question, though textbooks rarely acknowledge this fact.

b. Whale fossils

Textbooks increasingly present a series of fossils which purportedly document a transition from land-mammals to whales as evidence for evolution. But reconstructions of these fossils are often based upon evolutionary interpretation, not hard data. For example, the species *Pakicetus* may be portrayed as a fully-aquatic four-legged mammal, not because of the evidence but because textbooks want it to appear as an ancestor of whales. Yet the technical literature on the fossil notes that "the features of the skull indicate that pakicetids were terrestrial, and the locomotor skeleton displays running adaptations," leading to the conclusion that "Pakicetids were terrestrial mammals, no more amphibious than a tapir."[22]

But even if these fossils do have some intermediate traits, the claim that land-mammals evolved into whales by random mutation and natural selection faces a great hurdle from mathematics. Many changes would have been necessary to convert a land-mammal into a whale, including the emergence of the blowhole, modification of the eye for permanent underwater vision, ability to drink ocean water, forelimbs transformed into flippers, reduction of hindlimbs and pelvis, the origin of tail flukes and musculature, and the advent of blubber for temperature insulation, to name a few.[23] Each of these changes would necessarily involve many mutations. But the fossil record requires that evolution of whales from small land mammals took place in less than 10 million years,[24] which would only allow the fixation of a few thousand mutations—far too few to accomplish this transition.[25] Biologist Richard Sternberg has examined the requirements of this transition mathematically and concludes it requires "too many genetic re-wirings, too little time." Unfortunately, textbooks never acknowledge these obstacles.

(2) Anatomical and Molecular Homology

Textbooks commonly claim that anatomical and molecular (DNA) similarities between species indicate inheritance from a common ancestor. Textbooks cite homologous structures as similar structures which are inherited from a common ancestor. The similar bone structure in vertebrate limbs is often given as

---

[20] Robert A. Martin, *Missing Links: Evolutionary Concepts & Transitions Through Time*, p. 153 (Jones and Bartlett Publishers, 2004). *See also* Carl C. Swisher III et al. "Cretaceous age for the feathered dinosaurs of Lianoing, China," *Nature*, Vol. 400: 58-61 (July 1, 1999).

[21] For discussions of skeptics of feathered dinosaurs and the hypothesis that birds evolved from dinosaurs, see Devon E. Quick and John A. Ruben, "Cardio-Pulmonary Anatomy in Theropod Dinosaurs: Implications From Extant Archosaurs," *Journal of Morphology* (2009); Frances C. James and John A. Pourtless IV, "Cladistics and the Origins of Birds: A Review and Two New Analyses," *Ornithological Monographs*, Vol. 66:1-78 (2009). See also http://www.evolutionnews.org/2009/06/old_theories_die_hard_birdsevo021861.html and http://www.evolutionnews.org/2008/11/is_the_latest_feathered_dinosa013131.html.

[22] J. G. M. Thewissen, E. M. Williams, L. J. Roe, & S. T. Hussain, "Skeletons of terrestrial cetaceans and the relationship of whales to artiodactyls," *Nature*, Vol. 413:277-281 (September 20, 2001).

[23] List provided courtesy of Dr. Richard Sternberg.

[24] Alan Feduccia, "'Big bang' for tertiary birds?," *Trends in Ecology and Evolution*, Vol.18:172-176 (2003).

[25] See Walter ReMine, *The Biotic Message: Evolution Versus Message Theory* (Saint Paul Science, 2007).

an example of such homology. But then in a circular argument, homologous structures are often then claimed as evidence for common ancestry.

Critics point out that biological similarities need not necessarily reflect inheritance from a common ancestor, but instead may reflect common functional requirements. For example, hemoglobin molecules in different organisms are similar in sequence and in structure. But why should this be surprising if these molecules perform the same function: binding and releasing oxygen? Functional biological similarities do not require inheritance from a common ancestor.

There are also many difficulties encountered when evolutionary scientists attempt to use homology to construct a tree of life.

When arguing for common descent, textbooks typically assert that the degree of genetic (or anatomical) similarity between two species indicates how closely they are related. But there are numerous cases where this assumption fails, and anatomical or molecular data yield evolutionary trees (called "phylogenies") that conflict with conventional views of organismal relationships. The basic problem is that evolutionary trees based on one gene commonly differ strikingly from a phylogeny based on a different gene.

Leading evolutionists are loath to admit this fact during public debate. During the 2009 TSBOE hearings on the science TEKS, University of Texas Austin evolutionary scientist David Hillis cited himself as a "world's leading exper[t] on the tree of life" and told the TSBOE that there is "overwhelming agreement correspondence as you go from protein to protein, DNA sequence to DNA sequence" when reconstructing evolutionary history using biological molecules. Hillis's self-proclaimed expertise makes it all the more disconcerting that he tried to mislead the TSBOE about the widespread prevalence of incongruencies between various molecular phylogenies within his own field.

Indeed, the *very day* that Hillis testified before the TSBOE, the journal *New Scientist* published a cover story titled "Why Darwin was wrong about the tree of life." Directly contradicting Hillis's gross oversimplification of the case for common ancestry, the article reported that "The problem was that different genes told contradictory evolutionary stories." The article observed that with the sequencing of the genes and proteins of various living organisms, the tree of life fell apart:

> "For a long time the holy grail was to build a tree of life," says Eric Bapteste, an evolutionary biologist at the Pierre and Marie Curie University in Paris, France. A few years ago it looked as though the grail was within reach. **But today the project lies in tatters, torn to pieces by an onslaught of negative evidence. Many biologists now argue that the tree concept is obsolete and needs to be discarded. "We have no evidence at all that the tree of life is a reality,"** says Bapteste. That bombshell has even persuaded some that our fundamental view of biology needs to change.[26]

To reiterate, the basic problem is that one gene or protein yields one version of the "tree of life," while another gene or protein yields an entirely different tree. As the *New Scientist* article stated:

> The problems began in the early 1990s when it became possible to sequence actual bacterial and archaeal genes rather than just RNA. Everybody expected these DNA sequences to confirm the RNA tree, and sometimes they did but, crucially, sometimes

[26] Graham Lawton, "Why Darwin was wrong about the tree of life," *New Scientist* (January 21, 2009) (emphasis added).

they did not. RNA, for example, might suggest that species A was more closely related to species B than species C, but a tree made from DNA would suggest the reverse.[27]

Likewise, leading evolutionary bioinformatics specialist W. Ford Doolittle explains, "Molecular phylogenists will have failed to find the 'true tree,' not because their methods are inadequate or because they have chosen the wrong genes, but because the history of life cannot properly be represented as a tree."[28] Evolutionary biologists like Doolittle may claim that this problem is only encountered when one tries to reconstruct the evolutionary relationships of microorganisms, such as bacteria, which can swap genes through a process called horizontal gene transfer, thereby muddying any phylogenetic signal. **But this objection does not hold water, since the tree of life is challenged even among higher organisms where such gene-swapping is not observed.** As the *New Scientist* article noted, "research suggests that the evolution of animals and plants isn't exactly tree-like either."

Authority Carl Woese also observed that these problems extend well beyond the base of the tree of life: "Phylogenetic incongruities [conflicts] can be seen everywhere in the universal tree, from its root to the major branchings within and among the various taxa to the makeup of the primary groupings themselves."[29] **To reiterate, the problem was that even among higher organisms, the *New Scientist* article explains that "The problem was that different genes told contradictory evolutionary stories," therefore leading Syvanen to say regarding the relationships of these higher groups, "We've just annihilated the tree of life."** Many studies have reported such problems:

- A 2009 paper in *Trends in Ecology and Evolution* notes that: "A major challenge for incorporating such large amounts of data into inference of species trees is that conflicting genealogical histories often exist in different genes throughout the genome."[30] Similarly, a paper in the journal *Genome Research* studied the DNA sequences in various animal groups and found that "different proteins generate different phylogenetic tree[s]."[31]

- A study published in *Science* in 2005 tried to construct a phylogeny of animal relationships but concluded that "[d]espite the amount of data and breadth of taxa analyzed, relationships among most [animal] phyla remained unresolved."[32] Again, the problem lies in the fact that trees based upon one gene or protein often conflict with trees based upon other genes. Their study tried to avoid this problem by using a many-gene technique, yet still found that "[a] 50-gene data matrix does not resolve relationships among most metazoan phyla."

- Striking admissions of troubles in reconstructing the "tree of life" also came from a 2006 paper in the journal *PLoS Biology*, entitled "Bushes in the Tree of Life." The authors acknowledge that "a large fraction of single genes produce phylogenies of poor quality," observing that one study "omitted 35% of single genes from their data matrix, because those genes produced phylogenies

---

[27] Graham Lawton, "Why Darwin was wrong about the tree of life," *New Scientist* (January 21, 2009).
[28] W. Ford Doolittle, "Phylogenetic Classification and the Universal Tree," *Science*, Vol. 284:2124-2128 (June 25, 1999).
[29] Carl Woese "The Universal Ancestor," *Proceedings of the National Academy of Sciences USA*, Vol. 95:6854-9859 (June, 1998) (emphasis added).
[30] James H. Degnan and Noah A. Rosenberg, "Gene tree discordance, phylogenetic inference and the multispecies coalescent," *Trends in Ecology and Evolution*, Vol. 24(6) (March, 2009).
[31] Mushegian et al., "Large-Scale Taxonomic Profiling of Eukaryotic Model Organisms: A Comparison of Orthologous Proteins Encoded by the Human, Fly, Nematode, and Yeast Genomes," *Genome Research*, Vol. 8:590-598 (1998).
[32] Antonis Rokas, Dirk Krueger, and Sean B. Carroll, "Animal Evolution and the Molecular Signature of Radiations Compressed in Time," *Science*, Vol. 310:1933-1938 (Dec. 23, 2005).

at odds with conventional wisdom." The paper suggests that "certain critical parts of the [tree of life] may be difficult to resolve, regardless of the quantity of conventional data available." The paper even contends that "[t]he recurring discovery of persistently unresolved clades (bushes) should force a re-evaluation of several widely held assumptions of molecular systematics."[33]

- Another study published in *Science* found that the molecular data implied that six-legged arthropods, or hexapods (i.e. insects) are not monophyletic, a conclusion that differed strikingly from virtually all previous wisdom. The article concluded "Although this tree shows many interesting outcomes, it also contains some evidently untenable relationships, which nevertheless have strong statistical support."[34]

- A paper in the *Journal of Molecular Evolution* found that molecule-based phylogenies conflicted sharply with previously established phylogenies of major mammal groups, concluding that this anomalous tree "is not due to a stochastic error, but is due to convergent or parallel evolution."[35] Likewise, a study published in *Proceedings of the National Academy of Sciences USA* explains that when evolutionary biologists tried to construct a phylogenetic tree for the major groups of birds using mitochondrial DNA (mtDNA), their results conflicted sharply with traditional notions of bird relationships. Strikingly, they even find "convergent" similarity between some bird mtDNA and the mtDNA of distant species such as snakes and lizards. The article suggests bird mtDNA underwent "multiple independent originations," with their study making a "finding of multiple independent origins for a particular mtDNA gene order among diverse birds."[36]

When testifying before the TSBOE, professor Hillis also made the inaccurate claim that "there's overwhelming correspondence between the basic structures we have about the tree of life from anatomical data, from biochemical data, molecular sequence data." Yet many evolutionary scientists have recognized that evolutionary trees based upon morphology (physical characteristics of organisms) or fossils, commonly conflict with evolutionary trees based upon DNA or protein sequences (also called molecule-based trees).

For example, a review paper by Darwinian leaders in this field stated, "As morphologists with high hopes of molecular systematics, we end this survey with our hopes dampened. Congruence between molecular phylogenies is as elusive as it is in morphology and as it is between molecules and morphology."[37] Another set of pro-evolution experts wrote, "That molecular evidence typically squares with morphological patterns is a view held by many biologists, but interestingly, by relatively few systematists. Most of the latter know that the two lines of evidence **may often be incongruent**."[38]

The widespread prevalence of disagreement and non-correspondence between molecule-based evolutionary trees and anatomy-based evolutionary trees led a review article in *Nature* to report that

---

[33] Antonis Rokas and Sean B. Carroll, "Bushes in the Tree of Life," *PLoS Biology*, Vol. 4(11): 1899-1904 (Nov., 2006) (internal citations and figures omitted).
[34] Nardi et al., "Hexapod Origins: Monophyletic or Paraphyletic?," *Science*, Vol. 299:1887-1889 (March 21, 2003)
[35] Cao et al., "Conflict Among Individual Mitochondrial Proteins in Resolving the Phylogeny of Eutherian Orders," *Journal of Molecular Evolution*, Vol. 47:307-322 (1998).
[36] Mindell et al., "Multiple independent origins of mitochondrial gene order in birds," *Proceedings of the National Academy of Sciences USA*, Vol. 95: 10693-10697 (Sept. 1998).
[37] Colin Patterson et al., "Congruence between Molecular and Morphological Phylogenies," *Annual Review of Ecology and Systematics*, Vol. 24, pg. 179 (1993) (emphasis added).
[38] Masami Hasegawa, Jun Adachi, Michel C. Milinkovitch, "Novel Phylogeny of Whales Supported by Total Molecular Evidence," *Journal of Molecular Evolution*, Vol. 44, pgs. S117-S120 (Supplement 1, 1997) (emphasis added).

"disparities between molecular and morphological trees" cause "evolution wars" because "**Evolutionary trees constructed by studying biological molecules often don't resemble those drawn up from morphology.**"[39]

As one specific example, textbooks often cite the phylogenetic tree based upon cytochrome c as purportedly matching and confirming the standard anatomy-based phylogenetic tree of many vertebrates. But one paper in *Trends in Ecology and Evolution* noted that the cytochrome b tree yielded "an absurd phylogeny of mammals, regardless of the method of tree construction" where "[c]ats and whales fell within primates, grouping with simians (monkeys and apes) and strepsirhines (lemurs, bush-babies and lorises) to the exclusion of tarsiers." The paper concluded that "Cytochrome b is probably the most commonly sequenced gene in vertebrates, making this surprising result even more disconcerting."[40]

This problem also exists among higher primates as molecular data often conflicts with the prevalent phylogenetic tree which claims humans are most closely related to chimpanzees.[41] As one article in the journal *Molecular Biology and Evolution* found, "[f]or about 23% of our genome, we share no immediate genetic ancestry with our closest living relative, the chimpanzee."[42]

The common textbook claim that a universal "tree of life" has been established by congruent molecular and morphological phylogenetic trees is contradicted by much data and scientific opinion—but this information is almost always omitted from textbook instruction given to students.

(3) Biogeography—Darwin's Finches

Textbooks often claim that biogeography supports common ancestry. A common example given is the Galápagos finches, which are said to be an example of adaptive radiation, where a founding population of finches from the South American mainland arrived in the Galápagos islands and subsequently diversified into the various finch species observed on the various islands. The argument is made that this shows how populations can evolve and species diversify via descent with modification.

This story told about the finches is very likely true. But textbooks omit from students key details which show that this evolutionary story cannot be extrapolated to support universal common ancestry. Moreover, textbooks do not discuss critiques of adaptive radiation as an evolutionary explanation that is poorly understood.[43]

Aside from small differences in beak shape, size, and feeding habits, the finches are highly similar. They are so similar that it can be quite difficult to tell the finch species apart. In his Pulitzer Prize winning book *The Beak of the Finch,* Jonathan Weiner compares the largest and smallest species of Galápagos

[39] Trisha Gura, "Bones, Molecules or Both?," *Nature*, Vol. 406:230-233 (July 20, 2000) (emphasis added).
[40] Michael S. Y. Lee, "Molecular phylogenies become functional," *Trends in Ecology and Evolution*, Vol. 14(5): 177-178 (May, 1999).
[41] See for example, Asger Hobolth *et al.*, "Incomplete lineage sorting patterns among human, chimpanzee, and orangutan suggest recent orangutan speciation and widespread selection," *Genome Research*, Vol. 21:349-356 (2011); Ingo Ebersberger *et al.*, "Mapping Human Genetic Ancestry," *Molecular Biology and Evolution*, Vol. 24(10):2266–2276 (2007); Trisha Gura, "Bones, Molecules or Both?," *Nature*, Vol. 406:230-233 (July 20, 2000).
[42] Ingo Ebersberger *et al.*, "Mapping Human Genetic Ancestry," *Molecular Biology and Evolution*, Vol. 24(10):2266–2276 (2007).
[43] See Sergey Gavrilets and Jonathan B. Losos, "Adaptive Radiation: Contrasting Theory with Data," *Science*, Vol. 323:732-737 (February 6, 2009).

ground finches and remarks that they are "almost indistinguishable."[44] A paper in *BioScience* noted that after a full 14 million years of evolution, the finches remain highly similar and even "retain the ability to interbreed and produce viable, fertile hybrids."[45]

The small-scale differences between the finch species do not demonstrate that all living organisms are related through descent with modification. Rather, the finches show that after millions of years of evolution, very little has changed within a group of highly similar finches. They demonstrate microevolution, but cannot necessarily be extrapolated to demonstrate macroevolution. Textbooks rarely point this out.

If anything, the Galápagos finches demonstrate the limits of evolutionary processes. A famous study by the field biologists Peter and Rosemary Grant found that finches with larger beaks survived better during a drought, as they were able to crack the tougher seeds that remained. When the drought ended, the average beak size in the finch population returned to normal. Textbooks often omit mention of this fact, failing to acknowledge that the Galápagos finches only provide an example of oscillating selection, with no net evolutionary change.

Finally, textbooks often claim that Darwin studied the Galápagos finches during his voyage on the Beagle, and that the finches somehow played a major role in the development of his theory. Some textbooks may claim that Darwin identified some 13 or 14 species of finches and proposed currently accepted evolutionary explanations for how they obtained various specialized features used for feeding.

In fact, Darwin didn't come up with these ideas about finches, and didn't even mention them in *Origin of Species*. Far from identifying 14 species of finches, Harvard Darwin historian Frank J. Sulloway explains how badly Darwin botched his analysis of these birds:

> Just how greatly Darwin was misled by certain of the Galapagos finches is poignantly illustrated by his misclassification of the warbler finch as a "wren," or warbler. As for the remarkable woodpecker finch, thought by many to have stimulated Darwin's greatest evolutionary curiosity, this species was not even collected by Darwin; and its unusual tool-using behavior was not reported until 1919. Darwin collected, in fact, only nine of the present thirteen species of "Darwin's finches." Of these, he properly identified as finches only six species—less than half the present total—placing them in two separate groups, large- and small-beaked Fringillidae.[46]

And what about the claim that Darwin studied differences in finch beaks to determine that they evolved their differences to become adapted to a particular diet? Here, Sulloway explains:

> To establish a presumption that his Galapagos finches had indeed evolved such divergent forms through adaptive radiation, it was first necessary to show that the different shapes of their beaks were in some way effective in reducing competition. But Darwin lacked precisely this information. According to his own testimony, the several species of Geospiza were "indistinguishable from each other in their habits," feeding together on the ground in large irregular flocks. These observations were not only incomplete but also incorrect. ... Darwin failed

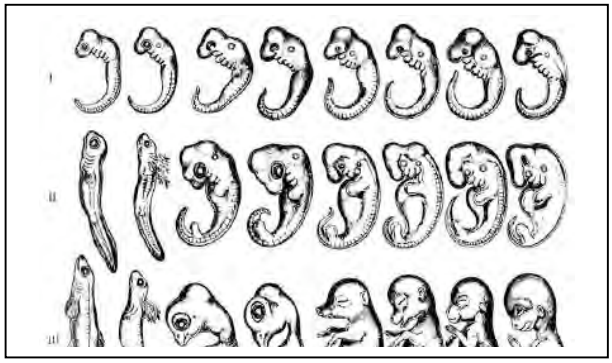
[44] Jonathan Weiner, *The Beak of the Finch*, p.43 (Vintage Books, 1994).
[45] Jeffrey Podos and Stephen Nowicki, "Beaks, Adaptation, and Vocal Evolution in Darwin's Finches," *BioScience*, Vol. 54(6):501-510 (June 2004).
[46] Frank J. Sulloway, "Darwin and His Finches: The Evolution of a Legend," *Journal of the History of Biology*, Vol. 15 (1):1-53 (Spring, 1982) (internal citations omitted).

> to correlate feeding habits in the Galapagos finches with their diverse beaks, and partly for this reason most subsequent ornithologists thought that there was no relationship.[47]

Textbooks often hold up the Galápagos finches as a good example of how biogeography supports Darwinian evolution. But they rarely point out that the small degrees of change between the species of Galápagos finches cannot be extrapolated to explain the larger claims of Darwinian macroevolution.

(4) Embryology - Haeckel's Embryos

Textbooks commonly claim that vertebrate embryos are highly similar in their earliest stages, and that these similarities point to their common ancestry. Some textbooks try to illustrate these claims by using inaccurate embryos drawings based on the work of the 19th century embryologist Ernst Haeckel—drawings which overstate the degree of similarity between embryos. Textbooks may also claim that human embryos have "gill slits."



It is widely acknowledged, even by leading evolutionary scientists, that Haeckel's embryo drawings were "highly inaccurate, exaggerating the similarities among embryos, while failing to show the differences."[48] Stephen Jay Gould called them "fraudulent"[49] and the leading embryologist Michael Richardson called them "fakes."[50] Even the journal *Science* acknowledges that "[g]enerations of biology students may have been misled by a famous set of drawings of embryos published 123 years ago by the German biologist Ernst Haeckel" because "the impression they give, that the embryos are exactly alike, is wrong."[51]

Unfortunately, some current biology textbooks continue to use Haeckel's inaccurate drawings to advocate for common ancestry. In fact, in 1997 Richardson acknowledged that there are "at least fifty recent biology textbooks which use the drawings uncritically"[52] and stated that the drawings "are still widely reproduced in textbooks and review articles, and continue to exert a significant influence on the development of ideas in this field."[53] This led Gould to exclaim in 2000:

> [W]e do, I think, have the right to be both astonished and ashamed by the century of mindless recycling that has led to the persistence of these drawings in a large number, if not a majority, of modern textbooks![54]

---

[47] *Id.*
[48] Michael K. Richardson et al., "There is No Highly Conserved Embryonic Stage in the Vertebrates: Implications for Current Theories of Evolution and Development," *Anatomy and Embryology*, Vol. 196:91 (1997) (internal citations omitted).
[49] See for example Stephen Jay Gould, "Abscheulich!(Atrocious!)," *Natural History*, (Mar. 2000).
[50] Elizabeth Pennisi, "Haeckel's Embryos: Fraud Rediscovered," *Science*, Vol. 277:1435 (1997).
[51] *Id.*
[52] Michael K. Richardson *quoted in* Elizabeth Pennisi, "Haeckel's Embryos: Fraud Rediscovered," *Science*, Vol. 277:1435 (1997).
[53] Michael K. Richardson et al., *There is No Highly Conserved Embryonic Stage in the Vertebrates: Implications for Current Theories of Evolution and Development*, 196 Anatomy and Embryology, 91, 92-93 (1997) (internal citations omitted).
[54] Stephen Jay Gould, "Abscheulich!(Atrocious!)," *Natural History* (March, 2000).

Because of these criticisms, in the past decade more and more biology textbooks have used photographs of embryos instead of inaccurate drawings. However, some current biology textbooks *continue to use* Haeckel's inaccurate drawings to advocate for common ancestry,[55] and in fact two curricula evaluated in this report use Haeckel's embryo drawings.[56] Nonetheless, whether textbooks use drawings or photographs, most textbooks still overstate the degree of similarity between vertebrate embryos. Contrary to the claims of textbooks, leading embryologists have acknowledged that the earliest stages of vertebrate embryo development are in fact very different. As a paper in the journal *Systematic Biology* explains:

> Recent workers have shown that early development can vary quite extensively, even within closely related species, such as sea urchins, amphibians, and vertebrates in general. By early development, I refer to those stages from fertilization through neurolation (gastrulation for such taxa as sea urchins, which do not undergo neurulation). Elinson (1987) has shown how such early stages as initial cleavages and gastrula can vary quite extensively across vertebrates.[57]

Vertebrate embryos start developing very differently, and at most temporarily converge at a somewhat similar stage midway through development, and then diverge again. Appearances during this similar or "conserved" stage—called the "tailbud," "phylotypic," or "pharyngula" stage—are cherrypicked in textbooks, ignoring earlier stages with much greater differences between embryos. A paper in the journal *Anatomy and Embryology* explains this "hourglass" pattern of development:

> According to recent models, not only is the putative conserved stage followed by divergence, but it is preceded by variation at earlier stages, including gastrulation and neurulation. This is seen for example in squamata, where variations in patterns of gastrulation and neurulation may be followed by a rather similar somite stage. Thus the relationship between evolution and development has come to be modelled as an "evolutionary hourglass."[58]

This 'hourglass' model of development is illustrated below, where it is seen that vertebrate embryos are actually quite different in their earliest stages of development, at the top of the hourglass:[59]

---

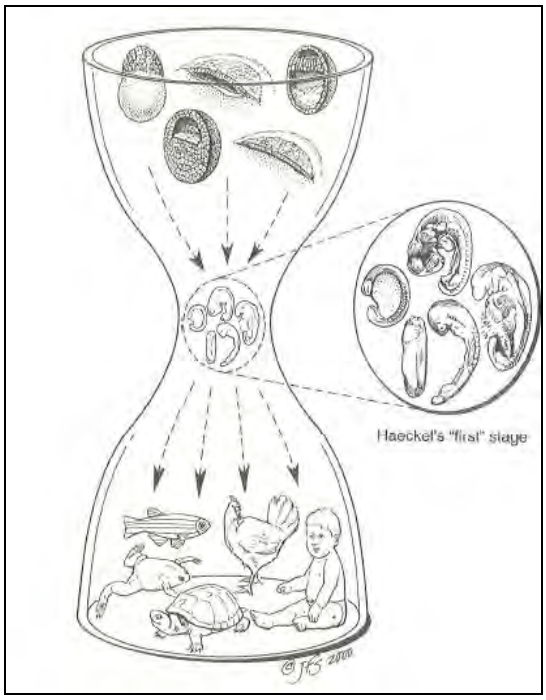
[55] For discussions, see: Casey Luskin, "The Constitutionality and Pedagogical Benefits of Teaching Evolution Scientifically," *University of St. Thomas Journal of Law & Public Policy*, Vol. VI (1): 204-277 (Fall, 2009); Casey Luskin, "What do Modern Textbooks Really Say about Haeckel's Embryos?," at http://www.discovery.org/a/3935

[56] For example, Adaptive Curriculum uses a colorized version of Haeckel's original drawings, and Rice University uses the original drawings themselves.

[57] Andres Collazo, "Developmental Variation, Homology, and the Pharyngula Stage," Systematic Biology, Vol. 49:3 (2000) (internal citations omitted).

[58] Michael K. Richardson *et al.*, "There is No Highly Conserved Embryonic Stage in the Vertebrates: Implications for Current Theories of Evolution and Development," *Anatomy and Embryology*, Vol. 196:91 (1997).

[59] The Embryonic Hourglass as published in Jonathan Wells, *Icons of Evolution: Why Much of What We Teach about Evolution is Wrong*, p. 100 (2000). Diagram Copyright 2000 by Jody Sjogren.



Copyright Jody F. Sjogren 2000

But even the existence of this purportedly similar and conserved "pharyngula" (or "phylotypic" or "tailbud") stage has been called into question. A paper by leading embryologists, titled "There is No Highly Conserved Embryonic Stage in the Vertebrates: Implications for Current Theories of Evolution and Development," found that differences in body size, body plan, growth patterns, and growth timing show "wide variation in morphology among vertebrate embryos," which "is difficult to reconcile with the idea of a phylogenetically-conserved tailbud stage."[60]

Finally, some textbooks also claim that human embryos have "gill slits," allegedly reflecting our fish ancestry. But biologist Jonathan Wells explains in *The American Biology Teacher* that human embryos do not have gill slits:

> [H]uman embryos do not really have gills or gill slits: like all vertebrate embryos at one stage in their development, they possess a series of 'pharyngeal pouches,' or tiny ridges in the neck region. In fish embryos these actually go on to form gills, but in other vertebrates they develop into unrelated structures such as the inner ear and parathyroid gland. The embryos of reptiles, birds and mammals never possess gills.[61]

Textbooks thus commonly provide an inaccurate depiction of vertebrate development, overstating the degree of similarity between vertebrate embryos while ignoring the differences, especially in the earliest stages. The result is misleading claims based upon cherry-picked data, or simply flat-out inaccurate claims, that are used in textbooks to bolster common ancestry of vertebrates.

---

[60] Michael K. Richardson *et al.*, "There is No Highly Conserved Embryonic Stage in the Vertebrates: Implications for Current Theories of Evolution and Development," *Anatomy and Embryology*, Vol. 196:91 (1997).
[61] Jonathan Wells, "Haeckel's Embryos & Evolution: Setting the Record Straight," *American Biology Teacher*, Vol. 61(5):345-349 (May, 1999) (internal citations removed).

(5) Vestigial Organs

Textbooks often present purportedly vestigial organs as evidence for common descent. The appendix is probably the most commonly cited organ which is purportedly an evolutionary holdover from our quadruped ancestors. Other allegedly vestigial organs that appear in textbooks include tonsils, the coccyx, or male nipples.

These popular arguments for evolution from vestigial organs are highly inaccurate. For example, the appendix serves as a storehouse for probiotics and also provides a variety of immune-related functions, helping to produce and train white blood cells, as well as playing important roles during fetal development.[62] In light of this evidence, Duke University immunologist William Parker observed that "Many biology texts today still refer to the appendix as a 'vestigial' organ" and thus "it's time to correct the textbooks."[63]

In addition to the appendix, examples of structures previously considered to be vestigial include:

- The tonsils: At one time, they were routinely removed. Now it's known they serve a purpose in the lymph system to help fight infection.
- The coccyx (tailbone): Rather than being vestigial, this is a vital bone required for the human bipedal body plan. It is used for the attachment of muscles, tendons, and ligaments which support the bones in our pelvis.
- Male nipples: Even under an evolutionary paradigm, male nipples are not an evolutionary holdover. They are a simple consequence of the mammalian body plan and development.

Textbooks rarely inform students about the important functions of these allegedly vestigial organs and instead simply cite them as evidence for common ancestry.

C. Natural Selection and Random Mutation

Textbooks almost universally present natural selection acting upon random mutations as the primary driving force behind evolution, and the mechanism responsible for generating life's diversity. The claim is commonly made that this neo-Darwinian mechanism can account for the complexity we observe in biology. But there are numerous reasons why scientists are increasingly disputing these claims. In particular, neo-Darwinian evolution relies on random mutations that are preserved by a blind, undirected process of natural selection that has no long-term "goals." Such a random and undirected process tends to harm organisms and does not improve them or build complexity.

In *Origin of Species*, Darwin stated that if "any complex organ existed which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down."[64]

---

[62] *See* Loren G. Martin, "What is the function of the human appendix? Did it once have a purpose that has since been lost?," *Scientific American* (October, 21, 1999), at http://www.scientificamerican.com/article.cfm?id=what-is-the-function-of-t

[63] William Parker quoted in Charles Q. Choi, "The Appendix: Useful and in Fact Promising," LiveScience on Yahoo News (August 24, 2009).

[64] Charles Darwin, *Origin of Species* (1859), Chapter 6, available at http://www.literature.org/authors/darwin-charles/the-origin-of-species/chapter-06.html.

In his book *Darwin's Black Box*, biochemist Michael Behe observes that "by opening the ultimate black box, the cell," modern science "has pushed Darwin's theory to the limit."[65]

The simplest cell requires hundreds of genes, numerous complex biological machines and biochemical pathways, and a fully functional genetic code in order to survive. Cells are like miniature factories using machine technology but dwarfing the complexity and efficiency of anything produced by humans. Cells use miniature circuits, motors, feedback loops, encoded language, and even error-checking machinery to decode and repair our DNA. Darwinian evolution struggles to build this type of integrated and irreducible complexity. In fact, some leading scientists have recognized that Darwinian evolution—blind natural selection acting on random mutations—has failed to provide explanations for how such basic cellular biochemistry might have evolved. Five years after Behe published *Darwin's Black Box*, biochemist Franklin Harold stated in an Oxford University Press monograph that "there are presently no detailed Darwinian accounts of the evolution of any biochemical or cellular system, only a variety of wishful speculations."[66]

Many other scientists are now questioning whether natural selection acting upon random mutations is sufficient to generate new species or complex biological features. Over 800 Ph.D. scientists have signed a statement that they are "skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life."[67] Leading biologist and National Academy of Sciences member Lynn Margulis,a supporter of evolution, believes that "new mutations don't create new species; they create offspring that are impaired."[68] She criticizes the standard Darwinian mechanism by stating that the "Darwinian claim to explain all of evolution is a popular half-truth whose lack of explicative power is compensated for only by the religious ferocity of its rhetoric," further saying:

> Mutations, in summary, tend to induce sickness, death, or deficiencies. No evidence in the vast literature of heredity changes shows unambiguous evidence that random mutation itself, even with geographical isolation of populations, leads to speciation.[69]

Similarly, past president of the French Academy of Sciences, Pierre-Paul Grassé, contended that "[m]utations have a very limited 'constructive capacity'" because "[n]o matter how numerous they may be, mutations do not produce any kind of evolution."[70] The research of University of Wisconsin-Superior biologist Ralph Seelke has confirmed this claim. He found that mutations can break features in bacteria but they cannot put even modestly complex features back together.[71] Likewise, Behe and physicist David Snoke have published research in the journal *Protein Science* showing that even simple biochemical features like many protein-protein interactions cannot be built by random mutations.[72]

---

[65] Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution*, p. 15 (Free Press, 1996).
[66] Franklin M. Harold, *The Way of the Cell: Molecules, Organisms and the Order of Life*, p. 205 (Oxford Univ. Press, 2001).
[67] See http://www.dissentfromdarwin.org/
[68] Lynn Margulis quoted in Darren Madden, "UMass Scientist to Lead Debate on Evolutionary Theory," *Brattleboro (Vt.) Reformer* (Feb 3, 2006).
[69] Lynn Margulis & Dorion Sagan, *Acquiring Genomes: A Theory of the Origins of the Species*, p. 29 (2002).
[70] Pierre-Paul Grassé, *Evolution of Living Organisms: Evidence for a New Theory of Transformation* (Academic Press: New York NY, 1977).
[71] Ann K Gauger, Stephanie Ebnet, Pamela F Fahey, Ralph Seelke, "Reductive Evolution Can Prevent Populations from Taking Simple Adaptive Paths to High Fitness," *BIO-Complexity*, Vol. 2010 (2010).
[72] Michael J. Behe & David W. Snoke, "Simulating Evolution by Gene Duplication of Protein Features That Require Multiple Amino Acid Residues," *Protein Science*, Vol. 13:2651-2664 (2004).

Natural selection has also come under scrutiny from many scientists. The late Dr. Philip Skell, another National Academy of Sciences member, also questioned the explanatory utility of natural selection, observing that "Darwinian evolution—whatever its other virtues—does not provide a fruitful heuristic in experimental biology."[73] In 2009, Günter Theißen of the Department of Genetics at Friedrich Schiller University in Jena, Germany wrote in the journal *Theory in Biosciences* that "Despite Darwin's undeniable merits, explaining how the enormous complexity and diversity of living beings on our planet originated remains one of the greatest challenges of biology."[74] An even more striking criticism of what he called the "dogmatic science" of neo-Darwinian thinking can be found in a 2006 paper by Theißen:

> Explaining exactly how the great complexity and diversity of life on earth originated is still an enormous scientific challenge . . . . There is the widespread attitude in the scientific community that, despite some problems in detail, textbook accounts on evolution have essentially solved the problem already. In my view, this is not quite correct.[75]

In 2008, *Nature* published an article covering the Altenberg 16 conference, where leading biologists gathered to evaluate and critique the neo-Darwinian model of evolution. The report quoted biologist Scott Gilbert stating that "[t]he modern synthesis is remarkably good at modeling the survival of the fittest, but not good at modeling the arrival of the fittest."[76] Stuart Newman stated in the same article, "You can't deny the force of selection in genetic evolution . . . but in my view this is stabilizing and fine-tuning forms that originate due to other processes."[77] Evolutionary paleobiologist Graham Budd was similarly open in the article about deficiencies in explanations of key evolutionary transitions: "When the public thinks about evolution, they think about the origin of wings and the invasion of the land, . . . [b]ut these are things that evolutionary theory has told us little about."[78]

Also in 2008, William Provine, a Cornell University historian of science and evolutionary biologist, gave a talk before the History of Science Society titled "Random Drift and the Evolutionary Synthesis." An abstract of his talk argues "[e]very assertion of the evolutionary synthesis below is false":

> 1. Natural selection was the primary mechanism at every level of the evolutionary process. Natural selection caused genetic adaptation . . . . 7. Macroevolution was a simple extension of microevolution. … 9. Speciation was understood in principle. 10. Evolution is a process of sharing common ancestors back to the origin of life, or in other words, evolution produces a tree of life. … 13. The evolutionary synthesis was actually a synthesis.[79]

---

[73] Philip S. Skell, "Why Do We Invoke Darwin? Evolutionary theory contributes little to experimental biology," *The Scientist* (August 29, 2005), at http://www.discovery.org/a/2816

[74] Günter Theißen, "Saltational Evolution: Hopeful Monsters are Here to Stay," *Theory in Biosciences*, Vol. 128:43 (2009).

[75] Günter Theißen, "The proper place of hopeful monsters in evolutionary biology," *Theory in Biosciences*, Vol. 124:349-369 (2006).

[76] John Whitfield, "Biological Theory: Postmodern Evolution?," *Nature*, Vol. 455: 281 (2008) (quoting Scott Gilbert).

[77] *Id.* quoting Stewart Newman).

[78] *Id.* (quoting Graham Budd).

[79] William Provine, Random Drift and the Evolutionary Synthesis, History of Science Society HSS Abstracts, http://www.hssonline.org/meeting/oldmeetings/archiveprogs/2008archiveMeeting/2008HSSAbstracts.html (last visited Dec. 18, 2009).

Despite the existence of significant scientific dissent from neo-Darwinian evolution, textbooks often present random mutation and natural selection as the primary driving force behind evolution, without any criticisms of that model.

(1) Peppered Moths

A classic textbook example given to supposedly bolster the power of natural selection is the peppered moth. During the industrial revolution, soot stained many tree trunks in England a darker color. According to the standard peppered moth story, this gave dark-colored moths a selective advantage over lighter-colored moths, because birds eat the moths off of tree trunks but could no longer see the darker forms and predate upon them.

But there is controversy over whether peppered moths actually rest on tree trunks. Many textbook photographs showing peppered moths on tree trunks are staged. Biologist Jonathan Wells writes in *The Scientist* that experimenters used "unnatural selection"[80] by artificially gluing moths to tree trunks to determine if they would be eaten by birds. But according to various researchers, experts now suggest that the moths typically rest in hidden locations where they are out-of-sight from hungry birds.[81] While predation by birds and cryptic coloration may be a factor in determining moth populations, Wells explains the evidence is inconclusive and textbooks are inaccurate:

> [T]extbooks continue to present the classical story of industrial melanism in peppered moths as an example of evolution in action. Clearly, this is misleading. In particular, it is misleading to illustrate the story with photographs showing moths on tree trunks where they do not rest in the wild. Our students deserve better.[82]

Additionally, the peppered moth story does not demonstrate anything more than trivial degrees of biological change as the moth forms are identical except for small differences in their color. Indeed, like Darwin's finches it may be no more than example of oscillating selection. In 2009, Richard Fox, director of a peppered moth study, reported that the moths were "making a big swing back to their original colour."[83] According to the researchers, environmental laws reduced the amount of pollution, and selection now favored the white-colored moths. Lightered colored moths are now again predominating in the population.

Even if the moth story were true, at most it would demonstrate oscillating selection and microevolution. Textbooks rarely point out doubts about the classical story, and instead inaccurately portray the moths as evidence for the power of natural selection.

---

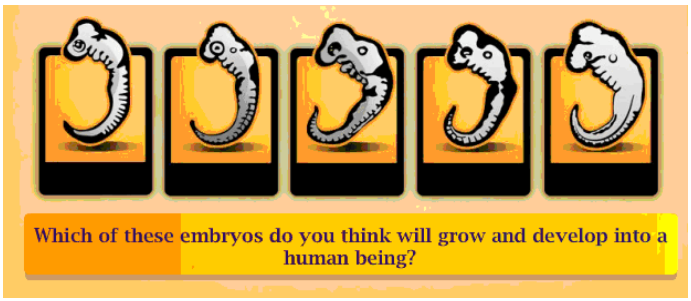
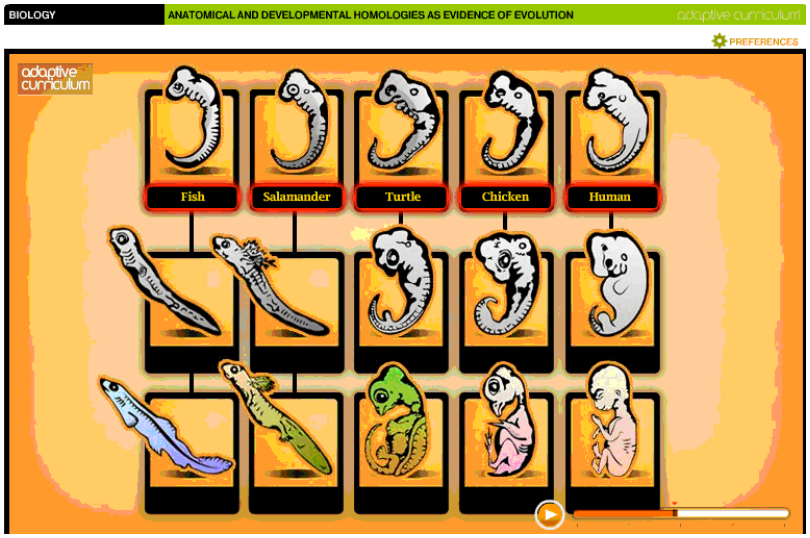
[80] Jonathan Wells, "Second Thoughts about Peppered Moths," *The Scientist*, Vol. 13(11):13 (1999).
[81] Much of this research is discussed in Jonathan Wells, "Second Thoughts about Peppered Moths," *The Scientist*, Vol. 13(11):13 (1999).
[82] Jonathan Wells, "Second Thoughts about Peppered Moths," *The Scientist*, Vol. 13(11):13 (1999).
[83] Richard Fox *quoted in* "Moth turns from black to white as Britain's polluted skies change colour," *London Daily Telegraph* (June 19, 2009) at http://www.telegraph.co.uk/earth/wildlife/5577724/Moth-turns-from-black-to-white-as-Britains-polluted-skies-change-colour.html

III. Detailed Analysis of Supplementary Curricula

Following is an analysis of the curricula that were available for online review.[84] The analysis reviews only the sections pertaining to biological and chemical evolution. We have not reviewed all aspects of every section in each curriculum that covers evolution, but each curriculum was reviewed sufficiently to determine whether or not it satisfied the TEKS.

[84] Curricula are listed at http://www.tea.state.tx.us/index4.aspx?id=2147499573

1. Adaptive Curriculum[85]

Section Identification	Error	Discussion
Anatomical and Developmental Homologies as Evidence for Evolution	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum claims that the embryos of humans, birds, reptiles, fish, and amphibians are "very similar and share many characteristics," thereby providing "evidence that they evolved from a common ancestor." There is no discussion of any differences between the early stages of embryonic development. To bolster the curriculum's incomplete, misleading, and inaccurate claims, it uses Haeckel's embryo drawings as follows:   It also wrongly claims that human embryos have gill slits, stating that in fish "embryonic gill slits develop into true gills while in humans they develop into the ears and throat." The information presented is inaccurate, and there is no real evaluation, analysis, critique, or objective presentation of all sides of the data.
Biogeography as Evidence for	Darwin's Finches. (See	The curriculum inaccurately implies the Galápagos finches played a major role in the formulation of Darwin's theory,

[85] http://texas.adaptivecurriculum.com/login/logintexas.jsp

Evolution	Section II, Part B – 3.)	stating: "when Darwin arrived on the Galapagos islands off the coast of South America, he saw that the finches living on the islands looked much like those on the mainland but not exactly. … Darwin theorized that once the finches arrived on the islands they adapted to the varying environmental conditions of the different islands, and so over time the finches changed so much from their original population that they could no longer reproduce with each other." It also wrongly claims that the finches (and their fossils) provide "powerful support for Darwin's theory," but does not discuss the fact that the finches are highly similar and consequently shows evidence of microevolution, not macroevolution. There is no discussion of biogeographical evidence that challenges neo-Darwinian evolution. The information presented is inaccurate, and there is no real evaluation, analysis, critique, or objective presentation of all sides of the data.
Biological Molecules as Evidence for Evolution	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	In a typically one-sided statement, the section states that "The molecular evidence from amino acid sequences matches the similarities seen in fossils, anatomy, and embryology, and so constitutes important molecular evidence that supports the theory of evolution." That is an inaccurate claim as there are many instances where amino acid sequences yield trees that conflict with the standard phylogenetic tree produced by fossils, anatomy, or embryology. The curriculum presents no molecular data that challenges standard models of common ancestry or the tree of life. The information presented is inaccurate, and there is no real evaluation, analysis, critique, or objective presentation of all sides of the data.
Fossils as Evidence of Evolution	The Fossil Record. (See Section II, Part B – 1.)	The curriculum ignores abrupt appearance of fossil forms and instances where there are abrupt jumps in the fossil record without transitional forms. It claims that mammals appear in the fossil record *after* birds, which is incorrect.[86] It claims that feathered dinosaur fossils exist without discussing any criticisms of how those fossils have been interpreted or problems with the dinosaur-to-bird hypothesis, and it ignores explosions in the fossil record, including Cambrian explosion. The curriculum presents no fossil evidence that challenges common ancestry. The information presented is oversimplified, incomplete, one-sided, inaccurate, and there is no real evaluation, analysis, critique, or objective presentation of all

[86] The first mammals appear well over 200 million years ago but the first generally accepted bird is *Archaeopteryx*, which lived 150 million years ago.

		sides of the data.
The Evolution and Complexity of Cells I and II	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum provides no discussion of any challenges to the ability of random mutation or natural selection to produce cellular complexity. There is no meaningful evaluation, critique, analysis, or discussion of all sides of the data. Also, the narrator badly mispronounces the name of Lynn Margulis.
Natural Selection	Peppered Moth. (See Section II – Part B.)	The curriculum uses an example akin to the peppered moth story, showing moths on tree trunks being eaten by birds, a claim which is misleading. As seen below, it shows a blue jay which purportedly "eats moths that are living on a tree trunk." It explains natural selection but says nothing about its limits. 
Anatomical and Developmental Homologies as Evidence for Evolution[87]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The calls similarities in vertebrate limbs "homologous" and states "the presence of homologous organs supports the idea that these varied vertebrates all evolved from a common ancestor." But it discusses no evidence that doesn't fit with claims of homology, and does not provide any evaluation or critique, nor does it discuss all sides of the data.

Final Analysis

There is no real evaluation or critique or presentation of all sides of the data in the materials prepared by Adaptive Curriculum. This curriculum also contains erroneous statements and uses inaccurate diagrams and drawings. It fails to adequately address the following TEKS as specified in the table below:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among	**NO**

[87] http://texas.adaptivecurriculum.com/proxy/ACTPlayer/v1.3.0/actplayer.jsp#app=ee37&5a8f-selectedIndex=3

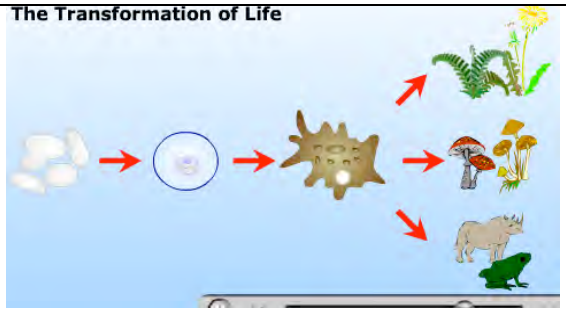
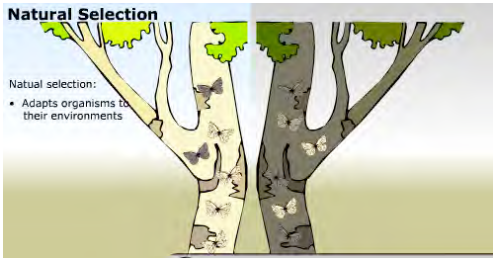
groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**NO**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**NO**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

2. Apex Learning[88]

a. Apex Learning AP Biology Semester 1:

Section Identification	Error	Discussion
5.1.1: Study: Darwin in Historical Context, Pages 2-3	Darwin's Finches. (See Section II, Part B – 3.)	While showing a slide that portrays finches, the curriculum says "Darwin noticed that while many of the Galápagos organisms were unique to the islands, they resembled the organisms of South America. It further states that Darwin's observations of the Galápagos finches **"**led to Darwin's theory of evolution" and that Darwin "collected a large amount of data on the 13 species of finches on the islands. He found that a finch's beak was specifically adapted for its home island food supply." It further states "Darwin catalogued the different beaks and how they related to the food source of the finch species." This is inaccurate since the finches played a minor role, if any, in the formulation of Darwin's ideas.
5.1.1: Study: Darwin in Historical Context, Page 5, The Evidence for Evolution.	See Section II.	The curriculum states that there's a "large amount of evidence to support" Darwin's theory of evolution. But no counter-evidence is discussed and the curriculum addresses no scientific weaknesses in neo-Darwinism. There is only presentation of the evidence supporting Darwinian evolution, with no critique or evaluation or presentation of all sides of the data.
5.1.1: Study: Darwin in Historical Context, Page 5, The Evidence for Evolution.	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states that "A strong piece of physical evidence supporting Darwinian evolution is the anatomical similarities among different species. Humans, whales, bats, and all other mammals have similar forelimbs." There is no critique or evaluation or presentation of all sides of the data.
5.1.3: Study: Mechanics of Evolution, Page 2	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum presents a molecules-to-man diagram of evolution (see below) and states: "The similarity between the two organisms reflects their common evolutionary origin." The fail to address the many instances where this rule fails, nor does it discuss any criticisms of common ancestry.

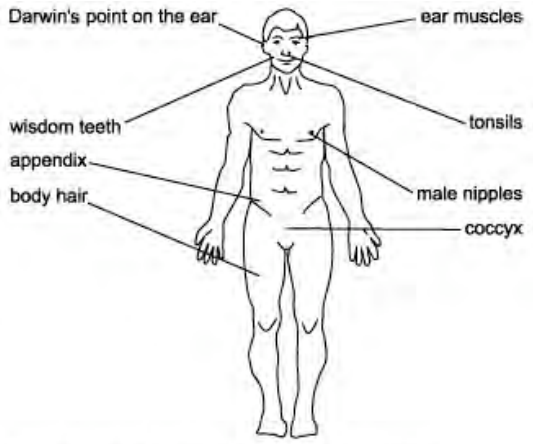
[88] http://www.apexvs.com/ApexUI/default.aspx

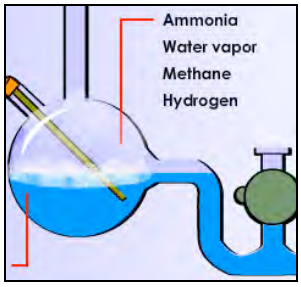
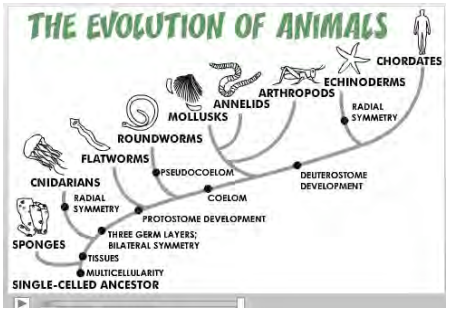
		
5.1.3: Study: Mechanics of Evolution, Pages 3-4, 6	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum states "mutations are the ultimate source of genetic diversity," but discusses no criticisms of the ability of natural selection and mutation to generate such diversity. It makes no mention of limitations to mutations and does not analyze or evaluate the effects of mutations in any critical way. It further states, "We'll discuss four evolutionary pressures that cause populations to change. They are genetic drift, gene flow, nonrandom mating, and natural selection." Finally, it states: "Natural selection promotes the reproductive success of individuals with favorable mutations, and decreases the reproductive success of individuals with damaging mutations. Natural selection alters the genetic makeup of the population." There is no discussion of scientific criticisms of the ability of those forces to cause change. There is no meaningful evaluation, critique, analysis, or discussion of all sides of the data.
5.1.3: Study: Mechanics of Evolution, Page 4	Peppered Moth. (See Section II – Part B.)	This section also promotes the peppered moth story, as seen in the diagram below. The curriculum states: "During the Industrial Revolution, the soot on trees favored the selection of dark- colored moths over white moths." It thus wrongly states that peppered moths rest on tree trunks, where they are eaten by birds. There is no evaluation or critique or presentation of all sides of the data. 
5.2.1. The Origin of Species: Study: Speciation, Page 6.	The Fossil Record. (See Section II, Part B – 1.)	This section states regarding punctuated equilibrium: "One reason scientists proposed the punctuated equilibrium theory is because of fossils. Only rarely can we find gradual transitions between fossil forms." While this provides some evaluation of common Darwinian claims, it still tries to explain away the lack of transitional forms as being due to the incompleteness of the

		fossil record, an explanation which is not accepted by some leading paleontologists.
5.2.1. The Origin of Species: Study: Speciation	Natural Selection and Random Mutation. (See Section II – Part B.)	As a purported example of speciation, the curriculum discusses nearly identical squirrel populations on opposite sides of the Grand Canyon, an observation from nature that illustrates microevolution but not macroevolution. The subsection fails to make this distinction, speaking instead of "a new species of squirrel" even though the two squirrel populations are virtually identical. There is no evaluation or critique of the ability of natural selection and random mutation to produce complex biological changes.
6.1: The Family Tree of Life, 6.1.1 Study: Systematics: Classifying Organisms, Pages 2 (Overview), 7 (Experiment).	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum presents universal common descent as an unequivocal fact, with no mention of data that challenges the hypothesis. It states in a dogmatic fashion that "We know that all living organisms arose from a single ancestral cell. Thus, all of them are ultimately related" and "great apes are very, very distant cousins, but cousins nonetheless." It further states that "The molecular results are combined with other data, like morphological and fossil evidence, to come up with the best possible model for the evolutionary relationships among species" and "variation in the morphology of species is a measure of their evolutionary divergence" even though there are many instances where molecular or morphological data conflict and do not paint a consistent picture of common ancestry. There is no real evaluation or critique or presentation of all sides of the data and the curriculum ignores evidence that doesn't support common ancestry.

b. Core Biology

Section Identification	**Error**	**Discussion**
4.1. Evolution	Section II.	This section of the curriculum states from the outset that it will only present the evidence that supports evolution: "This lesson will explore the world of fossils and other types of evidence that supports the theory of evolution. It will also describe different types of natural selection and other forces that drive evolution." The unit thus expressly frames itself as presenting only evidence that "supports" evolution—there is no critique or evaluation or presentation of all sides of the data.
4.1.3 Evidence for Evolution – Fossil Evidence, Page 3.	The Fossil Record. (See Section II, Part	This curriculum states "fossils are evidence of evolution." However, it does not mention any patterns from the fossil record might challenge evolution. There is no evaluation nor

	B – 1.)	critique nor presentation of all sides of the data.
4.1.3 Evidence for Evolution – Fossil Evidence, Page 10.	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: “Did you know that humans, lions, birds, and seals all have "arms," or forelimbs, made up of similar bones? This type of physically similar structure that performs different functions for different animals is known as a homologous structure homologous structure: A physically similar structure that performs different functions in different species.” But it discusses no problems with homology nor any data that does not fit expectations of homology. There is no meaningful evaluation, critique, or presentation of all sides of the evidence.
4.1.3 Evidence for Evolution – Fossil Evidence, Page 12.	Vestigial Organs. (See Section II, Part B – 5.)	As seen in the diagram below, this section makes long-debunked popular arguments for evolution from vestigial organs. The curriculum claims that the coccyx, appendix, tonsils, and many other functional organs are “vestigial” but fails to mention that these organs have important functions (e.g. appendix, coccyx, tonsils, etc.) or are not evolutionary holdovers (e.g. male nipples).  These structures are generally thought to be vestigial structures. Some of these structures may still have some function, but their primary function has been lost.
4.1.3 Evidence for Evolution – Fossil Evidence, Page 13.	Embryology. (Section II, Part B – 4.)	The curriculum claims: “Organisms with similar embryonic development are often considered to have similar ancestry.” It does not mention differences in early embryos in vertebrates. There is no critique or evaluation or presentation of all sides of the data.
4.1.3 Evidence for Evolution – Fossil Evidence, Page 14.	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: “Similar DNA and protein sequences indicate two organisms are closely related” but discusses no challenges to the tree-of-life hypothesis, such as conflicts between trees. It further states: “If two organisms have similar sequences in one gene, or similar protein sequences produced by that gene, it

		suggests that two organisms are closely related." But the section discusses no instances where that principle does not hold true and there is no evaluation or critique.
4.3.1 Life on Earth, The Formation of Biological Molecules, Page 5.	Miller-Urey Experiment. (See Section II – Part A.)	This section states regarding the Miller-Urey experiment: "They found that when gases that existed in the Earth's early atmosphere were subjected to continuous, high amounts of energy under certain chemical conditions, amino acids were formed." As seen in the diagram below, it implies that the early Earth's atmosphere contained appreciable amounts of ammonia and methane. Not only is this wrong, but the curriculum presents no critiques or evaluation of these claims, nor does it presents all sides of the data:  It states that as a conclusion, "It may have been possible for organic molecules to form spontaneously in primitive oceans." However, there is inaccurate information, and there is no evaluation or critique or presentation of all sides of the data pertaining to this statement.
4.3.3, Plants and Animals, Pages 1, 10	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum asserts as fact that "Life began as single cells and evolved into more complex forms." As seen in the diagram below, it portrays all animals as related even though these relationships are in dispute in many cases.  It discusses no evidence that challenges the standard phylogeny and provides no meaningful evaluation, analysis, or critique of common ancestry, nor does it discuss all sides of the data.

Final Analysis

There is no real evaluation or critique or presentation of all sides of the data in the curricula prepared by Apex Learning. The curricula also contain erroneous statements and use inaccurate diagrams and drawings, and they fail to adequately address the following TEKS:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**NO**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**PARTLY**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

3. Cengage Learning[89]

Section Identification	Error	Discussion
Evolution[90]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: "The theory of evolution provides a scientific explanation for the anatomical and molecular similarities found in diverse living organisms. It also explains the similarities and gradual changes seen in fossil organisms over time. And finally, evolution is able to account for the origin of new species over time. Most scientists believe all present-day living species evolved from ancient, simpler, single-celled organisms." This statement is made without any critique, evaluation, or critical evaluation of the evolutionary viewpoint. There is no presentation of all sides of the data.
Evolution[91]	Haeckel's Embryos. (Section II, Part B – 4.)	This curriculum states: "Support for the theory of evolution comes from a number of sources. One of these sources is the science of embryology, the study of early forms of an organism. Darwin reasoned that organisms that have passed through a period of evolution will retain some reminders of that history within their bodies. As its [sic] turns out, virtually all living creatures possess vestigial features. A vestigial feature is a structure that once served some function in an ancestor and remains in an organism at some stage of its development. But the structure no longer serves any function in that organism. As an example, the embryos of all vertebrates (animals with backbones) look remarkably alike at an early stage." This inaccurately promotes a concept similar to recapitulation theory. It also ignores differences between early stages of embryos. There is no evaluation or critique of these claims, nor is there presentation of all sides of the data.
Evolution[92]	Miller-Urey	The curriculum overstates and misstates the results of the

89

http://infotrac.galegroup.com/galenet/texasschool?cause=http%3A%2F%2Ffind.galegroup.com%2Ftxdc%2Fstart.do%3FprodId%3DTXDC%26userGroupName%3Dtexasschool%26curriculum%3DBiology%26finalAuth%3Dtrue&cont=&sev=temp&type=session&sserv=no

90

http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol029&userGroupName=texasschool

91

http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2644300421&mode=view

	Experiment. (See Section II – Part A.)	Miller-Urey experiment, declaring: "With energy provided by sunlight, lightning, and the heat of volcanoes, those compounds apparently came together to form amino acids. Those amino acids, in turn, reacted with each other to form proteins, the building blocks of all forms of life. In 1953, American chemist Stanley Miller (1930-) showed in a laboratory experiment how such reactions might take place." Stanley Miller died in 2007, so it wrongly implies he is still alive. More importantly, the passage misrepresents Miller's experiments in claiming that they showed how organic molecules could arise on the early Earth. There is no objective evaluation, analysis, critique, or presentation of all sides of the evidence pertaining to this claim.
Evolution[93]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum states: "Another important source of evidence about evolution comes from the fossil record. In general, one would expect, if evolutionary theory is correct, that the older a fossil is the simpler and more primitive it is. Such, in fact, is the case." The curriculum thus paints a highly incomplete and one-sided presentation of the fossil record, ignoring dramatic bursts of biological complexity which occur during explosions like the Cambrian explosion. There is no discussion of all sides of the data, nor any critique of evolutionary claims.
Valley of the whales: an Egyptian desert, once an ocean, holds the secret to one of evolution's most remarkable	The Fossil Record -- Whales. (See Section II, Part B – 1 (b).)	This article presents the evolution of whales from land-mammals as fact without discussing any scientific weaknesses in that hypothesis, and does not discuss all sides of the data.

92

http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2644300421&mode=view

93

http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2644300421&mode=view

94

http://ic.galegroup.com/ic/tsic/MagazinesDetailsPage/MagazinesDetailsWindow?displayGroupName=Magazines&prodId=TSIC&action=e&windowstate=normal&catId=&documentId=GALE%7CA238474904&mode=view

transformations[94]		
Homology[95]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum presents common ancestry and discusses homology with the following text: "Homology is a term used in comparative anatomy and evolutionary biology in reference to traits of organisms that have a common ancestry, but are now dissimilar in their structure, function, or behavior." There is no evaluation or critique or presentation of all sides of the data pertaining to this claim.
Common Ancestry[96]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	This curriculum defines homology stating "A homology is a feature found in two or more organisms that was inherited from a common ancestor. … That trait, shared because of their close evolutionary relationship, is a homology." In a circular fashion, it then uses homology as evidence of common ancestry: "Because of the underlying anatomical homology of the bones, however, the bat and the human have a common ancestor." There is no meaningful evaluation or critique of these claims, nor is there presentation of all sides of the data.
Common Ancestry[97]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	This curriculum states "A second kind of homology is molecular homology, which explores sequence similarities in DNA or amino acids that link organisms to a common ancestor with a similar sequence. … Molecular homology can serve to resolve questions that linger after anatomical analysis fails to provide full resolution." There is no discussion of problems encountered when constructing evolutionary trees using molecular homology. There is no meaningful evaluation or critique of these claims, nor is there presentation of all sides of the data.
Current Events Activity: Common Ancestry of	The Fossil Record. (See Section II, Part B – 1.)	The curriculum states: "In recent years, scientists have found increasing evidence that the birds we see all around us today and the dinosaurs that walked the earth tens of millions of years ago are closely related genetically. Multiple cladistic studies show

95 http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&prodId=TSIC&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2431500321&mode=view

96 http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol062&userGroupName=texasschool

97 http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol062&userGroupName=texasschool

Modern Birds and Dinosaurs[98]		that birds and dinosaurs have a common ancestor." But it discusses none of the cladistic studies that have critiqued this hypothesis. There is no evaluation or critique or presentation of all sides of the data.
Genetic Change and Evolution[99]	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum states: "it's possible for large mutations to be beneficial. For example, a virus can accidentally introduce genes from DNA taken from its previous host cell, and if the new host cell incorporates this DNA, it may gain a useful gene in the process. But viruses usually introduce their own genes into host DNA—sometimes in the middle of a host's gene—which is often harmful." But the curriculum discusses no evaluation or critique of the view that mutations are capable of building the complexity of life. There is no presentation of all sides of the evidence.
Natural Selection[100]	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum states: "Natural selection is one of the mechanisms by which evolution occurs. … Natural selection is a process through which the environment promotes the persistence of certain genes in a population because the features related to those genes give an organism an advantage. The organisms with features best suited to managing environmental pressures live and reproduce while those with features less suited to managing environmental pressures die." It presents no critique of natural selection or evaluation of the ability of natural selection to produce the complexity we observe in life. There is no presentation of all sides of the data.
Natural Selection[101]	Darwin's Finches. (See Section II, Part B – 3.)	The curriculum state: "For example, a species of finch may live in an environment that changes from a food source in the soil to a food source found in narrow holes in rocks. Some finches in the population may already have long, narrow beaks. These finches will live and reproduce, while finches with short, wide beaks cannot eat and will die. The finches that reproduce will pass on the trait of long, narrow beaks that best fit the changed environment, and that trait will start to accumulate in the population. This process of trait accumulation that changes a population over time is evolution by natural selection."

98

http://find.galegroup.com/txdc/retrieve.do?contentSet=GSRC&curriculum=Biology&inPS=true&sort=&tabID=T001&prodId=TXDC&userGroupName=texasschool&relatedDocId=1880106221

99

http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol063&userGroupName=texasschool

100

http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol066&userGroupName=texasschool

		This alludes to the Galápagos finches, but the curriculum makes no mention that the finches are nearly identical after millions of years of evolution. There is no evaluation or critique of evolutionary claims, nor is there a presentation of all sides of the data.

Other comments: It's very difficult to follow the ordering of this curriculum as it appears online. There is no clear order in which the articles are to be read. However, it's worth noting that this curriculum has a particularly philosophical bent, stating:

> For all living organisms, then, life can be seen as a struggle. A constant battle goes on among individuals to determine which survive and which will die. In determining the outcome of that battle, it should be obvious that those individuals best adapted to an environment will survive.[102]

In fact, the curriculum extensively discusses Darwin's views of religion, and how his evolutionary ideas turned him away from religion:

> One change he later regretted. In the closing paragraph of the first edition [of *The Origin*] Darwin wrote, "There is grandeur in this view of life, with its several powers, having been originally breathed [by the Creator] into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."
>
> Darwin added "by the Creator" in the third edition (1861). In 1863, he wrote to Hooker, "I have long regretted that I truckled to public opinion & used Pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process. It is mere rubbish thinking, at present, of origin of life; one might as well think of origin of matter."
>
> […]
>
> Generally, Darwin tended to think of science and religion as two separate and distinct areas of inquiry. In 1866, he wrote to Mary Boole (the wife of John Boole, the mathematician, and she herself a mathematician): "I am grieved that my views should incidentally have caused trouble to your mind but I thank you for your judgment & honour you for it, that theology & science should each run its own course & that in the present case I am not responsible if their meeting point should still be far off."
>
> Separate and distinct, but not unconnected. His scientific worldview took precedence. He wrote to N.A. Mengden in 1879, "Science has nothing to do with Christ, except in so far as the habit of scientific research makes a man cautious in admitting evidence." This was the crux of Darwin's skepticism—by the end of the voyage, having seen so much evidence firsthand, he could no longer accept anything on "faith."
>
> In his autobiography he wrote, "The old argument of design in nature, as given by Paley, which formerly seemed to me as conclusive, fails, now that the law of natural selection has been

---

101 http://find.galegroup.com/txdc/unitOfStudy.do?action=RETRIEVE_LEARNING_UNIT&curriculum=Biology&inPS=true&tabID=T002&prodId=TXDC&docId=biol066&userGroupName=texasschool

102 http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2644300421&mode=view

> discovered. We can no longer argue that, for instance, the beautiful hinge of a bivalve shell must have been made by an intelligent being, like the hinge of a door by man. There seems to be no more design in the variability of organic beings and in the action of natural selection, than in the course which the wind blows. Everything in nature is the result of fixed laws."[103]

In a section titled "The Evolution of the God Gene," this curriculum also claims that evolution explains the origin of religion:

> For atheists, it is not a particularly welcome thought that religion evolved because it conferred essential benefits on early human societies and their successors. If religion is a lifebelt, it is hard to portray it as useless.
>
> For believers, it may seem threatening to think that the mind has been shaped to believe in gods, since the actual existence of the divine may then seem less likely.
>
> […]
>
> Religion was also harnessed to vital practical tasks such as agriculture, which in the first societies to practice it required quite unaccustomed forms of labor and organization. Many religions bear traces of the spring and autumn festivals that helped get crops planted and harvested at the right time. Passover once marked the beginning of the barley festival; Easter, linked to the date of Passover, is a spring festival.
>
> Could the evolutionary perspective on religion become the basis for some kind of detente between religion and science? Biologists and many atheists have a lot of respect for evolution and its workings, and if they regarded religious behavior as an evolved instinct they might see religion more favorably, or at least recognize its constructive roles.[104]

This section seeks to undermine a traditional understanding of faith, while simultaneously commending its own, unorthodox religious perspective. This might offend the First Amendment's prohibition against religious establishment, as public schools cannot endorse or disparage religion.

Final Analysis

Cengage Learning's curriculum contains erroneous and biased statements, and there is no real evaluation or critique or presentation of all sides of the data. It also contains philosophically charged statements that discuss atheism, religion, and Darwin's theory. Some of these statements could be perceived as attacking some religious viewpoints while endorsing others, perhaps violating the Constitution. It fails to adequately address following TEKS, as seen in the table below:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and	**NO**

[103] http://ic.galegroup.com/ic/tsic/ReferenceDetailsPage/ReferenceDetailsWindow?displayGroupName=Reference&prodId=TSIC&action=e&windowstate=normal&catId=&documentId=GALE%7CTX2641500252&mode=view

[104] http://ic.galegroup.com/ic/tsic/NewsDetailsPage/NewsDetailsWindow?displayGroupName=News&prodId=TSIC&action=e&windowstate=normal&catId=&documentId=GALE%7CA212062622&mode=view

experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**NO**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**NO**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

4. Compass Learning[105]

Does not address any of the TEKS for evolution in materials available online.

[105] http://prod1.thelearningodyssey.com/tea.html

5. Holt McDougal[106]

Section Identification	Error	Discussion
Applying Darwin's Ideas[107]	Natural Selection and Random Mutation. (See Section II – Part B.)	This curriculum covers natural selection and states "In sum, Darwin's theory explains evolution as a gradual process of adaptation … Darwin's book On the Origin of Species by Means of Natural Selection presented evidence that evolution happens and offered a logical explanation of how it happens." This purely positive portrayal of natural selection provides no evaluation or critique of Darwinian evolution by natural selection, nor is there presentation of all sides of the data.
Applying Darwin's Ideas[108]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum states: "Sometimes, comparing fossils and living beings reveals a pattern of gradual change from the past to the present. Darwin noticed these patterns, but he was aware of many gaps in the patterns." It then states "Darwin predicted that intermediate forms between groups of species might be found. And indeed, many new fossils have been found…" There is no discussion of all sides the data; for example there is no information about explosions in the fossil record. There is no critique or meaningful evaluation of the evolutionary viewpoint.
Applying Darwin's Ideas[109]	The Fossil Record -- Whales. (See Section II, Part B – 1 (b).)	The curriculum states "Darwin once hypothesized that modern whales evolved from ancient, four-legged, land-dwelling, meat-eating mammals. Over the years since, scientists have collected a series of fossil skeletons that support this hypothesis." There is no critique of the whale series nor any evaluation or presentation of all sides of the evidence.
Applying Darwin's Ideas[110]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum states: "The ancestry of organisms is also evident in the ways that multicellular organisms develop from embryos. ... Scientists may compare the embryonic development of species to look for similar patterns and structures. Such similarities most likely derive from an ancestor that the species

[106] http://www.classzone.com/cz/index.htm

[107] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

[108] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

[109] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

		have in common." There is no discussion of differences between the embryos developing in their early stages, and no critique or evaluation of the evolutionary claims. There is no presentation of all sides of the data.
Applying Darwin's Ideas[111]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: "This pattern of bones is thought to have originated in a common ancestor. So, the bones are examples of homologous structures, characteristics that are similar in two or more species and that have been inherited from a common ancestor of those species." There is no mention of data that does not fit the claims of homology nor difficulties encountered when building phylogenetic trees. There is no evaluation nor critique of evolutionary claims, nor is there any presentation of all sides of the evidence.
Applying Darwin's Ideas[112]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: "Scientists have observed that genetic changes occur over time in all natural populations. A comparison of DNA or amino-acid sequences shows that some species are more genetically similar than others. These comparisons, like those in anatomy, are evidence of hereditary relationships among the species. For example, comparing one kind of protein among several species reveals the pattern shown in Figure 10. The relative amount of difference is consistent with hypotheses based on fossils and anatomy." There is no mention of the many instances where molecular trees conflict with morphological trees, nor is there any discussion of difficulties constructing phylogenetic trees using molecular homology. There is no evaluation nor critique of evolutionary claims, nor is there any presentation of all sides of the evidence.
Applying Darwin's Ideas[113]	Section II.	The curriculum purports to discuss the "strengths" and "weaknesses" of Darwin's theory but the weaknesses are faux

110 http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

111 http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

112 http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

113 http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_evo008_385.pdf

		weaknesses that simply pertain to Darwin's lack of knowledge about the mechanisms of genetic inheritance, which were not yet widely known or understood at the time he developed his theory. The textbook then claims that modern genetic has solved these problems, but there is no actual discussion of weaknesses of evolutionary claims. There is no evaluation, nor critique, nor is there any presentation of all sides of the evidence.
Similarities in Embryology[114]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum states: "The early stages of different vertebrate embryos are strikingly similar to each other. These similarities may provide another indication that vertebrates share a common ancestry. However, it is important to note that there are major differences in the embryonic development of different types of vertebrates, and the similarities fade as development proceeds." It also presents Haeckel-like drawings that overstate the degree of similarities between embryos:  The qualifications are meager and there is no meaningful evaluation of the evidence that embryology provides for common ancestry, nor is there a presentation of all sides of the data.
Similarities in Macromolecules[115]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states: "Modern biology proves on the molecular level what Darwin noticed on the anatomical level. The number of amino acid differences in homologous proteins of different species is proportional to the length of time that has passed since the two species shared a common ancestor. Thus, the more similar the homologous proteins are in different species, the more closely related the species are thought to be." There is no mention of the many instances where molecular trees conflict with morphological trees, nor is there any discussion of difficulties constructing phylogenetic trees using molecular homology. There is no evaluation nor critique of evolutionary claims, nor is there any presentation of all sides of the evidence.

[114] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/60271.html
[115] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/60272.html

Evolution of Life[116]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum presents the fossil record as one showing gradual evolutionary change and only briefly alludes to the Cambrian explosion, calling it "a time of great evolutionary expansion." It mentions no other explosions and instead says "Scientists think that birds evolved from feathered dinosaurs during the Jurassic Period." There is no evaluation or critique of evolutionary claims, nor is there discussion of all sides of the data.
Punctuated Equilibrium[117]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum discusses punctuated equilibrium but provides no critique of the model, stating "it is important to understand that this is a debate about how evolution occurs not about whether it occurs." There is no evaluation or critique of evolutionary claims, nor is there presentation of all sides of the data, such as discussing whether the fossil record demands change too quickly for evolutionary mechanisms.
Whales: Sequential Groups in the Fossil Record[118]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum discusses the evolution of whales stating "In recent years, fossil evidence, molecular evidence, and observations from the study of embryology and vestigial structures have all come together to strongly support the hypothesis that whales evolved from hoofed mammals that lived on land." There is no discussion of any critiques of this hypothesis, nor is there presentation of all sides of the data, such as mathematical challenges to Darwinian explanations for the rapidity of whale evolution as observed in the fossil record.
Genetic Change[119]	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum states: "Recall that Charles Darwin proposed natural selection as a mechanism that could drive evolution. Scientists have studied many examples of natural selection in action." There is no meaningful evaluation or critique of natural selection as a mechanism for evolution, nor is there presentation of all sides of the data and scientific views that dissent from the evolutionary claims in the curriculum.

[116] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_lif010.pdf

[117] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/B_CTXAESE625966_017.pdf

[118] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/B_CTXAESE625966_018.pdf

[119] http://www.classzone.com/cz/books/biology_9780547625966/secured/resources/applications/ebook/content/hx8_pop008.pdf

Reading: Complexity of Cells	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum notes that cells are extremely complex but just assumes that this complexity evolved: "The evolution of complexity in cells is an important part of a scientific understanding of both the unity and diversity of living things. The fact that many key characteristics are the same in the cells of all living things provides strong evidence that the cells of all organisms are descended from a common ancestral cell." The observation that cells have similarities does not explain how traits evolved, and there is no evaluation or critique of these evolutionary hypotheses. The curriculum further states: "Biologists use the term exaptation to refer to the tinkering process of evolution. Exaptation is the co-opting of existing features or properties for new uses or functions." This extremely speculative hypothesis is not critiqued, even though the examples given are very weak. There is no critique or evaluation of evolutionary hypotheses, nor is there any consideration of the possibility that Darwinian evolutionary causes or exaptation cannot explain the origin of biochemical complexity. There is no presentation of all sides of the data.

Final Analysis

There is no real evaluation or critique or presentation of all sides of the data in the Holt McDougal curriculum. It contains erroneous and biased statements, and it fails to adequately address the following TEKS, as seen below:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to	**NO**

produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data.	**NO**

6. International Databases, LLC[120]

This curriculum is the only one that encourages students to engage in any meaningful evaluation, analysis or critique of neo-Darwinian evolution or the unguided chemical origin of life. Since there are few deficiencies in that regard, corrections of such matters are not required. However, this curriculum also includes intelligent design, which is not recommended.

Regarding intelligent design, it is not called for by the TEKS, nor was it the intent of the 2009 TEKS to include intelligent design. The following excerpt from Discovery Institute's Science Education Policy describes Discovery Institute's position that intelligent design should not be included in public school curricula:

> As a matter of public policy, Discovery Institute opposes any effort to require the teaching of intelligent design by school districts or state boards of education. Attempts to mandate teaching about intelligent design only politicize the theory and will hinder fair and open discussion of the merits of the theory among scholars and within the scientific community. Furthermore, most teachers at the present time do not know enough about intelligent design to teach about it accurately and objectively. Instead of mandating intelligent design, Discovery Institute seeks to increase the coverage of evolution in textbooks. It believes that evolution should be fully and completely presented to students, and they should learn more about evolutionary theory, including its unresolved issues. In other words, evolution should be taught as a scientific theory that is open to critical scrutiny, not as a sacred dogma that can't be questioned.[121]

Additionally, there were numerous typographical errors in this curriculum as well as some other errors. These should be fixed if the curriculum is to be adopted. In that regard, the following limited comments pertain to materials submitted by International Databases, LLC.

Section Identification	**Error**	**Discussion**
Module 1, Origin Amino	Typographical and Stylistic	Many slides use changing fonts and small caps fonts that are difficult to read. This problem exists in many of the modules. There are also some misspellings of words, such as "chaperonon" which should read "chaperonin," The Biblical parody of materialistic theories on slide 3 is inappropriate.
Module 1,Origin Nucleotide, Slides 15-19	Includes Intelligent Design	These slides discuss intelligent causes. Discovery Institute would strongly recommend *against* bringing intelligent design into the discussion in public school curricula. See "Discovery Institute's Science Education Policy," at http://www.discovery.org/a/3164 for details.
Module 2, Archean 1	Typographical and Stylistic	There are various typographical errors, such as "carboxyylase" which should read "carboxylase." Also, unscientific terms like "pond-scum" are inappropriate. Inconsistent font colors and styles make it difficult to read.

[120] http://internationaldatabasesllc.com/
[121] Discovery Institute's Science Education Policy, at http://www.discovery.org/a/3164

Module 2, Archean 2	Includes Intelligent Design	There are various typographical errors, such as "Achean" which should read "Archean." Inconsistent font colors and styles make it difficult to read.
Module 3, Trilobites	Typographical and Stylistic	There are various typographical errors. Genus and species names should be italicized; "Cambrian" should be capitalized.
Module 3, Trilobite Conclusions	Typographical and Stylistic	There are various typographical errors. Slide 4 rightly notes that "According to the rules of science .... no miracles allowed," but it attacks Darwinian evolution for purportedly invoking "miracles" due to the theory's lack of explanations for the paucity of transitional forms. While the slide clearly is attacking Darwinian evolution for its lack of explanations for abrupt appearance in the fossil record, the curriculum should just critique the theory and not attack it as requiring "miracles," because Darwinian theory does not purport to invoke miracles. It is an unfair criticism of Darwinian theory to claim it invokes miracles.
Module 3, Formations	Typographical and Stylistic	There are various typographical errors, such as "Stephen J. Gould" which should read "Stephen Jay Gould."
Module 4, Cambrian Explosion 2, Slides 17, 20.	Includes Intelligent Design	These slides discuss intelligent design. Discovery Institute would strongly recommend *against* bringing intelligent design into the discussion in public school curricula. See "Discovery Institute's Science Education Policy," at http://www.discovery.org/a/3164 for details.
Module 7, Null, Slides 7-10.	Includes Intelligent Design	These slides discuss intelligent design. Discovery Institute would strongly recommend *against* bringing intelligent design into the discussion in public school curricula. See "Discovery Institute's Science Education Policy," at http://www.discovery.org/a/3164 for details.
Module 7, Science, Slide 6	Includes Intelligent Design	These slides discuss intelligent design. Discovery Institute would strongly recommend *against* bringing intelligent design into the discussion in public school curricula. See "Discovery Institute's Science Education Policy," at http://www.discovery.org/a/3164 for details.

Final Analysis

This is the only curriculum submitted that makes an actual attempt to fulfill the TEKS related to evolution. It makes good use of scientific critical analysis of topics pertaining to evolutionary biology and the chemical origin of life. However, there are many stylistic, grammatical, and typographical issues that need improvement. **Above all, this curriculum needs to be changed so that it does not include intelligent design.** While it does not attempt to cover very many of the TEKS that are unrelated to evolution, if these changes are made, we recommend adoption for the purpose of fulfilling the evolution-related TEKS. It fulfills the following TEKS:

TEKS:	Adequately addressed?
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**YES**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**YES**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**YES**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**YES**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**YES**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**YES**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**YES**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**YES**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**YES**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**YES**

7. Lazel[122]

Section Identification	Error	Discussion
Human Evolution Skull Analysis exercise[123]	The Fossil Record. (See Section II, Part B – 1.)	This curriculum asserts as fact that "Humans, chimpanzees, and the other great apes are hominids. Hominids evolved from a common ancestor that lived about 13 million years ago. Hominins are hominids that belong to the lineage that led to humans." There is no discussion of abrupt appearance or explosions in the fossil record. There is no critique or presentation of all sides of the data or meaningful evaluation of the claims promoted. While this exercise allows for much inquiry by the student, it encourages no meaningful evaluation of the hypothesis that humans evolved from ape-like ancestors.
Microevolution lesson[124]	Natural Selection and Random Mutation. (See Section II – Part B.)	The lesson equates microevolution with macroevolution, stating: "Both microevolution and macroevolution occur by processes that include natural selection, mutation, *gene flow* (immigration and emigration), and *genetic drift* (chance)." There is no critique of the ability of the Darwinian mechanism to explain life's complexity. There is no presentation of all sides of the data or meaningful evaluation of the claims promoted.
Mutation and Selection lesson[125]	Natural Selection and Random Mutation. (See Section II – Part B.)	The lesson simply asserts that "evolution can occur through natural selection." There is no qualification of that claim, and there is no meaningful evaluation or analysis of the ability of natural selection and other evolutionary mechanisms to produce the observed complexity of life.

Final Analysis

There is some attempt at inquiry in the Lazel curriculum but overall it amounts to an extremely biased and one-sided presentation. There is no real evaluation or critique or presentation of all sides of the data. It thus fails to adequately address following TEKS, as seen in the table below:

[122] http://www.explorelearning.com/index.cfm?method=cResource.dspStandardCorrelation&id=1122
[123] http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=576
[124] http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=521
[125] http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=554

TEKS:	Adequately addressed?
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**NO**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**NO**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

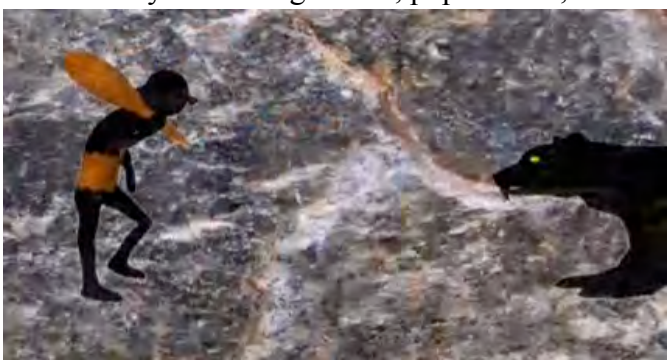
8. Learning.com[126]

We were unable to log in to access these materials to evaluate this curriculum.

[126] http://www.learning.com/

9. Pearson/Prentice Hall.[127]

No materials that address the Evolution TEKS are available online. The only high school biology TEK which is addressed in online material is 11B: "investigate and analyze how organisms, populations, and communities respond to external factors." The materials seem simplistic, and consist largely of students watching videos. This does not lend itself to student inquiry. The materials that are available online seem to take evolution as a given, talking about "cave-men" (see to the right), a pop-culture notion that does not encourage scientific inquiry.



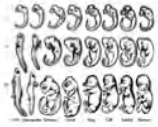
There are a couple of worksheets but they are simplistically written and very light on content. It's not possible to evaluate its treatment of the evolution TEKS based upon the material available online. We would not recommend adoption unless more materials can be evaluated.

[127] http://onlinelearningexchange.com/texas_demo/

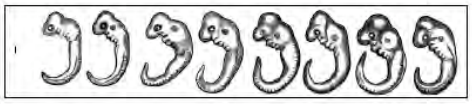
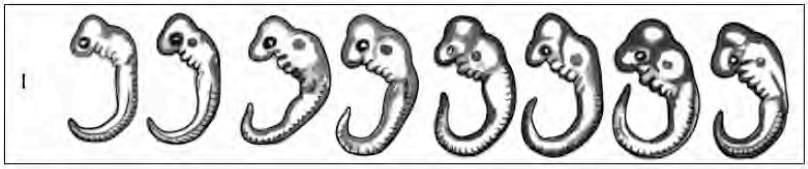
10. Perfection

We were unable to access materials related to evolution to evaluate this curriculum.

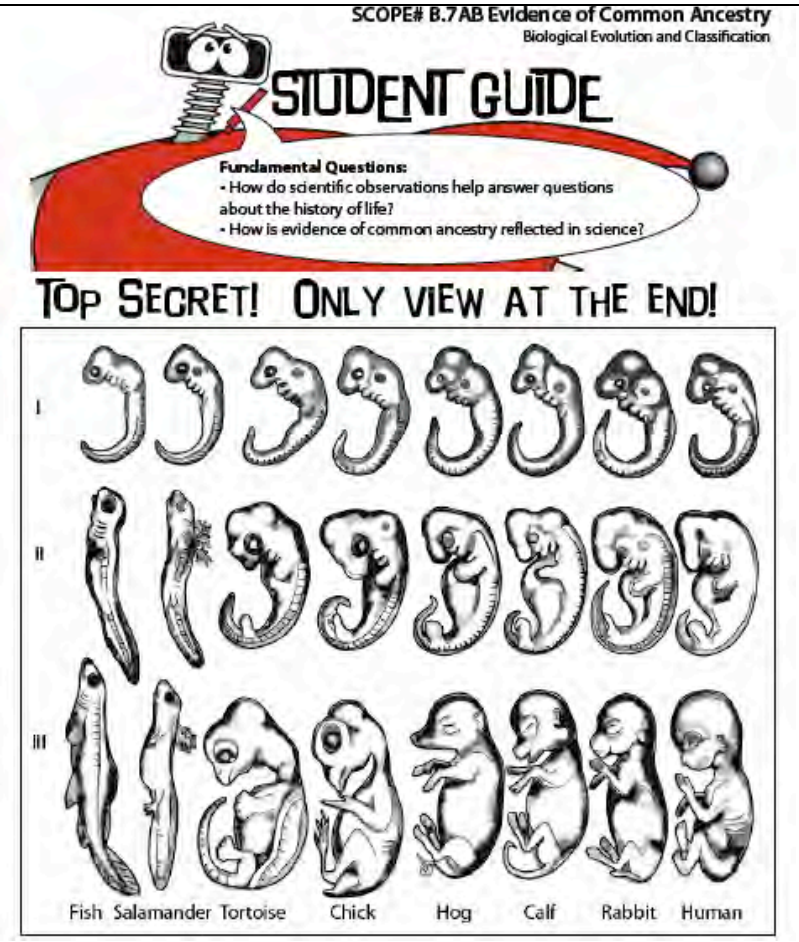
11. Rice University[128]

Section Identification	Error	Discussion
Evidence of Common Ancestry (B.7AB) – Pre-Assessment[129]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum uses Haeckel's discredited embryos as evidence for evolution: **4. The chart below was used to show how similar stages in development help establish evolutionary relationships. This type of evidence for evolution is known as –**  A. embryology B. biogeography C. natural selection D. paleontology The information presented is inaccurate, and there is no meaningful evaluation, critique, or discussion of all sides of the evidence.
Evidence of Common Ancestry (B.7AB) - Overview[130]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum states: "embryological studies also show similar developmental stages among different species indicating the evolution from a common ancestor." There is no discussion of differences between embryos, and there is no meaningful evaluation, critique, or discussion of all sides of the evidence.
Evidence of Common Ancestry (B.7AB) - Overview[131]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum states: "The stages of embryo development can also point to clues of a common ancestry, as embryos of related organisms pass through similar developmental patterns. … The various stages of embryonic development are thought to represent the progression of ancestral stages of common organisms." It further states "at some point in tetrapod embryological development, all embryos have gill slits." This information is inaccurate. It seemingly promotes a recapitulation-like view, and also wrongly claims that humans have gill slits. There is no evaluation or critique of these views, nor is there any presentation of all sides of the data.

[128] http://biologypreview.stemscopes.com/scopes
[129] From http://biologypreview.stemscopes.com/quiz_elements/162
[130] http://biologypreview.stemscopes.com/scopes/33
[131] http://biologypreview.stemscopes.com/scopes/33

SCOPE# B.7AB Evidence of Common Ancestry: Biological Evolution and Classification[132]	Haeckel's Embryos. (Section II, Part B – 4.)	This section also presents Haeckel's embryo drawings as evidence for evolution. The drawings appear in multiple locations as follows: *2. Vertebrate embryos show similar developmental patterns– a **developmental** homology.*  **Chordates**, from the Phylum Chordata, are animals that are vertebrates (and some related invertebrates). The animals represented in this lesson will include human, tortoise, fish, salamander, calf, chick, hog, and rabbit. You will review the common components of development of these embryos.  **PHASE I EMBRYOS** Observe these Phylum Chordata embryos in Phase I of development. They are (in no particular order) a chick, human, tortoise, salamander, hog, rabbit, fish, and a calf. In your Student Journal, record your observations and answer the questions on page 1.

132 http://biologypreview.stemscopes.com/system/pdf_elements/contents/400/original/B.7AB_STEMscopes_EXPLORE_StudentGuide.pdf?1300493958

		 The embryo drawings presented are inaccurate and overstate the similarities between the embryos. There is no evaluation or critique of evolutionary claims. There is no discussion of all sides of the evidence.
SCOPE# B.7AB Evidence of Common Ancestry: Biological Evolution and Classification, Student Journal	Haeckel's Embryos. (Section II, Part B – 4.)	The next section asks students to "Make a rough sketch of the embryos in Phase I" and then asks questions such as: "What were the similarities you noticed with these embryos?" and "How do you think these similarities point to common ancestry of Chordates?" It thus asks students to redraw the embryos and compare their similarities in order to infer common ancestry. In essence, the curriculum is using inaccurate drawings and then expecting students to redraw those inaccurate drawings and make inferences based upon them.
Teacher Guide "Evidence of Common Ancestry"[133]	Anatomical and Molecular Homology. (See Section II,	This curriculum states: "Homologies are traits that organisms share because they shared a common ancestor. Homologies can be structural, molecular, or developmental. For this activity, students will explore how developmental homologies point to a

[133] http://biologypreview.stemscopes.com/text_elements/322

	Part B – 2.)	common ancestry." There is no discussion of evidence that does not fit with the claims regarding homology. Nor is there any critique, nor evaluation nor presentation of all sides of the data regarding this concept.
Evidence of Common Ancestry (B.7AB): Next Step Inquiry[134]	The Fossil Record. (See Section II, Part B – 1.)	Positively, this curriculum does discuss the Cambrian Explosion saying "This is where we see most of the major animal groups making their first fossil appearance. Many of the body plans that are familiar to us today are found in rocks that date from 543 to 525 mya, the blink of an eye in geologic time." It even observes that "This was such an important event for modern organisms because no new phyla evolved after this period, so all of the major body plans that we see today originated during the Cambrian Explosion. But how did this occur?" However, the reasons it gives for the Cambrian explosion amount to the advent of hard parts that fossilize easily, the origin of warm shallow seas, or higher atmospheric levels of oxygen. None of this explains how the Cambrian explosion occurred, and there is no overall evaluation or critique of the evolutionary hypothesis, nor is there presentation of all sides of the evidence. In a catechism-like question-and-answer style, it leads students to predict that evolutionary causes of the Cambrian explosion will be found: 5. What do I expect to discover during this investigation? I expect to discover that there may have been specific events that led to the sudden appearance of groups of organisms in the fossil record. 6. What is my prediction? I predict that there were major events that occurred in the atmosphere and in organisms' development that led to the sudden appearance of so many groups in the fossil record during the Cambrian Explosion There is no evaluation of evolutionary hypotheses in general, nor does it provide any critique or evaluation of these evolutionary explanations for sudden appearance, nor is there presentation of all sides of the evidence.
Evidence of Common Ancestry (B.7AB):	Anatomical and Molecular Homology. (See Section II,	This curriculum promotes common ancestry as fact, stating: "Scientific reasoning tells us that the fact that every living organism on Earth has the same nucleotides demonstrates that every organism on Earth had a common ancestor at the Root."

[134] http://biologypreview.stemscopes.com/text_elements/312

Reading Science![135]	Part B – 2.)	There is no discussion of instances where DNA similarities produce contradictory trees. There is no evaluation or critique or presentation of all sides of the data.
Evidence of Common Ancestry (B.7AB): Writing Science[136]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	This section defines homology in a circular fashion, stating: "Common structures that are found in different species that share a common ancestry are called homologous structures. … the common features found in these animals points to a common ancestor. These types of structural homologies are called anatomical homologies." It poses questions that lead the student to support evolution only and do not foster true scientific inquiry: "How is evidence of common ancestry reflected in science?" There is no evaluation or critique of evolutionary hypotheses, nor is there discussion of all sides of the evidence.

Final Analysis

There is some attempt at inquiry and discussing abrupt appearance in Rice's curriculum, but the intent is to encourage students to agree with evolutionary causes, even when only weak and inadequate explanations are offered. There is no meaningful evaluation of evolutionary explanations of abrupt appearance. Additionally, this curriculum uses inaccurate information about embryology to promote common ancestry. There is no meaningful evaluation of common ancestry. It thus fails to adequately address following TEKS, as seen in the table below:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil	**NO**

[135] http://biologypreview.stemscopes.com/quiz_elements/161
[136] http://biologypreview.stemscopes.com/text_elements/320

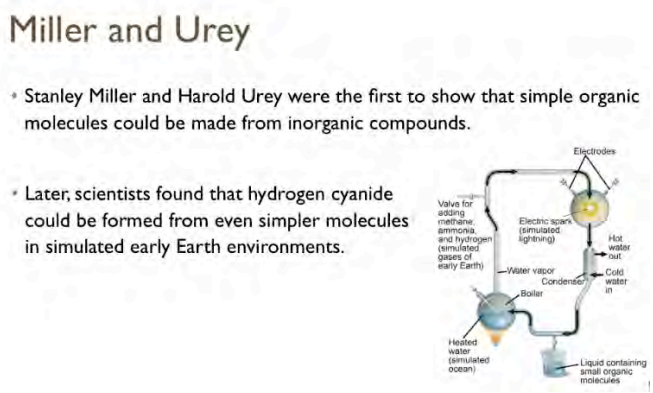
lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data.	

12. Sapling Systems[137]

From what can be found, this curriculum has only put test questions online. There are no questions that might actually lead to a discussion of scientific weaknesses of evolution. But there is not enough information available to evaluate how this curriculum fulfills the evolution TEKS.

[137] http://hs.saplinglearning.com/

13. School Education Group (McGraw Hill)[138]

Section Identification	Error	Discussion
The Origin of Life[139]	Miller-Urey Experiment. (See Section II – Part A.)	As seen in the diagram below, this curriculum promotes the Miller-Urey experiment, inaccurately suggesting that it "simulated early Earth environments."  There is no evaluation or critique of these claims, nor is there any presentation of all sides of the evidence.
Fossil Evidence of Change[140]	The Fossil Record. (See Section II, Part B – 1.)	This curriculum claims that "Birds evolved from a group of predatory dinosaurs in the middle of the Jurassic period." It fails to acknowledge that significant scientific dissent from that position and allow students to evaluate or critique those claims.
How do species compare?[141]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	This curriculum promotes common descent as fact, claiming that the cytochrome c produces a tree that matches the standard tree. It ignores phylogenetic trees that deviate from the standard tree, such as the cytochrome b tree which differs significantly from the standard phylogeny. There is no evaluation or critique of the hypothesis of common ancestry, nor is there presentation of all sides of the data.
Darwin's Theory of Natural Selection[142]	Darwin's Finches. (See Section II, Part B – 3.)	The wrongly curriculum implies that the Galápagos finches played a major role in the formulation of Darwin's theory.

[138] https://tx-science.cinchlearning.com/g_login.html
[139] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8539&pid=0
[140] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8538&pid=0
[141] http://media.cinchlearning.com/cinchmath/resources/cinchscience/glencoe_science_2012_texas/biology/lesson_14.2/labs/biology_lab_manual_-_lab_16.pdf

Evidence for Evolution[143]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states that "Common ancestry can be seen in the complex metabolic molecules that many different organisms have and "Organisms with closely related morphological features have more closely related molecular features," not mentioning the many instances where this rule fails to apply and there are conflicts among phylogenetic trees. There is no evaluation or critique of the hypothesis of common ancestry, nor is there presentation of all sides of the data.
Evidence for Evolution[144]	Tree of Life. (See Section II, Part B.)	This section only discusses how "fossils provide evidence of evolution," "morphology provides evidence of evolution," or "biochemistry provides evidence of evolution." The main idea is "Multiple lines of evidence support the theory of evolution." There is no evaluation or critique or discussion of all sides of the evidence. It only discusses evidence that supports evolution, and there is no objective analysis or meaningful evaluation or critique or discussion of all sides of the evidence.
Evidence for Evolution[145]	Vestigial Organs. (See Section II, Part B – 5.)	The curriculum shows the appendix and states "Vestigial structures are structures that are reduced forms of functional structures in other organisms" and "Evolutionary theory predicts that features of ancestors that no longer have a function for that species will become smaller over time until they are lost." There is no discussion of functions of the appendix, nor is there any critique or evaluation of these claims made in favor of evolution. There is no presentation of all sides of the data.
Shaping Evolutionary Theory[146]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum claims that "punctuated equilibrium explains rapid spurts of genetic change causing species to diverge quickly," not mentioning any criticisms of the theory. There is no evaluation or critique or presentation of all sides of the data.
Shaping Evolutionary Theory[147]	Natural Selection and Random Mutation. (See Section II – Part B.)	The curriculum states "Natural selection acts to select the individuals that are best adapted for survival and reproduction." While this is technically true, there is no discussion of limitations to this claim, such as scientists who criticize the ability of natural selection and random mutation to produce certain complex features. There is no evaluation or critique of evolutionary hypotheses, nor is there presentation of all sides of the data.

[142] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8541&pid=0
[143] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8542&pid=0
[144] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8542&pid=0
[145] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8542&pid=0
[146] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8543&pid=0
[147] https://tx-science.cinchlearning.com/te_presentation.html?rid=5&lesson=8543&pid=0

Final Analysis

There is some attempt at inquiry by the School Education Group (McGraw Hill) curriculum but overall it contains an extremely biased and one-sided presentation. There is no real evaluation or critique or presentation of all sides of the data. Moreover, it contains inaccurate information. It thus fails to adequately address the following TEKS:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential reproductive success;	**NO**
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**NO**

Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

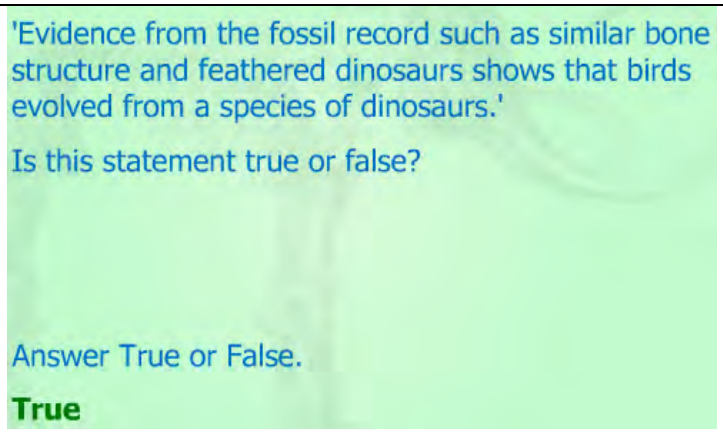
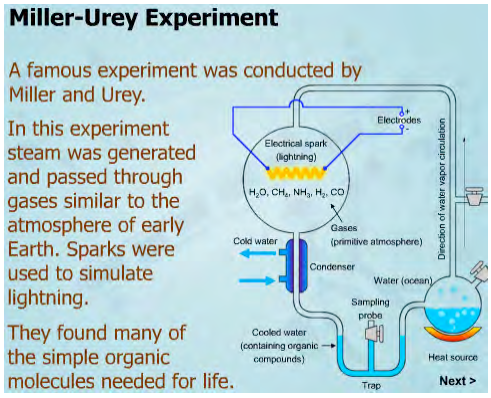
14. Technical Lab Systems[148]

Section Identification	Error	Discussion
Homology[149]	Section II.	The curriculum states: "The theory of evolution is supported by a great deal of scientific evidence." But nowhere is there any critique or evaluation of evolutionary claims, nor is there presentation of all sides the data.
Evidence from the Fossil Record[150]	The Fossil Record. (See Section II, Part B – 1.)	The curriculum claims that life has changed "gradually" and that "studying the fossil record provides good evidence for the theory of common descent." It makes make no mention of explosions in the fossil record and does not provide any evaluation or critique or presentation of all sides of the evidence. It further claims "there is a great deal of evidence of the evolution of birds from small feathered dinosaurs," but provides no critique or presentation of scientific viewpoints that are critical of that position. It also presents whale evolution stating "Whales evolved from a small hoofed carnivore" and "it is known that the back-to-the-water evolution did occur, thanks to the many fossils that have been uncovered." It does not actually evaluate the evidence but only presents one viewpoint, discussing no criticisms of that view. There is no evaluation or critique of whether the fossil record provides evidence for common descent, nor is there presentation of all sides of the evidence.
Biogeography[151]	Darwin's Finches. (See Section II, Part B – 3.)	It uses the Galápagos finches as biogeographical evidence for common ancestry, stating "In the Galapagos Islands, Darwin noticed that the islands contained a wider variety of finches than Ecuador, which is close by" and "He reasoned that each species had evolved from a common ancestor from the mainland, but had adapted in different ways to the different habitats on the islands." Purportedly, this helps show "how the worldwide dispersion of species and how they got there provides good evidence for evolution from a common ancestor." It fails to explain that the finches played a very minor role in the formulation of Darwin's ideas, and provides no discussion of the extreme similarities between the finches species, nor does it

[148] http://www.scitexlearning.com/
[149] http://eval.scitexlearning.com/?course=1&standard=7-1-3&component=238bbf01-d566-4103-a166-a46f2ca800d8&mode=1
[150] http://eval.scitexlearning.com/?course=1&standard=7-1-1&component=e408256f-8b80-4ab6-8bc2-c973e2423403&mode=1

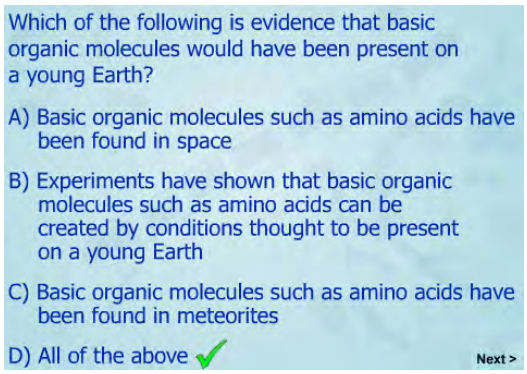
		provide any critique or evaluation of evolutionary hypotheses.
Homology[152]	Anatomical and Molecular Homology. (See Section II, Part B – 2.)	The curriculum states that "evidence of common ancestry among groups is provided by homology" but provides no examples where the evidence doesn't fit with homology. The curriculum uses a circular argument for common ancestry. First it defines homology in terms of common ancestry: "Homology is the idea that many characteristics of organisms are similar because they are derived from a common ancestor." Then, it uses homology as evidence for common ancestry: "Homologous structures can be seen throughout the living world, in plants and animals and suggest a common origin." It further claims: "Some of the strongest evidence of all for the idea of a common ancestor comes from DNA sequences." But it never provides any mention of instances where DNA data provides a conflicting picture of common ancestry. The curriculum concludes: "homology shows that many organisms have similarities; provides strong evidence that they share a common ancestor," and asks students to endorse common ancestry, stating "The genetic code of all living things is based on DNA or RNA. This provides good evidence that all life is descended from a common ancestor." It thus ignores scientific weaknesses in the hypothesis and criticisms of such arguments for universal common ancestry. There is no critique or evaluation or presentation of all sides of the evidence.
Homology[153]	Haeckel's Embryos. (Section II, Part B – 4.)	The curriculum states: "Species which have a common ancestor typically share the early stages of embryo development and differ in later stages." It further claims "in their early stages of development, chickens, turtles and humans look similar providing evidence that they shared a common ancestor." But there is no discussion of differences between the embryos, nor is there any critique or evaluation of evolutionary claims, or presentation of all sides of the data.
Evidence from the Fossil Record[154]	The Fossil Record. (See Section II, Part	The questions force students to assent to evolution, as seen in the following question and answer:

[151] http://eval.scitexlearning.com/?course=1&standard=7-1-2&component=7cf7b71e-801a-48bc-acf8-e8d47c697df0&mode=1
[152] http://eval.scitexlearning.com/?course=1&standard=7-1-3&component=238bbf01-d566-4103-a166-a46f2ca800d8&mode=1
[153] http://eval.scitexlearning.com/?course=1&standard=7-1-3&component=238bbf01-d566-4103-a166-a46f2ca800d8&mode=1
[154] http://eval.scitexlearning.com/?course=1&standard=7-1-6&component=e408256f-8b80-4ab6-8bc2-c973e2423403&mode=1

	B – 1.)	 The curriculum provides no discussion of critiques of the existence for "feathered dinosaurs" or the thesis that birds evolved from dinosaurs, nor does it discuss all sides of the evidence.
Natural Selection[155]	Natural Selection and Random Mutation. (See Section II – Part B.)	It treats evolution dogmatically saying "the theory of evolution is … one of the most accepted theories in all of science," mentioning no scientific dissent from natural selection or critique of that viewpoint. There is no actual evaluation of the ability of natural selection to produce observed biological complexity. The examples provided—antibiotic resistance or small changes in bird plumage—do not explain many observed features in life.
Origins of Life[156]	Miller-Urey Experiment. (See Section II – Part A.)	The curriculum states: "In this experiment steam was generated and passed through gasses similar to the atmosphere of the early Earth." It wrongly portrays the Miller-Urey experiment as follows:  It then asks a question which forces students to assent that the

[155] http://eval.scitexlearning.com/?course=1&standard=7-3-1&component=5d451a37-a3b7-4e70-ae01-0e53678dcffa&mode=1

[156] http://eval.scitexlearning.com/menu/menu.htm?ticket=wppZw68Uw7Qpw7EGSQvChAJwM3M%3D

		experiment accurately simulated conditions on the early earth:  There is no critique of the Miller-Urey experiment nor evaluation of its claims. There is no presentation of all sides of the evidence.

Other comments:

These presentations use an awkward computer generated voice that often mispronounces words.

Final Analysis

There is no real evaluation or critique or presentation of all sides of the data in the curriculum prepared by Technical Lab Systems. The curriculum also contains erroneous statements and uses inaccurate diagrams and drawings. It fails to adequately address the following TEKS:

TEKS:	**Adequately addressed?**
Biology (c) (3) (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	**NO**
Biology (c) (7) (A) analyze and evaluate how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies, including anatomical, molecular, and developmental;	**NO**
Biology (c) (7) (B) analyze and evaluate scientific explanations concerning any data of sudden appearance, stasis, and sequential nature of groups in the fossil record;	**NO**
Biology (c) (7) (C) analyze and evaluate how natural selection produces change in populations, not individuals;	**NO**
Biology (c) (7) (D) analyze and evaluate how the elements of natural selection, including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources, result in differential	**NO**

reproductive success;	
Biology (c) (7) (E) analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species;	**NO**
Biology (c) (7) (F) analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and	**NO**
Biology (c) (7) (G) analyze and evaluate scientific explanations concerning the complexity of the cell.	**NO**
Earth and Space Science (c) (8) (A) analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data;	**NO**
Earth and Space Science (c) (8) (F) discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems.	**NO**

15. Triumph

No evolution materials were available to review online.

IV. Summary Recommendation

Both because they fail to fulfill the 2009 TEKS and/or because they contain glaring scientific errors, 9 of the 10 proposed curricula which have posted material for online analysis clearly require significant revisions. One curriculum (International Databases, LLC) adequately fulfills the evolution-related TEKS, but it contains typographical and other errors that need to be corrected. It also goes beyond the TEKS because it addresses intelligent design, and so the material on intelligent design needs to be removed.