

An Analysis of the Treatment of the Scientific Controversy

over

Microevolution and Macroevolution

in

Biology Textbooks

currently being considered for adoption by the

Texas State Board of Education

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INTRODUCTION AND EXECUTIVE SUMMARY

The following analysis examines one important aspect of the treatment of Darwinian evolution in eleven biology textbooks currently being considered for adoption by the Texas State Board of Education. A central claim of Darwin's theory is that small-scale changes within existing species and gene pools (microevolution) can, if given enough time, produce the large-scale changes in living things (macroevolution) that have occurred in the course of Earth's history. This claim was controversial in Darwin's lifetime, and it continues to be controversial among scientists today. The following pages analyze eleven textbooks to determine whether they treat this controversy in a manner that is "free from factual errors" (Texas Education Code, § 31.023) and that enables students to "analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information." (TEKS §112.43c(3)A).

This analysis concludes that some of the textbooks contain factual errors in their coverage of this topic, while some others ignore it altogether. Even the textbooks that cover the topic fail to state frankly and fully the scientific reasons for questioning whether the processes of microevolution can account for macroevolution. Thus all eleven textbooks reviewed here fail, to varying degrees, to meet the Texas requirement for critical analysis. Unless students are taught about this continuing scientific controversy, they will not be equipped to critique evolutionary theory as to its strengths and weaknesses.

Study Methodology

The first few pages of the analysis contain background information (including references to recent peer-reviewed literature) regarding the scientific controversy over whether microevolution can account for macroevolution. Each textbook is then analyzed individually, beginning with the oldest, for its treatment of this controversy (or lack thereof). The evaluations of individual textbooks are followed by a summary table comparing the results, and an appendix containing suggested language for inclusion in biology textbooks.

This analysis was prepared by staff and fellows of the Center for Science and Culture in Seattle, WA. The Center is a project of Discovery Institute, a not-for-profit public policy organization. The Center for Science and Culture is committed to the accurate presentation of evidence and arguments for and against Darwinian evolution and its alternatives. Center Fellows include biologists, biochemists, physicists, mathematicians, philosophers and historians of science, and other scholars with Ph.D.s in their respective fields. Many of the Center's fellows also have affiliations with colleges and universities. For more information, please consult the Center's web site at <http://www.discovery.org>.

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The Scientific Controversy Over Whether Microevolution Can Account For Macroevolution

When Charles Darwin published *The Origin of Species* in 1859, it was already known that existing species can change over time. This is the basis of artificial breeding, which had been practiced for thousands of years. Darwin and his contemporaries were also familiar enough with the fossil record to know that major changes in living things had occurred over geological time. Darwin's theory was that a process analogous to artificial breeding also occurs in nature; he called that process natural selection. Darwin's theory was also that changes in existing species due primarily to natural selection could, if given enough time, produce the major changes we see in the fossil record.

After Darwin, the first phenomenon (changes within an existing species or gene pool) was named "microevolution." There is abundant evidence that changes can occur within existing species, both domestic and wild, so microevolution is uncontroversial. The second phenomenon (large-scale changes over geological time) was named "macroevolution," and Darwin's theory that the processes of the former can account for the latter was controversial right from the start. Many biologists during and after Darwin's lifetime have questioned whether the natural counterpart of domestic breeding could do what domestic breeding has never done -- namely, produce new species, organs, and body plans. In the first few decades of the twentieth century, skepticism over this aspect of evolution was so strong that Darwin's theory went into eclipse. (See Chapter 9 of Peter Bowler's *Evolution: The History of an Idea*, University of California Press, revised edition, 1989).

In the 1930s, "neo-Darwinists" proposed that genetic mutations (of which Darwin was unaware) could solve the problem. Although the vast majority of mutations are harmful (and thus cannot be favored by natural selection), in rare instances one may benefit an organism. For example, genetic mutations account for some cases of antibiotic resistance in bacteria; if an organism is in the presence of the antibiotic, such a mutation is beneficial. All known beneficial mutations, however, affect only an organism's biochemistry; Darwinian evolution requires large-scale changes in morphology, or anatomy. Midway through the twentieth century, some Darwinian geneticists suggested that occasional "macromutations" might produce the large-scale morphological changes needed by Darwin's theory. Unfortunately, all known morphological mutations are harmful, and the larger their effects the more harmful they are. Scientific critics of macromutations took to calling this the "hopeful monster" hypothesis. (See Chapter 12 of Bowler's book.)

The scientific controversy over whether processes observable within existing species and gene pools (microevolution) can account for large-scale changes over geological time (macroevolution) continues to this day. Here are a few examples of peer-reviewed scientific articles that have referred to it just in the last three years:

- David L. Stern, "Perspective: Evolutionary Developmental Biology and the Problem of Variation," *Evolution* 54 (2000): 1079-1091.

"One of the oldest problems in evolutionary biology remains largely unsolved... Historically, the neo-Darwinian synthesizers stressed the predominance of micromutations in evolution, whereas others noted the similarities between some dramatic mutations and evolutionary transitions to argue for macromutationism."

- Robert L. Carroll, "Towards a new evolutionary synthesis," *Trends in Ecology and Evolution*, 15 (January, 2000): 27.

"Large-scale evolutionary phenomena cannot be understood solely on the basis of extrapolation from processes observed at the level of modern populations and species."

- Andrew M. Simons, "The continuity of microevolution and macroevolution," *Journal of Evolutionary Biology* 15 (2002): 688-701.

"A persistent debate in evolutionary biology is one over the continuity of microevolution and macroevolution -- whether macroevolutionary trends are governed by the principles of microevolution."

It should be noted that all of the scientists quoted above are believers in Darwinian evolution, and that all of them think the controversy will eventually be resolved within the framework of that theory. Stern, for example, believes that new developmental studies of gene function will provide "the current missing link." (p. 1079) The important point here is that the controversy has not yet been resolved, precisely because the evidence needed to resolve it is still lacking. It is important for students to know what the evidence does or does not show -- not just what some scientists hope the evidence will eventually show. Only then can students be expected to "analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information." (TEKS §112.43c(3)A).

Since the controversy over microevolution and macroevolution is at the heart of Darwin's theory, and since evolutionary theory is so influential in modern biology, it is totally unacceptable for a biology textbook to ignore the controversy entirely. Furthermore, since the scientific evidence needed to settle the controversy is still lacking, it is unacceptable for a textbook to give students the impression that the controversy has been resolved and that all scientists have reached a consensus on the issue.

LIST OF TEXTBOOKS

1

William K. Purves, David Sadava, Gordon H. Orians & H. Craig Heller
Life: The Science of Biology
6th edition
Sunderland, MA: Sinauer Associates
2001
ISBN 0-7167-3873-2

2

Peter H. Raven & George B. Johnson
Biology
6th edition
Boston, MA: McGraw-Hill
2002
ISBN 0-07-303120-8

3

Neil A. Campbell & Jane B. Reece
Biology
6th edition
San Francisco, CA: Benjamin Cummings
2002
ISBN 0-8053-6624-5

4

Biological Sciences Curriculum Study
BSCS Biology: An Ecological Approach
9th edition (BSCS Green Version)
Dubuque, IA: Kendall/Hunt
2002
ISBN 0-7872-7525-5

5

Biological Sciences Curriculum Study
BSCS Biology: A Human Approach
2nd edition
Dubuque, IA: Kendall/Hunt
2003
ISBN 0-7872-8685-0

6

Joseph Raver
Biology: Patterns and Processes of Life
1st edition
Dallas, TX: J.M. LeBel
2004
ISBN 0-920008-05-4

7

Sylvia S. Mader
Biology
8th edition
Boston, MA: McGraw-Hill
2004
ISBN 0-07-121487-9

8

Alton Biggs, Whitney Crispen Hagins, Chris Kapicka, Linda Lundgren, Peter
Rillero, Kathleen G. Tallman, Dinah Zike & National Geographic Society
Biology: The Dynamics of Life
Texas Edition
New York, NY: McGraw-Hill
2004
ISBN 0-07-829904-7

9

George Johnson & Peter Raven
Holt Biology
Orlando, FL: Holt, Rinehart & Winston
2004
ISBN 0-03-068264-9

10

Kenneth R. Miller & Joseph Levine
Prentice Hall Biology
Texas edition
Upper Saddle River, NJ: Pearson Prentice Hall
2004
ISBN 0-13-115291-2

11

Cecie Starr & Ralph Taggart
Biology: The Unity and Diversity of Life
10th edition
Belmont, CA: Thomson
2004
ISBN 0-534-38801-9

Textbook 1

William K. Purves, David Sadava, Gordon H. Orians & H. Craig Heller
Life: The Science of Biology, 6th edition (2001)

On page 379 this textbook defines microevolution as "changes that happen during the lifetimes of species," and it defines macroevolution as "changes that involve the appearance of new species and evolutionary lineages." (These definitions are repeated in the chapter-end review on page 394.) On page 402 the book defines microevolution as "changes in the genetic structure of populations."

On page 411 the book explains: "Microevolutionary changes within populations are an important focus of study for evolutionary biologists. These changes can be observed directly, they can be manipulated experimentally, and they show the actual processes by which evolution occurs. Studies of these short-term changes identify the genetic bases of evolutionary changes and demonstrate how natural selection acts. By themselves, however, they do not enable us to predict -- or, more properly, to 'postdict' (because they already happened) -- the macroevolutionary changes we described in Chapter 20. The reason for this is that patterns of macroevolutionary change can be strongly influenced by events that occur so infrequently or so slowly that they are unlikely to be observed during microevolutionary studies...In subsequent chapters we will discuss the kinds of information that biologists assemble to study long-term evolutionary changes and infer the processes that led to them."

In the chapter-end review on page 412 the book reiterates: "Patterns of macroevolutionary change can be strongly influenced by events that occur so infrequently or so slowly that they are unlikely to be observed during microevolutionary studies. Additional types of evidence must be gathered to understand why evolution in the long term took the particular course it did."

This last statement is the closest the book comes to informing the student that there is a controversy over whether microevolutionary processes can explain macroevolution. The book never really fulfills its promise, however, to "discuss the kinds of information that biologists assemble to study long-term evolutionary changes and infer the processes that led to them."

SUMMARY: This book mentions both microevolution and macroevolution, and it clearly distinguishes between them. It also indicates that the processes of the former may not account for the latter, though it falls short of frankly acknowledging the scientific controversy that exists on this topic, and it fails to present fully and fairly the view that Darwinian microevolutionary processes cannot account for macroevolution.

Textbook 2

Peter H. Raven & George B. Johnson
Biology, 6th edition (2002)

On page 449 this book acknowledges the controversy over whether microevolution can account for macroevolution (though without using those terms): "Some critics of evolution accept that selection can lead to changes within a species, but contend that such changes are relatively minor in scope and not equivalent to the substantial changes documented in the fossil."

On page 455 the book expands on this and introduces the terms microevolution and macroevolution: "Is microevolution (evolution within a species) the mechanism that has produced macroevolution (evolution among species)? Most biologists that have studied the problem think so. Some kinds of animals produced by artificial selection are remarkably distinctive, such as Chihuahuas, dachshunds, and greyhounds. While all dogs are in fact the same species and can interbreed, laboratory selection experiments easily create forms that cannot interbreed and thus would in nature be considered different species. Thus, production of radically different forms has indeed been observed, repeatedly. To object that evolution still does not explain really major differences, like between fish and amphibians, simply takes us back to point 2 -- these changes take millions of years, and are seen clearly in the fossil record."

This paragraph is introduced by a caricature of one side of the controversy: "No scientist has come up with an experiment where fish evolve into frogs and leap away from predators." Of course, no scientist expects to change fish into frogs. By exaggerating the supposed claims of critics of Darwinian theory, this passage resorts to a "straw man" argument instead of dealing fully and fairly with both sides of the controversy.

Note also that the statement that "laboratory selection experiments easily create forms that cannot interbreed" is an exaggeration. Attempts to produce reproductive isolation in the laboratory have been disappointing, at best.

On page 472 the book points out: "The Cambrian explosion seems to have been a time of evolutionary experimentation and innovation... What prompted this explosion of diversity is still a subject of considerable controversy." The book does not point out, however, that this is one manifestation of the micro/macro controversy it downplayed earlier.

SUMMARY: This book mentions both microevolution and macroevolution, and it clearly distinguishes between them. It also indicates that the processes of the former may not account for the latter, though it falls short of frankly acknowledging the scientific controversy that exists on this topic, and it fails to present fully and fairly the view that Darwinian microevolutionary processes cannot account for macroevolution.

Textbook 3

Neil A. Campbell & Jane B. Reece
Biology, 6th edition (2002)

On page 450 this book defines microevolution as "a generation-to-generation change in a population's frequencies of alleles." On page 464 it defines macroevolution as "the origin of new taxonomic groups (new species, new genera, new families, even new kingdoms)."

On page 476 the book states: "Speciation is at the boundary between microevolution and macroevolution. Microevolution is a change over the generations in a population's allele frequencies, mainly by genetic drift and natural selection. Speciation occurs when a population's genetic divergence from its ancestral population results in reproductive isolation... The cumulative change during millions of speciation episodes over vast tracts of time must account for macroevolution, the level of change that is evident over the time scale of the fossil record... How do the evolutionary novelties that define taxonomic groups above the species level, such as classes and phyla, evolve? In this last section, we look at some of the mechanisms behind macroevolution."

The section introduced by this passage contains three sub-sections. The first begins: "We can extend the Darwinian concept of 'descent with modification' to account for the major morphological transformations of macroevolution." (This gives the impression that macroevolution is simply an extrapolation of microevolution.) The second sub-section begins: "Genes that control development play a major role in evolution." It concludes: "In producing evolutionary novelties, changes in developmental dynamics, both temporal (heterochrony) and spatial, have undoubtedly played important roles in macroevolution." (Pages 478-479) The last sub-section maintains that evolution is not goal oriented.

Although these passages represent the current views of many evolutionary biologists on the micro/macro problem, they fall short of frankly acknowledging the controversy that exists on this topic. For example, not all biologists agree that genetic divergence results in reproductive isolation; some maintain that it is the other way around, with reproductive isolation leading to genetic divergence. Furthermore, although many biologists now look to allele changes in developmental genes to explain changes in morphology (which are unexplained by speciation), the fact that morphology-affecting genes are very similar in widely diverse taxonomic groups poses a paradox for this explanation.

SUMMARY: This book mentions both microevolution and macroevolution, and it clearly distinguishes between them. It also indicates that the processes of the former may not account for the latter, though it falls short of frankly acknowledging the scientific controversy that exists on this topic, and it fails to present fully and fairly the view that Darwinian microevolutionary processes cannot account for macroevolution.

Textbook 4

Biological Sciences Curriculum Study
BSCS Biology: An Ecological Approach, 9th edition (Green Version, 2002)

Nowhere does this book even use the terms "microevolution" or "macroevolution," much less define them, distinguish them, or point out that there is a scientific controversy over whether the processes of microevolution can account for macroevolution.

On page 221 the book asserts: "Evolution, change through time (genetic change through time), is the biological process that links all species, no matter how they differ." On page 230 it states: "Mechanisms other than natural selection also have been proposed and have supporting evidence. Thus, the question is not *whether* evolution occurs, but *how* it occurs, and *how rapidly* it occurs." It goes on to acknowledge that "several evolutionary mechanisms can affect populations" (page 232), that "major genetic changes may have caused new species to evolve in relatively few steps" (p. 237), and that "biologists do not completely agree about the mechanisms of evolution" (p. 239), but it never explicitly acknowledges that there is a scientific controversy over whether observed processes of microevolution can account for macroevolution.

SUMMARY: This book does not even mention microevolution or macroevolution, much less distinguish between them or discuss the scientific controversy over whether the processes of the former can account for the latter.

Textbook 5

Biological Sciences Curriculum Study
BSCS Biology: A Human Approach, 2nd edition (2003)

Nowhere does this book even use the terms "microevolution" or "macroevolution," much less define them, distinguish them, or point out that there is a scientific controversy over whether the processes of microevolution can account for macroevolution.

The closest the book comes to raising the issue is on page 80, where it asks: "How far can we extend the statement that biological diversity results from random genetic change combined with natural selection? Is all variation among different species the result of selection for adaptive characteristics? Alternatively, are there limitations to the explanations we can offer about some characteristics?"

The book provides students with no resources, however, for inferring that there might actually be limits to the power of "random genetic change combined with natural selection." On page 59 the book cites bacterial antibiotic resistance (a biochemical change within a single species) as the "model of evolution." On page 62 the book approvingly quotes E.O Wilson to the effect that "the accumulation of large reservoirs of unique genes" is sufficient to account for "great biological diversity" given "long stretches of geological time." Finally, on page 139 the book tells students that "mutations result in adaptations" that account for evolution, without informing students all known beneficial genetic mutations are biochemical, not morphological.

SUMMARY: This book does not even mention microevolution or macroevolution, much less distinguish between them or discuss the scientific controversy over whether the processes of the former can account for the latter.

Textbook 6

Joseph Raver

Biology: Patterns and Processes of Life, 1st edition (2004)

This book states on page 110 that Darwin concluded that natural selection, "given the expansive time of Earth's history, could produce the variety of plants and animals alive today." On page 127 it defines microevolution as "adaptations and evolution at the level of populations and species," and macroevolution as "evolution of higher (broader) taxonomic groups (genera, families, orders, etc.)." The book gives no indication, however, that microevolutionary processes might not account for macroevolution. On the contrary, the book dismisses the problem with the following assertion on page 129: "The differences between birds and reptiles we see today are the result of many millions of years of natural selection, mutation, adaptation and other changes."

The closest the book comes to acknowledging any controversy on this subject is the following statement about the Cambrian explosion on page 186: "Though a number of theories have been put forward, debate on the causes of the sudden appearance of most animals during the Cambrian will continue."

SUMMARY: This book mentions both microevolution and macroevolution, and it clearly distinguishes between them. It fails to acknowledge, however, that the processes of the former may not account for the latter, and it largely ignores the scientific controversy over this problem.

Textbook 7

Sylvia S. Mader
Biology, 8th edition (2004)

This book defines "microevolution" as "the accumulation of small changes in the gene pool over a relatively short period of two or more generations" (page 303). It goes on to tell the student: "Microevolution is involved in the origin of species to be discussed later in this chapter, as well as in the history of life recorded in the fossil record." The "causes of microevolution" are listed as genetic mutations (which are called "the raw materials for evolutionary change"), gene flow, nonrandom mating, genetic drift, and natural selection.

The book does not mention macroevolution, much less define it, distinguish it from microevolution, or point out that there is a scientific controversy over whether the processes of microevolution can account for macroevolution.

The closest the book comes to hinting at the problem is to ask on page 338: "Does the process of evolution always have to be the same?" The only things discussed under this heading, however, are the rate of speciation and the possible role of continental drift.

SUMMARY: This book discusses microevolution, but it does not even mention macroevolution, much less distinguish between the two. It completely ignores the scientific controversy over whether the processes of microevolution can account for macroevolution.

Textbook 8

Alton Biggs et al.

Biology: The Dynamics of Life, Texas Edition (2004)

Nowhere does this book even use the terms "microevolution" or "macroevolution," much less define them, distinguish them, or point out that there is a scientific controversy over whether the processes of microevolution can account for macroevolution.

The book informs the student on page 405 that "evolution occurs as a population's genes and their frequencies change over time," but it does not call this microevolution and it does not point out that there is a scientific controversy over whether the same process can account for macroevolution. (See also pages 397, 414 and 468.)

SUMMARY: This book does not even mention microevolution or macroevolution, much less distinguish between them or discuss the scientific controversy over whether the processes of the former can account for the latter.

Textbook 9

George Johnson & Peter Raven
Holt Biology (2004)

Nowhere does this book even use the terms "microevolution" or "macroevolution," much less define them, distinguish them, or point out that there is a scientific controversy over whether the processes of microevolution can account for macroevolution.

On pages 279-293, the book gives the standard description of Darwin's theory and lists as evidence changes in peppered moths, antibiotic-resistant bacteria and Galápagos finches. On page 282 it discusses the tempo of evolution and mentions the theory of punctuated equilibrium, but it makes no mention of the distinction between microevolution and macroevolution. On page 292 it goes so far as to state -- falsely -- that "the way natural selection leads to the formation of new species has been thoroughly documented." In fact, the role of natural selection in the origin of new species remains controversial.

SUMMARY: This book does not even mention microevolution or macroevolution, much less distinguish between them or discuss the scientific controversy over whether the processes of the former can account for the latter.

Textbook 10

Kenneth R. Miller & Joseph Levine
Prentice Hall Biology, Texas edition (2004)

This book defines macroevolution on page 435 as "large-scale evolutionary patterns and processes that occur over long periods of time." It never mentions microevolution, however, so it does not distinguish between microevolution and macroevolution.

Under the heading of macroevolution the book discusses (on page 439) the concept of punctuated equilibrium, and it points out that the concept "has generated much debate and is still somewhat controversial among biologists today," but the discussion is limited to the rate of evolution.

The book does not raise the question of whether the processes of microevolution can account for macroevolution. Perhaps the closest the book comes to acknowledging any controversy at all is on page 386: "Researchers still debate such important questions as precisely how new species arise." And on page 410: "New discoveries continue to support new hypotheses that refine and expand Darwin's original ideas. No scientist suggests that all evolutionary processes are fully understood. Many, many unanswered questions remain."

SUMMARY: This book discusses macroevolution, but it does not even mention microevolution, much less distinguish between the two. It completely ignores the scientific controversy over whether the processes of microevolution can account for macroevolution.

Textbook 11

Cecie Starr & Ralph Taggart

Biology: The Unity and Diversity of Life, 10th edition (2004)

At first glance, this book might seem to deal adequately with microevolution and macroevolution, since it contains one chapter (17) entitled "Microevolution" and another chapter (19) entitled "The Macroevolutionary Puzzle." Closer examination reveals, however, that the book systematically confuses the two concepts.

The book defines "microevolution" on page 271 as "changes in the allele frequencies of a population over time." On the same page, however, the book lays the foundation for confusing microevolution and macroevolution by stating that "evolution simply means genetic change in a line of descent over the generations." When the book gets around to defining "macroevolution" on page 305, that word is said to mean "the major patterns, trends, and rates of change among lines of descent, or lineages, during the history of life." Thus instead of informing the student that microevolution refers to changes within existing species while macroevolution refers to large-scale changes above the species level, the book gives the student the impression that macroevolution is simply microevolution extended over time.

The book further confuses the distinction between microevolution and macroevolution by covering many of the same topics in Chapter 17 and Chapter 19, including biogeography, comparative morphology, the fossil record, and the geological time scale.

The closest the book comes to acknowledging that questions remain about the processes of macroevolution is on page 336: "What caused the 'Cambrian explosion' of diversity?" The passage goes on to suggest some possible answers, however; it gives the student no resources to pursue the matter.

SUMMARY: This book discusses microevolution and macroevolution, but it fails to distinguish clearly between the two. It completely ignores the scientific controversy over whether the processes of microevolution can account for macroevolution.

SUMMARY

	1	2	3	4	5	6	7	8	9	10	11
I	Y	Y	Y	N	N	Y	Y	N	N	Y	Y
II	Y	Y	Y	N	N	Y	N	N	N	N	Y
III	?	Y	Y	N	N	N	N	N	N	N	N
IV	N	N	N	N	N	N	N	N	N	N	N

Textbooks:

- 1 Purves et al.
- 2 Raven & Johnson
- 3 Campbell & Reece
- 4 BSCS Ecological
- 5 BSCS Human
- 6 Raver
- 7 Mader
- 8 Biggs et al.
- 9 Johnson & Raven
- 10 Miller & Levine
- 11 Starr & Taggart

Questions:

- I** Does the book mention either microevolution or macroevolution?
- II** Does the book clearly and correctly distinguish between the two?
- III** Does the book acknowledge that there is a scientific controversy over whether the processes of the former can account for the latter?
- IV** Does the book fairly present both sides of the controversy, or does it merely defend the standard Darwinian view?

MARGINALLY ACCEPTABLE: Textbooks 1, 2, and 3 distinguish between microevolution and macroevolution, and they contain hints that the processes of the former may not account for the latter, but they fall short of frankly acknowledging the scientific controversy on this issue, and they do not fully and fairly present both sides in the controversy.

SERIOUSLY DEFICIENT: Textbooks 7 and 10 don't distinguish clearly between microevolution and macroevolution, much less discuss the controversy over whether the processes of the former can account for the latter.

TOTALLY UNACCEPTABLE: Textbooks 4, 5, 8, and 9 don't mention either microevolution or macroevolution.

TEXTBOOK	RATING
1. Purves et al.	MARGINALLY ACCEPTABLE
2. Raven & Johnson	MARGINALLY ACCEPTABLE
3. Campbell & Reece	MARGINALLY ACCEPTABLE
4. BSCS (Ecological)	TOTALLY UNACCEPTABLE
5. BSCS (Human)	TOTALLY UNACCEPTABLE
6. Raver	DEFICIENT
7. Mader	SERIOUSLY DEFICIENT
8. Biggs et al.	TOTALLY UNACCEPTABLE
9. Johnson & Raven	TOTALLY UNACCEPTABLE
10. Miller & Levine	SERIOUSLY DEFICIENT
11. Starr & Taggart	DEFICIENT

APPENDIX

Suggested Language About the Controversy Over Whether Microevolutionary Processes Can Account For Macroevolution

Ever since Charles Darwin published *The Origin of Species* in 1859, there has been controversy over his theory that the processes of microevolution (generation-to-generation changes within existing species) can account for macroevolution (the major changes in living things that we see in the fossil record). Many biologists have questioned whether natural selection is capable of producing macroevolution. Some biologists have suggested that genetic mutations can account for large-scale changes, but although rare beneficial biochemical mutations do occur, mutations that produce the beneficial changes in anatomy needed for evolution have never been observed. Although many biologists believe that the problem of macroevolution will eventually be solved within the framework of Darwinian theory, there is not enough evidence to solve it now. Thus the scientific controversy continues.