

# **Analysis of David Shormann's "Errors" in the Holt McDougal Supplemental Biology Instructional Materials**

**Steven Schafersman, Ph.D.  
Texas Citizens for Science  
2011 July 26**

## **Introduction**

The eight reported "errors" in the Holt McDougal supplemental biology instructional materials were identified by a single person, David Shormann, an aggressive Young Earth Creationist appointed to the biology review panel by State Board of Education member and recently-appointed Chairwoman Barbara Cargill. Dr. Shormann's profession is writing pseudoscientific instructional materials for home schools and private religious schools for fundamentalist religious parents who want their children taught Creationism and don't want them exposed to biological evolution. As bad as this is for accurate and competent science education, it is legal in our country to do this. Shormann also writes mathematics instructional materials, but I am not familiar with these.

The various publishers' biology instructional materials were randomly assigned to one of five sub-panels (tables) of biology reviewers. I was present at the science review as an observer; when it was made clear to me that I would not be able to actually observe (listen to) the discussions at the various biology tables (as I expected to do under the Texas open meeting law), I left Austin very early. The Holt McDougal biology materials were assigned to Table 1 on which David Shormann was present. The protocol was that if any member of the table identified an "error" in the submitted materials, that error must be included on the panel's list of "errors." It is almost certain that the other two members of Table 1—who are biology teachers whose names and affiliations I will not identify here—did not share Shormann's belief that the "errors" were actually factually incorrect, so he alone is responsible for them.

As was surprisingly announced last Friday during the Board meeting, the members of Table 1 were the only ones who did not sign a consensus statement about the identified errors. The publishers were given an opportunity to respond to the "errors" later and Holt McDougal did so in their case; I read their responses and think they are scientifically excellent. It is common for newly-prepared materials to have errors, mostly figure, punctuation, grammar, spelling, and syntax errors; one publisher had hundreds of these errors. Factual errors are less common but do occur. It is appropriate to identify and list these errors when in truth they are factual errors, but it is not appropriate to identify bogus errors for ideological reasons, which is what David Shormann did.

Holt McDougal was very unlucky to be randomly assigned to the table at which David Shormann was sitting. The other two major publishers have topics and presentations similar to those of Holt but were not penalized by the process. I consider the process to be very unfair to Holt for this reason. The bogus errors that Shormann claimed should have been weeded out by further discussion or a different method. Perhaps professors at the University of Texas could have reviewed the identified "factual errors" and commented. The various anti-evolutionists on the State Board of Education did nominate several anti-evolutionists to the biology panel in addition to Shormann; these included Ide Trotter, an individual well known to me since he served as the spokesman for the anti-evolutionist/pro-Intelligent Design Creationist Texans for Better Science Education in 2009

when the science standards were being written and in fact he personally wrote some of the bad ones that the Board voted to adopt. Other anti-evolutionists were present in addition to Ide Trotter and David Shormann but they apparently had no destructive effect. I believe it was the intention of several Board members to salt the biology panel with anti-evolutionists to create precisely the situation that Holt unfortunately found itself in: having to fight bogus errors about evolution identified by the TEA's own review process. This is really a bad way to conduct a review of scientific instructional materials and greater care needs to be taken in the future to be sure that only qualified individuals are chosen to sit on TEA review panels of all education disciplines.

In addition to defending the original Holt McDougal text for the eight text passages and its official responses, I include several suggested additions that might appropriately clarify each passage in a scientifically responsible way. These suggested additions could serve as a scientifically accurate compromise for each criticized passage.

Before I continue with my analysis of the eight "errors" identified by David Shormann, let me refer readers to an error in the Holt biology materials I found that was probably not identified by the members of Table 1. If you go to [http://www.texscience.org/files/endosymbiosis\\_correction.htm](http://www.texscience.org/files/endosymbiosis_correction.htm) this error will be clearly explained. The same error occurs in the McGraw Hill Glencoe biology materials. I urge that both publishers voluntarily correct this error because unless it was identified by the TEA biology review panel members, they are unfortunately under no obligation to do so. When I attend the science review panel session in Austin, I tried to inform the biology panel of this error but was prevented by the rules. This seemed inordinately senseless to me.

### **Analysis of David Shormann's mistakenly identified "errors" in the Holt McDougal supplemental biology instructional materials**

#### **Page 1 (of TEA-provided handout)**

#### **Epigenesis and Evolution**

David Shormann's criticism and suggested change is scientifically incorrect. Epigenetic activity affects development and is slightly heritable, but there is no evidence that new species can form during evolution over time as a result of only epigenetic processes with no underlying genetic changes.

The example he cites, *Podarcis sicula*, has a recent human-initiated island founder (or "bottlenecked") population with novel phenotypic features and the same mitochondrial DNA, not the same nuclear DNA (see [http://en.wikipedia.org/wiki/Italian\\_wall\\_lizard](http://en.wikipedia.org/wiki/Italian_wall_lizard) and [http://scienceblogs.com/pharyngula/2008/04/still\\_just\\_a\\_lizard.php](http://scienceblogs.com/pharyngula/2008/04/still_just_a_lizard.php)). This is an example of rapid evolution with the formation of new morphological features in only about 30 generations. Nuclear DNA change is assumed. Shormann's suggestion that epigenetics alone accounts for the evolution is wrong. His suggestion of changing "should" to "might" is disingenuous, mendacious, and scientifically inaccurate; it is an attempt by a Creationist/anti-evolutionist to weaken the evolution content of this text. His statement that "Epigenetic adjustments can cause changes in species WITHOUT changing genes" is nonsense if by "changes in species" is meant change from one species to a descendant species over time, which is the context of the original text. If it is meant to refer to changes within a single species during development in a single population due to

phenotypic change through environmental influences on gene expression, then it is correct, but the lizard evolution example he cites obviously underwent underlying nuclear DNA changes to produce novel anatomical structures. Shormann may possibly be deliberately conflating two different meanings of "change in species" in order to make his specious point, a misleading and illogical error.

The description of epigenetics at <http://en.wikipedia.org/wiki/Epigenetics> is a paragon of clarity and completeness. It provides no support for the idea that epigenetic changes alone lead to the evolution of new species over time without underlying changes in nuclear DNA. Epigenetic changes can lead to changes within a particular species over multiple generations often due to environmental stresses (as happened with the lizard).

Holt's response that "should" is necessary because in context the sentence is supposed to be a testable prediction is completely accurate. The passage does not and should not be changed. It could, however, be expanded to include some of the details related above to clarify the presentation.

## **Page 1**

### **The Red Blood Cell is a Eukaryotic Cell**

There is no error in Holt's presentation. Of course erythrocytes are eukaryotic cells; to claim otherwise as Shormann does is nonsense. Red blood cells are highly derived and have lost many ancestral features due to adaptation for a single function. This is a good example of how evolution can lead to simplification and reduction of features rather than increased complexity of features and this aspect could be added to the passage to clarify the situation. In fact, I recommend that it should be added so students aren't confused and misled as David Shormann so obviously is.

## **Page 2**

### **Human/Chimp Genetic and Skull Homologies**

There is no error in the Virtual Lab just as Holt states. As Holt explains, the 30% genetic difference applies only to the male-specific region of the Y-chromosome, not the entire chimp and human genomes, which overall differ by less than 1%. The 30% difference in the MSY gene content is explained by rapid divergent evolution of this particular region. Although not elaborated upon, the divergence has taken place in the human MSY, not the chimp's, and the reason is the subject of scientific investigation. There is a large literature about this interesting phenomenon, including some popular news articles in the British press at <http://www.telegraph.co.uk/science/science-news/5360172/Men-on-road-to-extinction.html> and <http://www.dailymail.co.uk/sciencetech/article-1185056/This-WOMANS-world-Men-face-mass-extinction-male-genes-dying-out.html>. The New York Times has a more accurate article at <http://www.nytimes.com/2010/01/14/science/14gene.html>. The main paper is in Nature at <http://www.nature.com/nature/journal/v463/n7280/full/nature08700.html>.

David Shormann's claims that, "The human/chimp skull homology does not match the genetic homology" and "The similarities in human skulls with other hominids may be convergent evolution, but it is erroneous to pretend that common ancestry is the cause" are untrue and simply nonsensical. Only a Creationist/anti-evolutionist would make such claims. Common ancestry of humans and

apes as illustrated by homologous skeletal features has been well-understood and completely accepted by mainstream biology since the later nineteenth century. Thomas Henry Huxley was the first scientist to make this point in his "Evidence as to Man's Place in Nature" published in 1863. So the human/chimp skull homology does indeed fully match the genetic homology. In fact, Shormann is using a fact about a large difference in genes in a tiny region of the chromosomes to falsely and misleadingly extrapolate to a much larger and totally erroneous conclusion. This is not only unscientific, it is shameful sophistry.

The passage does not need to be changed. However, some discussion about the large evolutionary divergence of only the MSY in humans despite the overall great similarity (only 1% difference) in human and chimp genomes, could be added to clarify the presentation and perhaps pique the interest of some students.

### **Page 3**

#### **Whale Evolution and Fossil Succession**

David Shormann's objection is written in a sneering and mocking manner, totally alien to scientific practice. Four fossils is indeed a transition and a magnificent one at that. As Holt explains, "There is no scientific basis to the assertion that hundreds of intermediates would be required to establish a transition in the fossil record." Today we have several more intermediate forms. Please see the following pages for examples and discussion:

<http://darwiniana.org/landtosea.htm#Whales>

<http://darwiniana.org/whale1.gif>

<http://biologos.org/blog/evidences-for-evolution-part-2b-the-whales-tale>

[http://biologos.org/uploads/static-content/Figure\\_1.png](http://biologos.org/uploads/static-content/Figure_1.png)

[http://www.bio.miami.edu/dana/160/160S11\\_3.html](http://www.bio.miami.edu/dana/160/160S11_3.html)

[http://www.bio.miami.edu/dana/pix/whale\\_evolution.jpg](http://www.bio.miami.edu/dana/pix/whale_evolution.jpg)

[http://www.neoucom.edu/DEPTS/ANAT/Thewissen/whale\\_origins/index.html](http://www.neoucom.edu/DEPTS/ANAT/Thewissen/whale_origins/index.html)

<http://pigeonchess.files.wordpress.com/2008/04/whales-graph.jpg?w=426&h=825>

Of course *Pakicetus* was primarily a land-dwelling mammal. That's what the figure caption explains. As for Shormann's requirement that a full, complete skeleton is necessary to identify a fossil vertebrate, this is just nonsense. Most vertebrate skeletons paleontologists have discovered are incomplete. Completeness is not a requirement for excellent anatomical and evolutionary analysis and understanding. Comparative anatomy, the practice of inferring skeletal features from examining the partial skeletons of many different fossils, was established by Georges Cuvier and Richard Owen in the early nineteenth century.

Absolutely nothing needs to be changed in the Holt McDougal text, but some additional discussion could be added to clarify the evidence about how paleontologists can infer features and make evolutionary comparisons using incomplete fossil material by using the well-established 200-year old practice of comparative anatomy. Also, if it could be easily done, I would add the new fossils to the whale sequence making the transition 6- or 7-fossils long, although this isn't absolutely necessary.

## Page 4

### **Congruence of Genetic and Anatomical Phylogenies**

The two "errors" identified by David Shormann here are similar and I will discuss them together. Holt's responses are perfectly scientifically accurate. It is a fact that "some species are more genetically similar than others" and "these comparisons, like those in anatomy, are evidence of heredity relationships among the species." Figure 10 shows that "the relative amount of [genetic] difference is consistent with hypotheses based on fossils and anatomy." This is not only good science, it is wonderful science. The study of molecular phylogenies and systematics based on DNA sequences has revolutionized modern biology's understanding of the evolutionary relationships of many species, lineages, and clades of organisms. One of the planet's foremost scientific investigators of these relationships is molecular systematist Professor David Hillis of UT Austin. Please phone him (512-471-5792 and 512-471-5661) and ask him to evaluate this page. He will be happy to help.

It is true that molecular phylogenies and anatomical phylogenies are sometimes not congruent, but this is far less common than the opposite case of finding good congruence. When patterns or phylogenies differ, it is the responsibility of the scientist to determine why and explain it. Reasons include very strong convergent evolution, evolution into very narrow niches, selection for specific adaptations, and so forth that tend to mask taxonomic relationships based on traditional morphology. This is what Holt is referring to when it says "incongruencies can be accounted for by factors consistent with evolutionary dynamics." I would have no objection to including an example of one of these incongruent situations in addition to explaining to students that the overwhelming situation is excellent congruence between molecular and anatomical patterns (and fossil patterns when fossils are involved). This would be a case of the exception proving the rule.

Shormann's suggested rewording is scientifically inaccurate: "These comparisons may suggest patterns of descent inconsistent with expectations based on comparative anatomy." The change he suggests is an attempt to confuse and mislead students by weakening the correct scientific conclusion about the ability of evolution to explain patterns visible in organisms. In fact, such comparisons suggests great confidence in evolution by finding molecular patterns of descent consistent—not inconsistent—with expectations based on comparative anatomy. As noted above there are sometimes exceptions that result from other factors, but these in no way are the common case that should be suggested to students.

## Page 5

### **Similarity of both Anatomical and Molecular Features Documents the Common Descent of Organisms**

Once again David Shormann's criticisms are misplaced. The degree of similarity in proteins, amino acids, DNA sequences, and other molecular data between two species is proportional to the degree of evolutionary relationship, that is, to the length of time that has passed since the two species shared a common ancestor. This description is totally accepted by modern mainstream molecular systematic biologists and does not need to be changed.

What you would not want to do is change the wording of the text to what David Shormann suggests: "Yet modern biochemical phylogenies often contradict Darwin's anatomical phylogenies." This claim is untrue in several ways. First, molecular phylogenies are rarely or sometimes incongruent with anatomical phylogenies, not "often" contradictory as claimed. Usually such phylogenies match each other pretty well. Second, it is scientifically incorrect to personalize anatomical phylogenies with the word "Darwin's." Many, many scientists in addition to Darwin have constructed phylogenies based on anatomy and other phenotypic attributes. Today, in fact, it is most common to construct phylogenies (called cladograms or trees in this case) based on shared derived characters, not on evolutionary inferences, and Darwin did not originate this method. It is most common to compare trees based on molecular data with trees based on phenotypic data, not to construct evolutionary phylogenies (because such phylogenies contain extra evolutionary inferences that are not necessary to show relationships that can be easily tested). Systematists today most commonly identify common ancestors, not hypothesize direct lineages, within clades.

I suggest leaving the Holt passage unchanged and perhaps adding an example of an incongruency that can be explained by a special evolutionary process or event. The same example of this could be used for all three of the text passages discussed on pages 4-5 of the TEA document. I note, however, that examples of such topics are usually not covered in high school biology but await students in university biology classes on evolution and grad school. Discussing the details at this level may itself confuse students who often are not prepared to understand the details.

## **Page 6**

### **Similarities in Macromolecules and Phylogenies Based on Them**

David Shormann wants teachers to respond to the question, "Do phylogenies based on comparative anatomy and comparative biochemistry always agree with each other?" with a "No." This is true but the answer would be confusing and misleading to students, because most often such phylogenies do agree. Next he asks that convergent evolution be introduced and misleadingly implies in his suggested teachers' questions that it usually weakens "homologies as evidence of close common ancestry." While convergent evolution does sometimes have this effect, usually it is not a factor (because it affects some attribute other than the one whose molecular sequence is under investigation for phylogeny construction). Also, most such studies focus on species that exhibit no convergent evolution. Finally, there are many, many examples of homologies that illustrate common ancestry, most without convergence. Shormann's suggested teachers questions are suggested to have the effect of confusing and misleading students into thinking that the existence of convergent evolution makes it difficult to construct accurate and reliable phylogenies when usually this is not the case. The intent is to damage the evolution content in this audiovisual.

Shormann's last suggested question, "Do fewer transitional forms in the fossil record enhance or reduce the evidence for 'convergent evolution'?" with his suggested teacher's answer of, "They reduce it." This question and answer are incomprehensible and are apparently suggested to create the suggestion that phylogenies based on transitional fossils are unreliable due to the ubiquity of convergent evolution. First, convergent evolution is not ubiquitous. Second, the fossil record continues to provide more transitional forms, not fewer. Third, I can't see how transitional fossils of any amount enhance or reduce the evidence for convergent evolution. Convergent evolution is a well-established evolutionary process that occurs under certain circumstances, usually for the exploitation of a highly-desirable niche (such as flying organisms or a streamline shape for

swimming organisms). Transitional fossils are recognized by far more than similar shape due to convergent evolution; they typically have highly-derived homologous structures that are conserved over time as the rest of the body changes in a way that is adaptive for the convergent niche. The entire organism and its relatives need to be analyzed to construct a reliable and predictive phylogeny; transitional changes simply ascribed to "convergent evolution" are speculative and need further investigation.

Holt says the current text is correct and I agree. Again, I would suggest no changes in the text but if Holt agrees a single example of noncongruent molecular and anatomical phylogenies could be introduced to illustrate how other dynamic evolutionary processes can skew the results in uncommon circumstances. Such an example would have the beneficial effect of showing students that some investigation and critical thinking is necessary to solve some biological problem that involves evolution. The description and resolution of such a problem would have to be carefully explained in an audiovisual so the student is not confused or misled about the rigor of evolutionary explanations. Prof. David Hillis could provide a suitable example. Again, such a counter-example may be too complicated or advanced for a high school biology class for most students. This is a pedagogy problem that I am not qualified to address. It is important first to provide students with the evidence for the reality of evolution before going into details since the topic is often difficult and confusing. Notoriously, many high school biology teachers themselves have a poor understanding of how evolution works in nature and could inadvertently confuse students without intending to do so. We don't want state biology instructional materials to confuse students about any topic concerning evolution since that would provide anti-evolutionists with an unintended victory.

## **Conclusion**

In this analysis, it is clear that David Shormann—with his identification of bogus errors and faulty suggestions about how to correct them—is trying to confuse and mislead students about the accuracy and reliability of evolution as a natural process. Holt's original text was perfectly scientifically accurate and needs no revisions. The only possible acceptable changes would be to add a few sentences to clarify or explain topics with a little more detail. It is important for such additions to be positive and not confusing since students can be easily misled by poor presentation or pedagogy. That is why experienced scientists and science educators should be responsible for the content of these instructional materials, not anti-science reviewers or elected public officials.