The Coverage of Human Evolution in the High School Biology Textbooks of the 20th Century

By

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Abstract: Evidence that textbooks both catalyze and reflect cultural and educational controversies within communities is documented convincingly by the minimal coverage of evolution and, more specifically, human evolution in high school biology textbooks published prior to the 1960s when the NSF-funded Biological Sciences Curriculum Study (BSCS) developed three different textbooks that gave human evolution unprecedented emphasis. Increased emphasis then occurred in other biology textbooks. Antievolutionists responded with various and sometimes successful attempts to eliminate, weaken, or neutralize this increased emphasis, and as a result, word changes, deletions, and omissions in the textbooks of the 1970s and early 1980s weakened the coverage of both evolution and human evolution. Judicial decisions, increased involvement of scientists, science teachers, and professional organizations, and the emergence of state science education standards that emphasized evolution provided needed support to editors, publishers, educators, and policy-makers, and in the mid-1980s the textbook coverage of evolution and human evolution increased significantly. As a result, current biology textbooks tend to give human evolution comprehensive treatment. However, evidence that the teaching of evolution and human evolution is still being resisted and restricted is reflected in the failure of most state science education standards to include human evolution and the steady call of antievolutionists for textbooks and teachers to "teach the controversy" that surrounds evolution.

> The evidence for evolution abounds, within us, beneath us, crowning and surrounding us. (Angier 2007, p. 162)
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> Gunter Blobel (cell biologist at Rockefeller University and Nobel 6ylaureate): When it comes right down to it, you are not twenty or thirty or forty years old. You are 3.5 billion years old. Some people may say how terrible it is, this idea that we come from monkeys. Well it is worse than that…or better depending on your perspective. We come from cells from 3.5 billion years ago…It's continuous life, and continuous cell division, and we are all an extension of that continuity. (Angier 2007, p. 182)
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> The core of science is not controlled experiment or mathematical modeling; it is intellectual honesty. (Harris, 2006).

Introduction

Apple (1991, p. 2) claimed "that what counts as legitimate knowledge is the result of complex power relations and struggles among individuals, class, race, gender/sex, and religious groups" and that it is "naïve to think of the school curriculum as neutral knowledge."

The history of evolution education in the United States provides much legitimacy to Apple's claim. Overall, the goal to have evolutionary theory seen by the public as legitimate knowledge and deserving of an unfettered emphasis in the biology textbooks and classrooms of this nation has not been achieved despite the large body of knowledge and active scholarship that gives evolutionary theory legitimacy within the scientific community.

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The premise that the textbook is very important in shaping what is emphasized in classrooms is accepted widely. Thus, an analysis of biology textbooks provides important evidence of the nature of the curriculum and instruction at a particular time. Also, as claimed by Hurd (1961, p. 186), the influence of special interest groups on the biology curriculum can be assessed best by noting "the content of high school biology textbooks and curriculum for omissions and inclusion which, the research biologist could only view with suspicion."

Because of the textbook's centrality in shaping what is taught, the analysis of textbooks can provide a generally accurate portrayal of past curricula. On the basis of this premise, I have analyzed over 100 biology textbooks published during the 20th Century to determine the emphasis given to 44 evolution-related topics such as the evidences of evolution, the mechanisms of evolution, the process of evolution, the evolution of various groups of organisms, theories pertaining to evolution, and human evolution (Skoog, 1969, 1979, 2005).

The content analysis completed in 1969 focused on the following areas related to human evolution: 1) Statements that noted that humans wee the product of evolution and/or had an evolutionary history; 2) Human fossil record; 3) Uniqueness of humans; 4) Cultural evolution, and 5) Racial differentiation. These topics served as organizers as they were often emphasized in the textbooks analyzed in the 1969 study. However, during the last three decades the topics concerned with both biological evolution and human evolution changed and the discrete and general categories used in my original research became less useful.

I also tracked trends and differences in textbooks and described collectively the emphasis given to evolution by textbooks published during a specific decade. My analysis of textbooks published after 1990 was less detailed and thorough inasmuch as judicial decisions, involvement of the scientific community, and other factors weakened antievolutionist influences and, as a result, available textbooks tended to give evolution quite comprehensive coverage.

In my original research "word counts" were used as relative measures of the emphasis given to each topic. Counting the number of lines allocated to a specific topic and multiplying the result by the average number of words per line determined word count totals. This relative number was used to note trends and changes in the emphasis given a particular topic. For example, the coverage given to the life of Darwin in the 1974 and 1979 editions of a textbook was 1,373 and 296 words, respectively. The reduction in the word totals for this and many other topics plus significant word changes provided clear evidence to me that evolution was being deemphasized and pre-censored as the revision occurred. Generally, when a revised edition of a textbook had less emphasis on evolution than the previous edition, it was not the result of the new edition having fewer total pages or the addition of new or important topics that crowed out evolution. For example, in the successive editions of one textbook, which decreased the emphasis on evolution, the emphasis on the anatomy of the frog, grasshopper, and other organisms was increased. Space obviously was not the problem.

The placement of content concerned with evolution within a textbook and the use of the word evolution were used as evidence that evolution was being deemphasized or "hidden." Some examples follow:

- The 1933 edition of *Dynamic Biology* by Baker and Mills, which was the most widely used textbook in the 1930s, discussed evolution in the last chapter and did not use the word evolution in the text, glossary, or index, which was the same pattern present in the 1943, 1948, and 1953 editions.
- Only 3 of the 15 textbooks reviewed for the period 1940-49 used the term evolution in the index, glossary, and text. Ten of the textbooks omitted or used the term infrequently.
- The word evolution did not appear anywhere in 7 of the 14 textbooks published in the 1950s. A1959 textbook used the word once despite using the word frequently in earlier editions.
- All 14 textbooks in the 1950s placed the content on evolution in one of the final chapters.

See the following table for more data.

Frequency of the Term Evolution in Secondary Biology Textbooks: 1900-1977

1900-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1977	Total	
5/8	7/14	8/15	7/15	6/14	16/17	10/10	59/93	Text
0/0*	1/10*	3/14*	4/15	7/14	6/8*	7/7*	28/69	Glossary
3/7*	4/14	5/14*	6/15	6/14	16/17	10/10	50/91	Index

This chart should be read as follows: Five of eight textbooks reviewed in the period 1900-1919 had the word evolution in the text.
*Several textbooks did not have an index or glossary.
Reference: Skoog, G. (1979). Topic of evolution in secondary school biology textbooks: 1900-1977, *Science Education* 63 (5): 621-640.

As shown in the preceding table, the word evolution appeared regularly in biology textbooks in the 1960s for the first time in the 20th Century.

Coverage of Evolution and Human Evolution in Biology Textbooks 1900-2006

The data and descriptions that follow provide an overview of the coverage given evolution and, more specifically, human evolution in high school biology textbooks during the period 1900-2006.

1900-1919

Two of the eight textbooks analyzed for this period stressed the validity of evolution. References to creation or creationism were very rare in the biology textbooks analyzed for this study. However, Atwood (1914, p. 306-307) in attesting to the validity of evolution rejected the "doctrine of Creation" as follows:

> There is a very good reason for believing, however, that the doctrine of Creation, as it has come to be called, is not tenable. Practically all modern biologists believe that the species of animals and plants now on earth have not always been here in their present form, but they have been transformed from other preexisting types . . . In the nature of things, direct evidence for such an hypothesis is not abundant, but the inferential evidence is overwhelming. .

None of the eight textbooks provided any emphasis on human evolution or the human fossil record. The term cultural evolution did not appear but there were brief accounts of how humans had changed culturally. Some insight into the social thought of this period was reflected by emphasis many authors gave eugenics. For example, Hodge and Dawson (1918, p. 344) concluded, "the heavy burden imposed upon society by the idiotic, imbecile, and insane, the paupers, alcoholics, and criminals is caused by mental and moral defect."

1920-1929

Each of the fourteen textbooks analyzed for this period had some emphasis on evolution. Two authors attested to the widespread acceptance of evolutionary theory. Atwood (1922, p. 353-354) declared:

> The mass of evidence which we have outlined constitutes so complete a case that all well read biologists accept the doctrine of evolution as the explanation of how the life on the earth came to exist in its present form.

Trafton (1923, p. 580-581) also strongly supported the validity of the concept of evolution when he wrote:

> …gradually scientists began to accept the theory of evolution till today it is universally accepted by scientists as fact, and we rarely hear any arguments about it. The matter about which scientists now disagree is related to the question of how evolution takes place; but the fact of evolution no scientist doubts.

Statements attesting to the validity and importance of evolution as made by Atwood and Grafton were extremely uncommon prior to the 1960s.

Five of the fourteen textbooks had some content concerned with human evolution and the human fossil record. For example, the 1921 and 1926 editions of *Biology for Beginners* (Moon 1921, 1926, p. 321 & p. 359) stated:

> Very gradually, information accumulated, and the idea of relationship developed into the theory that not only man but all living things, both plant and animals are not only related, but actually descended from common ancestors. This is called the theory of descent, or evolution.

The 1921 edition of *Biology for Beginners* provided the basic organizational pattern that appeared throughout the 20th Century in successive editions of this textbook, which were titled *Modern Biology* starting in 1947. However, the directness that characterized the aforementioned statement regarding evolution was not present in many of the subsequent editions. For example, it was claimed that the 1921 edition of *Biology for Beginners* was based on the "fundamental ideas of evolution." The phrase "fundamental idea of development" was used in the 1926 edition.

Eleven of the fourteen textbooks emphasized the uniqueness of humans. Hunter (1926, p. 250) claimed "Man is the only creature that has moral and religious instincts" and " we know that man is separated by a wide gap from all other animals." Clement (1925 p. 117) also claimed humans were unique because their "capacity for spiritual development."

Cultural evolution was discussed in ten of the fourteen textbooks.

There was much emphasis in the textbooks of this period on natural selection's application to humans. Material on eugenics tended to follow. Concern was often voiced over the possibility that natural selection was no longer operating on humans and, as a result, the population of "defective" humans was increasing. Gruenberg (1925, p. 581) claimed

> By saving lives, or postponing death, civilization interferes with natural selection. Many people have feared that for this reason civilization must lead to complete degeneration of the race, until we become quite unfit to live.

Many of the textbooks suggested negative eugenic programs that would be characterized by stricter immigration laws and/or sterilization of the pauper, the mentally ill, the alcoholic, and the criminal.

Clement (1924, p. 452) cited a report of the National Conservation Commission, which suggested that the government would have to give bounties or prizes to couples that conformed to specified standards while forbidding marriage among paupers, criminals, and the feebleminded.

Most textbooks had discussions of the Jukes and the Kallikak families, who represented the unfit and became the cultural shorthand or stereotype for the

rural poor in America. In contrast, the success of the Edwards family, who represented the fit families, was touted.

Antievolutionist activity aimed at keeping evolutionary theory out of textbooks and classrooms surfaced in many states during this decade. The most well known of these activities was the anti-evolution law passed in Tennessee, which resulted in the following verdict in the 1925 Scopes Trial from Judge Raulston:

> Mr. Scopes, the jury has found you guilty under this indictment, charging you with having taught in the schools of Rhea county in violation of what is commonly known as the anti-evolution statute, which makes it unlawful for any teacher to teach in any of the public schools of the state . . . any theory that denies the story of the divine creation of man, and teach instead thereof that man has descended from a lower order of animals. (Rhea County History Society, 1978, p. 313)

The Scopes trial was preceded and followed by much legislative activity in the 1920s when thirty-seven bills were introduced in twenty states which proposed to make the teaching of evolution in the public schools illegal (Johnson, 1954). The bills became law in three states (Tennessee, Arkansas and Mississippi) but local regulations and crystallized public opinion brought about censoring of textbooks, dismissal of teaching, and restraints in teaching elsewhere. (Johnson, 1954). In 1924, the Governor of North Carolina successfully petitioned the state board of education to restrict the teaching of evolution, which resulted in the removal of two textbooks from the state approved list and a directive that teachers restrict the teaching of evolution (Wilhelm, 1978, p. 90). In 1925, the Governor of Texas orchestrated actions that resulted in material related to evolution being deleted from adopted biology textbooks and had the State Textbook Commission threaten teachers with dismissal if they taught evolution. The State Superintendent cooperated as he claimed, “the old time religion is good enough for me.” After the defeat of the 1926 antievolution bill in Louisiana, the State Superintendent of Education directed all parish superintendents to remove references to evolution in all high school biology classes (Wilhelm, 1978, p. 88). The Superintendent in Meridian, MS in response to the antievolution act passed in his state in 1926 organized a public bonfire to burn all the textbook pages that referred to evolution (Wilhelm, 1978, p. 89). The Superintendent of Schools in Cleveland, OH banned textbooks with evolution and proclaimed “No teenage pupils will be taught that they originated from Monkeys while I am in charge” (Wilhelm, 1978, p. 89-90).

<u>1930-1939</u>

Historian Howard K. Beal (1936, p. 279) observed that publishers were reluctant to admit that changes were being made in biology textbooks or to confess that special editions had been issued in antievolution regions. However, he noted that the number of biology textbooks that had appeared in the last ten years with no references to the evolution and the lack of the use of the word evolution were significant. The fifteen textbooks analyzed for this period reflected his observations, as their coverage of evolution was brief and non-controversial. Although the word evolution was not in the index, glossary, or text material of a

majority of these textbooks, only one failed to define or develop the concept of evolution. Smith (1938, p. 572) was more definite about the validity of evolution than most other authors as she concluded, “Evolution is a fact. Plants and animals do change and have been changing.”

Four of the fifteen textbooks mentioned human evolution. Typically, the discussions were brief and consisted of little more than 100 words. Smith’s (1938, p. 529) textbook, which was one of the four that provided brief, but clear, statements regarding human evolution, stated:

> All biologists agree that man, like other animals, arose not suddenly in his modern form, but by a gradual series of changes in some pre-existing primitive species, changes that have been going on through a period of from one to two million years.

Hunter’s two textbooks (1931, p. 275, 1935 p.275) noted that “Evidence in the forms of fossil bones and parts of skulls show that man has been changing during these many centuries” but that did not mean that “man has descended from an ape.” Two textbooks by Hunter (1931,275) p. 276; 1935, p. 276) claimed “If we follow the early history of man upon the earth, we must find that at first he must have been little better than one of the higher vertebrates.”

Six textbooks had brief discussions of the human fossil record. The existence of the Java, Peking, Heidelberg, Piltdown, and Cro-Magnon fossils was noted by Smallwood et al. (1934, 1937). Moon and Mann had a similar discussion of these fossils in their 1938 textbook, but not the 1933 edition.

Six textbooks emphasized the racial differentiation of humans. Using a chart, Moon and Mann (1938, p. 544) classified humans by race and place of origin, characteristics, and culture. For the Ethiopian or Negroid culture the chart stated “Ethiopian savages represent low human types; some are cannibals; homes, weapons, and implements most primitive.” In contrast, Caucasians had developed the “highest modern civilizations” in nations where “Nordic, Alpine, and Mediterranean races predominate.” Peabody and Hunt (1933 p. 290) claimed “The North American Indians represent a somewhat higher stage of civilization than the Eskimo, at least since they came under the influence of European colonists.”

The cultural evolution of humans was discussed in ten of the fifteen textbooks. Three textbooks, which failed to include any material on human evolution or the human fossil record, had material on cultural evolution.

As in the 1920s, many authors were concerned that human beings were interfering with the process of natural selection and, as a result, human beings who were unfit were surviving and producing more of their kind and there was a need for negative methods of control such as immigration laws, sterilization, and institutionalization of “defectives” to prevent the “propagation” of unfit human beings. Peabody and Hunt (1933, p. 262) noted that humans were “slowly

learning that any permanent improvement of the human race can come only as a result of better heritage." Smallwood et al. (1937, p. 395) claimed that "general ability and a tendency to industry and thrift" could be inherited and the benefactors of such traits

> should strive to keep them unimpaired and to strengthen them, so that we may pass them on to our children, in order that the next generation shall possess men and women who will be able to advance human progress beyond our best effort.

Many of the textbooks continued to use the Kallikak and Jukes families to support the need for eugenics. Smith (1938, p. 494-497) was skeptical of programs aimed at improving humans by "breeding from best families" and reducing the number of children in less fortunate families. The growing body of knowledge that explained how hereditary and environmental factors influenced human development informed her argument.

It's interesting to contrast the language and coverage given to eugenics with that of evolution. The science supporting eugenics was shallow and being refuted by the scientific community. Yet, the textbooks made claims that must have been unsettling to many students and citizens. In contrast, evidence supporting evolutionary theory and that of human evolution was increasing. However, the emphasis given to evolution was brief and the language cautious.

1940-1949

The fifteen textbooks analyzed from this period gave greater emphasis to evolution than those published during the period 1900-1939. The three textbooks with the greatest coverage of evolution were published prior to 1945. The word evolution failed to appear in the text, index, or glossary of seven of the fifteen textbooks. All fifteen textbooks defined or explained the concept of evolution. The directness of these definitions and descriptions varied. Vance and Miller (1946, p. 471) noted "life must have descended through the ages from preexisting life and must have changed from time to time as it did so." These authors (1946, p. 580) also concluded "all reputable biologists have agreed that the evolution of life on the earth is an established fact." As in 1938, Smith (1943, p. 345; 1949, p. 488) emphasized that the truth of evolution was established by several facts whereas no facts existed which could disprove it. She also stated in the 1943 edition (p. 545) "Modern biologists accept evolution as proved."

The human fossil record was discussed in nine of the fifteen textbooks, but the degree of emphasis varied. Moon, Mann, and Otto (1941, 1947) decreased its coverage of this topic from 700 words in the 1941 edition to 50 words in the 1947 edition. Hunter (1941) covered the human fossil record in nearly 1100 words in his 1941 edition, but Hunter and Hunter (1949) used 235 words on the same topic. Smith also reduced the total of words on this topic from 1943 to 1949. Typically, these discussions centered on the characteristics of the Java, Peking, Piltdown, Neanderthal, and Cro-Magnon fossil remains.

Four textbooks had statements that noted directly that humans resulted from an evolutionary process. Gruenberg and Bingham (1944, p. 515) provided the most comprehensive coverage as they noted similarities in the life functions, biochemical phenomena, genetic composition, and other resemblances between humans and other animals and concluded that humans were a product of the same forces that had shaped other species. Vance and Miller (1946, p. 589) after summarizing the concept of evolution stated "Mankind has been no exception to this law of change." Smith (1943, p. 537; 1949, p. 485) was also definite in stating that "man himself did not appear suddenly on the earth in his present form, but has gradually developed from a much more primitive species." Hunter (1941, p. 527) claimed that humans had become "master of the world" and did not need to be "concerned over his origin." However, he (1941, p. 525) stated cryptically "We have some evidence that man originated in the Far East, perhaps in the 'Garden of Eden'."

The textbooks of this period gave considerable emphasis to the uniqueness of humans as human intelligence and our ability to modify the environment were cited as reasons that made humans unique and superior to other animals.

Cultural evolution was discussed in seven of textbooks but no discussion exceeded 550 words in length.

The racial differentiation of humans continued to be included in some textbooks. As in 1938, Moon and Mann (1941, p. 544) exemplified the Caucasian as having the highest civilization and the Ethiopians as the savages of the low human type. Smith (1949, pp. 96-106) provided a comprehensive discussion of the topic that totaled nearly 6,500 words. After comparing physical characteristics (hair, shape of the head, skin color, stature, etc.) and addressing the question of whether one race was superior over another, she concluded the evidence was inconclusive.

Material on eugenics was less frequent and less onerous than in the previous decade, but still was present in some textbooks. Gruenberg and Bingham (1944, p. 555) in applying the concept of the "survival of the fittest" to humans stated:

> The doctrine that "nature selects" the fittest by forcing all living beings to "struggle for existence" against great odds appeared to justify intensive competition as a means of ensuring "justice" and "progress." Competition results in justice because it enables the "fittest" to get ahead of the others. It makes for "progress" because it forces the less able out.

Among the questions posed by Gruenberg and Bingham (1944, p. 592) were:

- Why do most of the children of poor families remain poor?
- Are all the criminals in your community alike in color of hair? In nationality? In religious beliefs? in political beliefs? in status?
- How do marriage laws in you state make for race improvement? How can the good qualities in your population be preserved?
- What would be the result if we removed the constant restraints of civilized life and returned to natural selection? What classes of people

would suffer the most? What would be the advantages of such return? The disadvantages?

Despite some increases and changes in content, many of the textbooks in the 1940s were identical with their predecessor editions in their treatment of evolution and human evolution.

1950-1959

Oscar Riddle, who provided the impetus for the formation of the National Association of Biology Teachers, provided a fitting description of the treatment evolution received in the textbooks of the 1950s when he stated

> Since the anti-evolution laws and the Scopes trial of the twenties, all born of religious fervor, the high school textbook will omit, disguise, or soften the word, evolution, and the informed teacher will well know that he walks on eggs when that word is mentioned (Riddle, 1959 p. 182).

The emphasis on evolution in high school biology textbooks of this period was outdated and sparse. As a result, the emphasis given to evolution, as well as human evolution, decreased during the decade and reversed the trend by publishers to gradually increase the emphasis on evolution decade by decade.

In part, the inadequate and outdated coverage of evolution in these textbooks reflected the failure of publishers to revise their textbooks from edition to edition as many of the fifteen textbooks analyzed for this period had new copyright dates, but were very similar to their earlier editions. For example, the 1953 textbook by Curtis et al. covered evolution in the same manner as the 1940, 1943, and 1946 editions and only slightly different than the 1933 edition. The content concerned with evolution was identical in the 1943, 1948, and 1953 textbooks by Baker and Mills and only slightly different than their 1933 edition. Their 1959 edition had basically the same coverage of evolution as the 1953 edition. Thus, there was minimal change in the five editions published during a 26-year span. The 1951 and 1956 editions of *Modern Biology* were only slightly different than the 1947 edition and had the same basic organization and content concerned with evolution as in the 1941 edition.

Despite this high degree of stability in the textbooks of this period, changes were made that resulted in less emphasis on evolution as certain topics were shortened or abbreviated. The word evolution was not used in the text, glossary, or index of seven of the fourteen textbooks. Smith (1959) used the word evolution only once even though the word had been used liberally in her earlier editions. Some authors substituted for evolution expressions such as progressive development, racial development, or change. The unit or chapter on evolution was typically at or near the end of these textbooks.

Direct statements concerning the evolution of humans were found in three of the fourteen textbooks. However, the evidence presented for human evolution by four of these textbooks would not necessarily have been interpreted as support for the

premise that humans had evolved. Overall, eight textbooks either lacked material on both the evolution of humans and the human fossil record or the material was so limited, it was insignificant.

The human fossil record received varying emphasis in seven textbooks. *Exploring Biology* (Smith, 1954, 1959) reflected this varying emphasis as the 1954 edition had 1450 words on the topic whereas the 1959 edition had none. The Java, Peking, and Cro-Magnon men were discussed in six of the fourteen textbooks. The Piltdown man, which was declared a hoax in the early 1950s, was discussed briefly in three textbooks. Two of these textbooks noted the evidence provided by the Piltdown remains appeared incongruent with other established facts.

Material on cultural evolution appeared in five of the textbooks. Material concerned with cultural evolution in two different textbooks was eliminated when the two textbooks were revised in the 1950s.

The differentiation of races was emphasized in seven of the fourteen textbooks. Smith (1954, p. 496) after a lengthy analysis of the evidence for the superiority of any given race concluded "Differences in the way people live in different parts of the world today are due largely to differences in their learned ways, not to racial differences." Smith (1959) reduced the emphasis on racial differences and no longer posed the question of whether there was a superior race.

Authors during this and previous decades, who delineated human races through the use of discrete characteristics, failed to recognize that genetic traits are distributed independently among a population. The pseudoscience that formed the basis for the classification of races present in a small number of textbooks had the potential to leave students misinformed and racism unquestioned. Ironically, many of these authors at the same time were withholding evidence that supported evolutionary theory as well as the evolution of humans.

Discussion of eugenics continued to be present, primarily in textbooks that had not been thoroughly revised for a number of years. *Elements of Biology* (Dodge, et al. 1952) still discussed the Jukes, Kallikak, and Edwards families while advocating a firm eugenics program. This textbook (Dodge, et al. 1952, p. 386) still claimed, "general ability and a tendency to industry and thrift are qualities that can be inherited." Some authors cited the importance of improving the environment to enhance the human condition.

Moon (1951, p. 650) continued to use the Kallikaks as a case study and claimed "low-grade heredity was prominent in both the Jukes and Kallikak families." This statement was followed by this series of questions:

> What, do you suppose, was the environment of these families? What chance would a normal child have had in the sort of homes feeble-minded parents would provide? While feeble-mindedness cannot be corrected, children with

> normal inheritance may sink to become worthless individuals if they are forced to tolerate the squalor of the homes of these social outcasts.

1960-1969

Only sixteen of 66 reviewed textbooks published during the period 1900-1959 had direct statements that would lead a reader to the conclusion that humans had evolved. Twenty-seven of the 66 textbooks had some emphasis on the human fossil record. The emphasis on human evolution changed in the 1960s as a new era in biology education as well as in evolution education emerged. Nationally there was growing dissatisfaction with the status of biology education and as well as all of K-12 science education. As a result, the National Science Foundation supported a variety of curriculum development projects, which included that of the Biological Sciences Curriculum Study (BSCS). These projects brought scientists, science educators, and teachers together to develop new curriculum materials. Reflecting the diversity of the team, BSCS conceptualized three versions of high school biology textbooks. Nine themes were identified that could be used to provide a sense of unity within and across the three textbooks. The first theme identified was "Change of living things through time: evolution," which was later reworded as "Evolution: patterns and products of change." The three textbook versions that emerged gave evolution unprecedented emphasis. As the BSCS textbooks became more widely used, competing published responded by increasing the emphasis on evolution in their textbooks. As a result, more was written on the topics concerned with evolution in the 17 reviewed textbooks published in the 1960s than in the 66 reviewed textbooks published from 1900-1959 (Skoog 1969, 1979).

Prior to the 1960s, statements regarding the status and validity of evolutionary theory were often evasive or non-existent. The BSCS textbooks shattered this tradition. The 1961 edition of *Green Version* (BSCS 1961b, p. 558) asserted that the theory of evolution was as basic to biology as the molecular theory is to physics. The 1961 *Blue Version* edition (BSCS 1963a, p. 29) stated that there was "no longer any reasonable doubt that evolution occurs" whereas the 1961 *Yellow Version* edition (BSCS 1961c, p. 4) described evolution as "once a hotly debated theory, now a well established concept." The 1961 and 1963 editions of *Yellow Version (BSCS 1961, p. 733, BSCS 1963b, p. 589)* credited evolution with being the "most inclusive of the great unifying principles of biology." The 1963 *Blue Version* edition asserted, "it is no longer possible to give a complete or even a coherent account of living things without the history of evolution" (BSCS 1963, p. 207). The 1968 editions of the three versions tended to describe evolution as theory rather than a concept.

Also, the word evolution now appeared regularly in biology textbooks. Only one textbook (Moon et al. 1960) failed to include the word evolution anywhere.

The introduction of the BSCS textbooks resulted in an unprecedented emphasis on human evolution and the use of definitive and direct language such as

- Biologists are convinced that the human species evolved from nonhuman forms of life (BSCS 1963b p. 411).
- On a time scale that is measured in millions of years, descendents of these fish-like descendents came out on land. Through a series of changes, so slight as to be unnoticeable in even a thousand years, some of these animals eventually became man (BSCS 1961c, p.4).
- A century after Darwin, the natural, or scientific answer seems clear. Man has evolved (BSCS 1973b, p. 787)

All seventeen textbooks reviewed had material on the human fossil record. Most textbooks also discussed the evolution of humans from primates and noted that humans had not evolved from apes, but shared an ancestor.

Fifteen of the textbooks discussed the differentiation of human races and tended to explain the differences in characteristics in terms of adaptations for specific environmental conditions. Authors usually noted that the evidence for presence of one superior race among humans was nonexistent.

Material on cultural evolution was included in twelve of the seventeen textbooks. The three BSCS Yellow Version editions provided the most extensive treatment whereas cultural evolution received no emphasis in the 1968 BSCS Blue and Green Versions.

The widespread adoption of 2.25 million copies of the 1963 BSCS textbooks in five years influenced the decisions of other publishers and catalyzed additional changes in biology education and textbooks. As a result, there was a growing presence in nation's classrooms of textbooks that gave evolution unprecedented emphasis, which prompted varied responses by antievolutionists in large textbook adoption states such as Texas and California. In 1964, Reul Lemmons, head of the Firm Foundation Publishing Company in Austin, who asserted that the BSCS textbooks made the "most vicious attack we have ever seen on the Christian religion," led a campaign to prevent the Texas adoption of the three BSCS textbooks (Wilhelm, 1978, p. 100). As a result of his and other activity during the 1964 textbook adoption proceedings in Texas, the Texas Textbook Commission received 1408 communications regarding the biology textbooks being adopted, which included the three BSCS versions. The BSCS textbooks were the target of objection by 844 and the support of 114 of the letter writers. Each publisher was required to respond in writing to each of the objections, which was a major task. Eventually, the three BSCS textbooks were adopted with the requirement that the word "fact" be changed to "theory" in reference to evolution (Wilhelm 1978, pp. 102-104).

The textbook adoption process in Texas traditionally has provided an important venue for antievolutionists to influence textbook decisions. In 1974 the following rule was adopted in Texas:

> Textbooks presented for adoption which treat the subject of evolution substantially in explaining the historical origins of humankind shall be edited, if necessary, to clarify the treatment is theoretical, rather than factually verifiable. Furthermore, each textbook must carry a statement on an introductory page that any material on evolution included in the book is clearly presented as theory rather than fact.
>
> The presentation of the theory of evolution should be done in a manner which is not detrimental to other theories of origin. (Texas Administrative Code, Title 19, Chapter 81, Subchapter D. State Textbook Program)

This rule was dropped by the SBOE in April 1984 after the Texas Attorney General ruled it unconstitutional. This ruling created a less threatening policy atmosphere for textbook publishers in Texas. However, the thinking that supported the rule in 1974 has continued to be pervasive and influential.

In the early 1960s, the California State Board of Education was pressured unsuccessfully to mandate that the Genesis account of creation by giving equal time in science classrooms and textbooks with evolution. In the early 1970s, a lengthy procedure in the state resulted in the Attorney General ruling as unconstitutional an equal time mandate for scientific creationism that had been approved by the State Board of Education.

Nationwide 22 bills mandating equal time for either creationism or scientific creationism were introduced in state legislatures between 1964 and 1978 (Wilhelm, 1978). In 1979-1980, similar bills were introduced in at least eleven states (Skoog, 1980). Laws passed and declared unconstitutional included mandates for equal time for evolution and the Genesis account of creation in Tennessee (Daniel v. Waters, 515 F. 2485, 489) in1973, equal time for creationism in Arkansas (McLean v. Arkansas Board of Education. 529 F. Supp. 1255) in 1981 and equal time for scientific creationism in Louisiana (Edward v. Aguillard. 482 U.S. 96) in 1987. These judicial rulings stalled the push for those who wanted to neutralize the teaching of evolution with some form of creationism. However, the anti-evolution sentiment stirred up by the controversy had its impact on the coverage of evolution in biology textbooks during the 1970s and 1980s.

Changing Emphases on Evolution in the 1970s and 1980s

The unprecedented emphasis given to evolution and human evolution in the 1960s and early 1970s was partially negated as publishers became more cautious and restrictive. This caution was exemplified by *Experiences in Biology* (Bauer et al 1981), which had no chapter on evolution and never used the word evolution even though some material concerned with evolution and natural selection was diffused throughout the textbook. Eugene Frank, Laidlaw publisher, admitted “You’re not going to find the word ‘evolution’ in this textbook” and stated “The reason for self-censorship is to avoid the publicity that would be involved in a controversy over a textbook. We’d like to sell thousands

of copies." (People for the American Way, 1983) In a one-day conference on the emphasis of evolution in textbooks sponsored by the National Academy of Science in 1983, which I attended, Frank admitted he made a mistake as he thought there was a market for textbook without evolution.

Two textbooks (Hanson et al. 1980; Creager et al. 1981) did not include evolution in their glossaries.

Word deletions and changes were common as textbooks were revised in the 1970s and early 1980s. Changes in *Biology* (Smallwood & Green 1968, 1974, 1977, 1981) were drastic as topics concerned with evolution were either eliminated or reduced. As a result, the chapters dealing with evolution made up 13.5%, 10%, 4.4%, and 2.6% of the total pages in the 1968, 1974, 1977, and 1981 editions, respectively. The human fossil record, which received comprehensive coverage in the 1968 and 1977 editions, was reduced significantly in 1981. Word changes that impacted the integrity of the coverage of human evolution also occurred. For example, the 1974 edition of this textbook stated "*A. Africanus* evolved" (p. 281) whereas the 1977 edition asserted "*A. Africanus* could have evolved" (p. 281).

The following series of statements reflect how one passage in *Modern Biology* (Otto & Towle 1969, 1973, 1977) was "softened" through two revisions.

- Likewise, modern man has probably evolved from primitive, more generalized ancestors (1969, p. 551).
- Likewise, it is hypothesized that modern man has probably evolved from primitive, more generalized ancestors (1973, p. 623).
- Darwin was suggesting that humans may also have evolved from less specialized ancestors (1977, p. 516).

The BSCS textbooks were not immune to changes that weakened the coverage of evolution. For example, the following statements were edited out of *BSCS Blue Version* textbooks:

- Man is the most outstanding product of evolution" (*BSCS Blue Version* 1968, p. 657). (not present in the 1973 edition)
- Biologists are convinced that human species evolved from nonhuman forms of life. (*BSCS Blue Version* 1963a, p. 411). (not present in the 1968 and 1973 editions)
- To biologists there is no longer any doubt that evolution occurs. (*BSCS Blue Version* 1963a, p. 29). (not present in the 1968 edition)

Despite some changes, BSCS textbooks continued to provide unprecedented emphasis to evolution overall and human evolution specifically in the 1970s and 1980s.

The climate influencing publishers and policy-makers in the early 1980s was exemplified by the protests filed in 1982 by the Gablers against textbooks being

considered for adoption in Texas. Their documents totaled 600 typewritten pages, weighed 19 pounds, and specified 2,151 objections to content in 45 textbooks. The transcripts of the Gablers' testimony during the textbook adoption hearings covered 110 pages of the 364 pages of testimony provided by all witnesses (People for the American Way, 1983). Rules at that time didn't allow individuals to identify strengths of a textbook and speak to support its inclusion on the list of approved textbooks. This rule was eventually changed

The erosion in the textbook coverage of evolution was reversed in the late1980s when a science editor of *Modern Biology* conceptualized a biology textbook that opened with material on evolutionary theory and gave solid treatment to the topic throughout the textbook. The action of this editor along with other factors emboldened other publishers to do likewise. Also, the guidelines for the 1990 adoption of biology textbooks in Texas included evolution for the first time since the 1960s. Antievolutionist options for eliminating or neutralizing the teaching of evolution were also narrowing due to judicial ruling and legislative failures that kept equal time mandates for creationism out of the classroom and textbooks. Also, scientists, science teachers, and various organizations became more active and successful in challenging antievolutionist initiatives.

1990-2007

Due to consolidation of publishing firms and other business-related factors, the number of high school biology textbooks became much smaller than in earlier decades. The increase in the quality and emphasis given to evolution in non-BSCS textbooks in the late 1980s and 1990s "leveled off" the major differences in the coverage of evolution among the textbooks. The biology textbooks published during this period varied in the amount of emphasis given to human evolution. However, all recognized that humans had evolved and provided coverage that was straightforward. Some passages from representative textbooks follow.

Miller and Levine (1991, p. 757), authors of a widely used biology textbook, noted that despite some differences in the interpretations of the data concerned with "our species" past, researchers agree on the following:

> We know, for example, that humans evolved from common ancestors we share with other living primates such as chimpanzees and apes. Our species almost certainly evolved in Africa and then spread around the world. We know that the first *Homo Sapiens* appeared about 500,000 years ago, practically the day before yesterday on an evolutionary time scale.

Strauss and Lisowski (1998, p. 281) emphasized that humans did not evolve from apes but that orangutans, gorillas, chimpanzees, and humans were "thought to have evolved from a common ancestor between 8 and 5 million years ago" and that their relationship is evidenced by biochemical analysis. The authors also noted that the term race had been misused and that all human belong to *Homo sapiens.*

Biggs et al. (2000) concluded "gibbons were probably the first apes to evolve followed by the orangutans" and then "the African apes, chimpanzees, and gorillas" (p. 35). The authors then noted "Some anthropologists suggest that one of the groups of African apes was the ancestor of modern humans" (p. 435).

A sampling of the important concepts related to human evolution in the 2006 BSCS Blue Version textbook follows:

- Classification focuses on structures that indicate *a related evolutionary ancestry* (p. 466).
- Cladists assume that each group has an ancestor that other species do not share. For example, all mammal species have milk glands, but no other organisms do. Therefore, all mammals must be descended from a species that has no other living descendants (p. 474).
- …there is no basic difference between our evolution and the evolution of other species (p. 519).
- Humans are a distinct species, but they differ from other primates by *degree* rather than special characteristics. Humans are particularly closely related to chimpanzees and gorillas, as shown by a variety of lines of evidence (p. 523).
- Comparisons of DNA and other protein sequences indicate that chimpanzees are the closet relatives to humans (p. 527).
-

A sampling of the important concepts related to evolutionary theory in the 2006 edition of *Green Version* (BSCS 2006b) is provided by the following:

- How did today's species come to be? Evolution, change through time (genetic change through time), is the biological process that links all species, no matter how they differ (p. 233)
- Darwin's theory of evolution by natural selection has been supported by the findings of thousands of other biologists (p. 241).
- Ultimately, it is possible that all of today's species came from our ancestral species (p. 280).
- Animals show evidence for a common evolutionary origin (p. 387).
- No one can examine a large collection of fossils without being impressed by the evidence of change (p. 597).
- The fossil record shows that organisms in one geological period are descended from ancestral forms present in earlier periods, though not necessarily directly (p. 597).

BSCS Biology: A Human Approach (2006) presented evolution in the first unit with the first chapter titled The Human Animals. Chapter 2 began with a photograph of the fossil remains of Lucy and the statement:

> As you look further and further into the past, the skeletons of ancient organisms look less and les like organisms that are alive today. This is because populations of living organism change across time. In this chapter, you will begin to understand how living organisms change and why change is important to understanding the relationship between biological systems (p 35).

Students are presented information about the discovery of Lucy and then presented with an activity where they are to "think about how Lucy may have looked and behaved while she was alive, and you will begin to appreciate how much humans have changed across time" (p. 37). Among the prompts provided students are the following:

- Describe in your journal how Lucy may have looked.
- Try to describe how she may have communicated with family members and others living in her group.
- What evidence from the Lucy find could help scientists develop an explanation about the gap between modern humans and early nonhuman primates?
- Compare hominids from Lucy's lifetime to your own. Do you think there have been more changes in physical characteristics of the body (such as hands, feet, head, posture) or more changes in how hominids lived (types of shelter, ways of getting around, ways of gathering food?
- What aspects of your descriptions did you base on evidence? Which aspects of your descriptions were inferences related to evidence? Which aspects of your descriptions were guesses? (p. 37-38)

Later in the chapter students write a newspaper account that appears in 2034, which is the 175th anniversary of Darwin's book *On the Origin of Species*. This assignment requires students to answer several questions including "How does evolution take place?" and "Why are biologists so interested in it?" Later, students are asked to consider "What makes Darwin's theory any more convincing than a theory that you or I might suggest?" (p. 50-51)

Many other activities, graphics, and text material follow in this textbook's first unit that are designed to help students better understand evolutionary theory, characteristics which human share with other organisms, characteristics which are different, and how to use evidence, inference, and inquiry appropriately.

Summary

The emphasis on evolution and human evolution in the high school biology textbooks of the 20th Century fluctuated. None of the textbooks analyzed for the period 1900-1920 had any material on human evolution. During the period 1920-50, some of the textbooks had brief but straightforward coverage of human evolution whereas other textbooks had no coverage. Only 44 of the 83 textbooks analyzed for the period 1900-1968 had some emphasis on the human fossil record and only 29 or the 83 textbooks had language that stated directly that humans were a product of evolution. The three versions of the BSCS textbooks, which were first published in 1961, gave evolution, as well as human evolution, unprecedented emphasis. The widespread adoption of the BSCS textbooks in the 1960s influenced other publishers, who made editorial decisions that resulted in increased emphasis on evolution in all available textbooks. The presence of biology textbooks that

emphasized evolution energized antievolutionist activity, which diminished the emphasis given to evolution in textbooks published in the late 1970s and 1980s. In the late 1980s, the emphasis on evolution and human evolution increased and has persisted despite the continued efforts of special interest groups to minimize or neutralize the emphasis on evolutionary theory in the science curricula of the nation's schools.

State Science Education Standards

All states but Iowa currently have state science education standards. These standards link policy to practice and, as such, are becoming increasingly influential in regard to the content emphasized in textbooks and curricula. These standards also provide insight into what knowledge is seen as legitimate. Michigan and Pennsylvania are the only two states that have science education standards that focus on human evolution. Their standards are:

- Describe what biologists consider to be evidence for human evolutionary relationships to selected animal groups (Michigan State Department of Education 2000)
- Examine human history by describing the progression from early hominids to modern humans. (Pennsylvania Department of Education 2002).

Earlier versions of the state science education standards in Utah, Indiana, Illinois, and North Carolina had some emphasis on human evolution, which was removed in later revisions.

Discussion

Legitimate Knowledge

Apple's (1991, p. 2) assertion that "what counts as legitimate knowledge is the result of complex power relations and struggles" and that it is "naïve to think of the school curriculum as neutral knowledge" is reflected in the policy debates that have occurred historically as decisions on the content related to evolutionary theory in biology textbooks and the adoption and use of these textbooks in American schools. My research of the coverage of human evolution and other evolution-related topics in high school biology textbooks and state science education standards provides evidence that that the "politics of cultural control" have been and continue to influence the science curricula in this nation. State science education standards and science textbooks tend to be the focal points of opposition. However, rather than attempting to eliminate evolution or neutralize it with creationism and/or intelligent design, there are concerted efforts to influence how evolution is presented and taught. Thus, there are calls to "teach evolution as a theory, not a fact," "teach the controversy," and "teach the weaknesses." Allegations of censorship and arguments that "it's not fair to teach only one side of the issue" are also heard in various discussions where policy regarding science education standards are developed and science textbooks adopted.

Teach Evolution as a Theory

New Florida science education standards are in the review process and the proposed statement that evolution is "the fundamental concept underlying all of biology and is supported in multiple forms of scientific evidence" has been under attack by parents, school boards, and public school administrators. In particular, there has been a persistent call that evolution should be taught as theory instead of as fact. A member of the Board of Education in Jackson County Florida noted

> I felt we needed to take a stand for ourselves. What we were saying is that evolution is a theory, and a theory is an educated guess. Personally I don't believe I came from a lower life form; I was created by God (Spencer, 2008) **.**

According to Taleb (2007 p. 53), this board member's statement reflects naïve empiricism, which he described as a "tendency to look for instances that confirm out story and our vision of the world" which "are easy to find" and often used as "*evidence*" to corroborate our theories.

Also as reflected in this board member's statement, many advocates of this position are perpetuating a common misunderstanding of the nature of a scientific theory and the magnitude of evidence that underlies theories such as evolution.

Teach the Weaknesses of Evolution

Don McLeroy, chair of the Texas State Board of Education, joins many other critics who allege that existing biology textbooks "do not cover the weaknesses of evolution," and instead "present evolution as an absolute fact" (Brock, 2008). Thus, McLeroy and others argue that science education standards, textbooks, and science teachers should "teach the weaknesses" and/or "teach the controversy" regarding evolutionary theory. However, as stated in the National Academy of Sciences 2008 report *Science, Evolution, and Creationism*, there are questions about "*how* evolution occurs, not *whether* evolution occurs." This report also asserted that arguments "suggesting that there are fundamental weaknesses in the science of evolution are unwarranted based on the overwhelming evidence that supports the theory (p. 50)."

Teach Critical Thinking Skills

The strategy of "teaching the controversy" is often justified for use in teaching critical thinking. Critical thinking requires one to approach a question or problem with an open mind that is amenable to evidence and reason and with the acceptance of the possibility that existing viewpoints and conclusions may be modified or eliminated. Do advocates of intelligent design and/or creationism accept the possibility that when their central ideas as well as those of evolution are emphasized and critiqued that there is a possibility that student convictions regarding creationism, intelligent design, and evolution may be altered in an unexpected manner?

Fairness

Advocates for the inclusion of creationism and/or intelligent design often use "fairness" as a rationale for this action. Fairness is a seductive concept and

teachers like to be fair. The National Academy of Sciences 2008 report *Science, Evolution, and Creationism* responded to this argument by concluding that "evolution should be taught in science classes because it is the only tested, comprehensive scientific explanation for the nature of the biological world today that is supported by overwhelming evidence and widely accepted by the scientific community (p. 53)." In contrast, creationist and intelligent design tenets are not supported by evidence and not accepted by the scientific community. The National Science Teachers Association, the world's largest organization of science teachers, asserts that it is not fair to teach something in science that is false. Finally, it is difficult to define fairness operationally. If it's fair to introduce tenets of creationism in the science curriculum, is it fair to introduce satanic or Hindu versions of creation in the public school. Seemingly, it is fair to teach in science classes only those concepts and ideas that are useful in helping students understand the history and nature of the natural world and also help prepare them for citizens in a world where what is known about evolutionary relationships and the evolutionary history of humans informs medical and scientific research.

Censorship

The absence of creationist tenets in biology textbooks now and in the past is not the result of censorship as often alleged. The creationist tenets were the center of human thought as late as the 1800s and were emphasized in university science courses. A Natural Theology course, which emphasized creationists and intelligent design, was taught at most universities and often by the institution's president. However, new discoveries challenged creationist tenets about the age of the Earth and the history of the natural world, including humans. Thus, as these tenets lost their explanatory power, they moved outward from the center of human thought. When John Hopkins University was opened in 1876, the science courses were free of theological and Biblical tenets. Later, science courses at Harvard University were redesigned and creationist tenets were omitted. Then, as now, secondary school science courses were influenced by and reflected the nature of collegiate science courses. Thus, creationist tenets have not been included in high school biology textbooks. The lack of emphasis of creationist tenets in the K-12 science curriculum historically and presently is not the result of censorship, but a result of their consistent failure to provide a coherent and evidence-supported view of the nature and history of the natural world.

Textbook Adoptions

In South Carolina, the adoption of Prentice-Hall's textbook *Biology* was delayed because of protests concerning its treatment of evolution. The textbook was approved for adoption recently by the vote of 10 of the 16 members of the SBOE.

Several issues related to evolution education have emerged recently in Texas. The science director of the Texas Education Agency alleges that she was forced to resign because she was not being neutral in regard to evolutionary theory and creationism/intelligent design. Her resignation is of significance because a revised

set of the Texas Essential Knowledge and Skills (TEKS) in Science will be approved in 2008-2009 and set the requirements for the biology textbook that will be considered for adoption in 2009-2010 and used in the schools the following year. The Texas State Board of Education is responsible for approving the TEKS and making the final decision in regard to which biology textbooks are adopted. Currently, the Board is controlled by social conservations and the Board chair has publicly avowed his support for intelligent design. However, he indicates evolution should be a part of the science curriculum, but its alleged "weaknesses and strengths" should be analyzed.

The headquarters for the Institute for Creation Research (ICR) recently were moved from San Diego to Dallas. ICR has submitted an application to the Texas Higher Education Coordinating Board for a Masters Degree in Science Education. The proposed courses in this degree plan are embedded with creationist concepts. This proposal has been opposed in editorials by major Texas newspapers and the voices of many scientists and science educators in and outside of Texas. A decision on this application will be made in April.

Discussion

Each year *Science*, which is the official journal of the American Association for the Advancement of Science, names the "Breakthrough of the Year." The most recent breakthrough has to do with human genetic variation. In highlighting this breakthrough, Pennisi (2007, p. 1842) stated

> Less than a year ago, the big news was triangulating variation between us and our primate cousins to get a better handle on genetic changes along the evolutionary tree that led to humans. Now, we have moved from asking what in our DNA makes us human to striving to know what in my DNA make me me.

Pennisi noted that our knowledge of individual genomes offers great promise for improving health through personalized medicine.

At the end of each year *Science* also identifies areas to watch. Paleogenomics was identified as one of these areas as there is an expectation that a rough draft of the Neandertal genome will be completed in 2008 and comparisons of the genes of Neandertal and *Homo sapiens* will occur (Science, 2008).

In writing about the domain specificity of our reactions, Taleb (2007, p. 53) concluded

> We react to a piece of information not on its logical merit, but on the basis of which framework surrounds it, and how it registers with our socio-emotional system. Logical problems approached one way in the classroom might be treated differently in daily life. Indeed they are treated differently in daily life.

If Taleb is correct and the availability of copies of our individual genomes become readily available and personalized medicine becomes a reality, one has to expect those who have opposed the teaching of human evolution may readily accept medical advances that are informed by

knowledge of our evolutionary history and attributes of our individual genome. In the meantime, it seems evident that evolution is not seen as legitimate knowledge that has a rightful place in the textbooks and science classrooms of this nation.

References

Angier, N. 2007. *The Canon: A Whirligig Tour of the Beautiful Basics of Science*. Boston: Houghton Mifflin.

Apple, M. and Christian-Smith, L. 1991. *The Politics of the Textbook. New York:* Routledge, Chapman and Hall, Inc.

Apple, M. 2004. *Ideology and Curriculum*. New York: RoutledgeFalmer.

Atwood, W. 1922. *Civic and Economic Biology*. Philadelphia: P. Blakiston Sons and Co.

Baker, A. and L. Mills. 1933. *Dynamic Biology*. Chicago: Rand McNally.

Baker, A. and L. Mills. 1943,1948, 1953. *Dynamic Biology Today*. Chicago: Rand McNally.

Baker, A., L. Mills, and J. Tanczos. 1959. *Dynamic Biology Today*. Chicago: Rand McNally.

Bauer, P., M. Magnoli, A. Alvarez, D. Chang-Van Horn, and D. Gomes. 1981. *Experiences in Biology*. River Forest, IL: Laidlaw Publishers.

Beale, H. 1936. *Are American Teachers Free?* Report of the Commission on the Social Studies, Part III. Chicago: Charles Scribner's Sons.

Biggs, A., Gregg, K., Hagins, W., Kapicka, C., Lundgren, L, Rillero, P., & National Geographic Society. 2000. *Biology: The Dynamics of Life*. New York: Glencoe McGraw Hill.

Brock, K. 2008. Battle looms over evolution lessons, *Fort Worth Star-Telegram,* January 19, 2008.

BSCS. 1973a. *Biological Science: An Ecological Approach*. Chicago: Rand McNally.

BSCS. 1978. *Biological Science: An Ecological Approach*. Chicago: Rand McNally.

BSCS. 1982. *Biological Science: An Ecological Approach*. Boston: Houghton Mifflin.

BSCS. 1998. *BSCS Biology: An Ecological Approach*. Dubuque, IA: Kendall/Hunt Publishing Company.

BSCS. 1990. *Biological Science: A Molecular Approach*. Lexington, MA: D.C. Heath.

BSCS. 1996. *Biological Science: A Molecular Approach*. Lexington, MA: D.C. Heath.

BSCS. 1963a. *Biological Science: An Inquiry into Life*. Chicago: Harcourt, Brace and World.

BSCS.1968a. *Biological Science: An Inquiry into Life*. Chicago: Harcourt, Brace and World.

BSCS.1973b. *Biological Science: An Inquiry into Life*. Chicago: Harcourt, Brace and World.

BSCS.1980. *Biological Science: An Inquiry into Life*. Chicago: Harcourt, Brace and World, Chicago.
BSCS. 1963b. *Biological Sciences: Molecules to Man*. Boston: Houghton Mifflin Company.
BSCS. 1968b. *Biological Sciences: Molecules to Man*. Boston: Houghton Mifflin.
BSCS. 1973c. *Biological Sciences: Molecules to Man*. Boston: Houghton Mifflin.
BSCS. 2006. *BSCS Biology A Human Approach.* Dubuque: Kendall/Hunt
BSCS. 2006. *BSCS Biology A Molecular Approach*. Columbus, OH: Glencoe/McGraw Hill.
BSCS. 2006. *BSCS Biology An Ecological Approach*. Dubuque, IA: Kendall/Hunt.
BSCS. 1961a. *High School Biology, Blue Version*. Boulder: Biological Sciences Curriculum Study.
BSCS. 1963c. *High School Biology, BSCS Green Version*. Chicago: Rand McNally.
BSCS. 1961b. *High School Biology, Green Version*. Boulder: Biological Sciences Curriculum Study.
BSCS. 1961c. *High School Biology, Yellow Version*. Boulder: Biological Sciences Curriculum Study.
Clement, A. 1924, 1925. *Living Things*. Syracuse: Iroquois Publishing Co.
Creager, J., P. Jantzen, and J. Mariner. 1981, 1985. *Biology*. New York: Macmillan.
Curtis, F. D., O. W. Caldwell, and N. H. Sherman. 1934. *Biology for Today*. Chicago: Ginn.
Curtis, F. D., O. W. Caldwell, and N. H. Sherman. 1940, 1943, 1946, 1953. *Everyday Biology*. Chicago: Ginn.
Daniel v. Waters. 515 f.2d 485, 6th Cir., 1975.
Edward v. Aguillard, 482 US 96, 1987.
Gruenberg, B. 1925. *Biology and Human Life*. Boston: Ginn & Co.
Gruenberg, B. & Bingham, N. 1944. *Biology and Man*. Boston: Ginn & Co.
Hanson, E., Lockard, J. & Jensch, P. 1980. *Biology*. Boston: Houghton Mifflin.
Harris, S. 2006. *Letter to a Christian Nation.* New York: Alfred A. Knopf.
Hodge, C. & Dawson, J. 1918. *Civic Biology*. Boston: Ginn & Co.
Hunter, G., & Hunter, G.W. III. 1931. *Problems in Biology*. Boston: American Book Publisher.
Hunter, G. 1911. *Essentials of Biology Presented in Problems*. Boston: American Book Publisher
Hunter, G. 1926. *New Civic Biology*. Chicago: American Book Co.
Hunter, G. 1935. Problems in Biology. Chicago: American Book Co.
Hunter, G. 1941. *Life Science--A Social Biology*. Chicago: American Book Co.
Hunter, G. & Hunter, F. R. 1949. *Biology in Our Lives*. Chicago: American Book Co.
Hurd, P.D. 1961. *Biological Education in American Secondary Schools 1890-1960*. Washington, DC: American Institute of Biological Sciences.

Johnson, L. 1954. *The Evolution Controversy During the 1920's. Unpublished Doctoral Dissertation. New York: New York University.*
Miller, K. & Levine, J. 1991. *Biology*. Englewood Cliffs, NJ: Prentice Hall.
Michigan Department of Education. 2000. *The Michigan Curriculum Standards*. [On-line]. Available: http://www.michigan.gov/mde/0,1607,7-140-28753_38684_28760---,00.html
McLean v. Arkansas Board of Education. 529 F. Supp. 1255, 1982.
Moon, T. J. 1921, 1926, 1930. *Biology for Beginners* (October 1930 edition). New York: Henry Holt Company.
Moon, T. J., & Mann, P. B. 1938, 1941. *Biology*. New York: Henry Holt Company.
Moon, T. J., Mann, P. B. & Otto, J. H. 1947. *Modern Biology*. New York: Henry Holt Company.
Moon, T., P. Mann, and J. Otto, J. H. 1947, 1951, 1956. *Modern Biology*, Henry Holt , New York.
Muller, H. H. 1959. One hundred years without Darwinism are enough, *School Science and Mathematics*. **59**: 304-306, April.
National Academy of Sciences Institute of Medicine. 2008. *Science, Evolution, and Creationism*. Washington: The National Academies Press.
Otto, J. H. and A. Towle. 1969, 1973, 1977, 1981. *Modern Biology*. New York: Holt, Rinehart, and Winston.
Peabody, J. and Hunt, A. 1933. *Biology and Human Welfare*. New York: Macmillan Company.
Pennsylvania Department of Education. 2002. *Academic Standards for Science and Technology*, Harrisburg, PA. [Online]. Available: http://www.pde.state.pa.us/stateboard_ed/cwp/view.asp?Q=76716
People for the American Way. 1983. *As Texas Goes, So Goes the Nation: A Report on Textbook Selection in Texas*. Washington, DC: People for the American Way.
People for the American Way. 1983. "Scientific" Creationism is Boosted by Texas "Anti-Science" Rules. Washington, DC: People for the American Way
Rhea County Historical Society.1978. *The World's Most Famous Court Trial.* Dayton, TN: Rhea County Historical Society.
Riddle, O. 1959. The present content of biology in the secondary schools, *American Biology Teacher,* **21**:179-84, May 1959.
Skoog, G. 2005. The coverage of human evolution in high school biology textbooks in the 20th Century and in current state science standards, *Science and Education.* **14**(3-5): 395-422.
Skoog, G. 1984. The coverage of evolution in high school biology textbooks published in the 1980s, *Science Education*. **68**(20): 117-128.
Skoog, G. 1980. Legal issues involved in evolution vs. creationism, *Educational Leadership*. **30**(2): 154-156.
Skoog, G. 1992. The textbook controversy: issues, aspects and perspectives, in *The Textbook Controversy*, edited by J. Herlihy, 71-89, Norwood, NJ: Ablex Publishing.

Skoog, G. 1969. The Topic of Evolution in Secondary School Biology Textbooks, 1900-1968. Unpublished Doctoral Dissertation, University of Nebraska-Lincoln, Lincoln, NB.
Skoog, G. 1979. Topic of Evolution in Secondary School Biology Textbooks: 1900-1977, *Science Education*. **63**(5), 621-640.
Smallwood, W. and E. Green. 1968, 1974, 1977, 1981. *Biology*. Morristown, NJ: Silver Burdett.
Smallwood, W., I. Reveley, and G. Bailey. 1934, 1937. Chicago: *New Biology*. Allyn and Bacon.
Smith, E. T. 1938, 1943, 1949, 1954, 1959. *Exploring* Biology. New York: Harcourt, Brace and Co.
Spencer, A. 2008. Jackson County School Board opposes the teaching of evolution as fact, *Jackson County Floridian*. January 21.
Strauss, E. & Lisowski, M.1998. *Biology*: *The Web of Li*fe. Glenview, IL: Scott Foresman Addison Wesley.
Taleb, N. 2007. *The Black Swan*. New York: Random House.
Texas Administrative Code, Title 19, Chapter 81, Subchapter D. State Textbook Program
Trafton, G. 1923. *Biology of Home and Community*. New York: Macmillan.
Vance, B. B. & Miller, D. F. 1946. *Biology for You.* Chicago: J. B. Lippincott Company.
Wilhelm, R. 1978. A Chronology and Analysis of Regulatory Actions Relating to the teaching of Evolution in Public Schools. Ph.D. dissertation, University of Texas at Austin.

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