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**AN EVALUATION  
OF TEN RECENT  
BIOLOGY TEXTBOOKS**

A REPORT FOR THE  
CENTER FOR THE RENEWAL  
OF SCIENCE AND CULTURE  
BY SENIOR FELLOW DR. JONATHAN WELLS

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Discovery Institute's Center for the Renewal of Science and Culture  
1402 Third Ave. Seattle, WA 98101  
(206) 292-0401 (206) 682-5320(FAX)  
[www.discovery.org](http://www.discovery.org) [www.crsc.org](http://www.crsc.org)

# **AN EVALUATION OF TEN RECENT BIOLOGY TEXTBOOKS**

**And their use of selected icons of evolution**

evaluated by Dr. Jonathan Wells

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# LIST OF TEXTBOOKS EVALUATED

(All have copyright dates of 1998 or later. Books are listed alphabetically by first author's last name.)

1. Alton Biggs, Chris Kapicka & Linda Lundgren, *Biology: The Dynamics of Life* (Westerville, OH: Glencoe/McGraw-Hill, 1998). ISBN 0-02-825431-7
2. Neil A. Campbell, Jane B. Reece & Lawrence G. Mitchell, *Biology, Fifth Edition* (Menlo Park, CA: The Benjamin/Cummings Publishing Company, 1999). ISBN 0-8053-6573-7
3. Douglas J. Futuyma, *Evolutionary Biology, Third Edition* (Sunderland, MA: Sinauer Associates, 1998). ISBN 0-87893-189-9
4. Burton S. Guttman, *Biology*, (Boston: WCB/McGraw-Hill, 1999). ISBN 0-697-22366-3
5. George B. Johnson, *Biology: Visualizing Life, Annotated Teacher's Edition* (Orlando, FL: Holt, Rinehart & Winston, 1998). ISBN 0-03-016724-8
6. Sylvia Mader, *Biology, Sixth Edition* (Boston: WCB/McGraw-Hill, 1998). ISBN 0-697-34080-5
7. Kenneth R. Miller & Joseph Levine, *Biology, Fifth Edition* (Upper Saddle River, NJ: Prentice-Hall, 2000). ISBN 0-13-436265-9
8. Peter H. Raven & George B. Johnson, *Biology, Fifth Edition* (Boston: WCB/McGraw-Hill, 1999). ISBN 0-697-35353-2
9. William D. Schraer & Herbert J. Stoltze, *Biology: The Study of Life , Seventh Edition* (Upper Saddle River, NJ: Prentice Hall, 1999). ISBN 0-13-435086-3
10. Cecie Starr & Ralph Taggart, *Biology: The Unity and Diversity of Life, Eighth Edition* (Belmont, CA: Wadsworth Publishing Company, 1998). ISBN 0-534-53001-X

## SPECIFIC EVALUATION CRITERION

In general, an "A" requires full disclosure of the truth, discussion of relevant scientific controversies, and a recognition that Darwin's theory -- like all scientific theories -- might have to be revised or discarded if it doesn't fit the facts. An "F" indicates that the textbook uncritically relies on logical fallacy, dogmatically treats a theory as an unquestionable fact, or blatantly misrepresents published scientific evidence.

# ICONS OF EVOLUTION EXPLAINED

## The Miller-Urey Experiment

Many modern scientists believe that living cells arose from chemical building-blocks that formed on the early Earth. In 1953, Stanley Miller used an electric spark to simulate lightning in a mixture of gasses thought to resemble the Earth's primitive atmosphere, and produced some of the chemical building-blocks of life. The experiment is pictured in many biology textbooks to show that scientists now understand an important early step in the origin of life. But scientists determined over a decade ago that the Earth's primitive atmosphere was probably nothing like the mixture of gasses Miller used, and now acknowledge that the origin of life's building-blocks remains unexplained.

A = does not include a picture or drawing of the Miller-Urey apparatus, or else accompanies it with a caption pointing out that the experiment (though historically interesting) is probably irrelevant to the origin of life because it did not simulate conditions on the early Earth; text mentions the controversy over oxygen in the primitive atmosphere, and includes extensive discussion of the other problems faced by origin-of-life research, acknowledging that they remain intractable.

B = does not include a picture or drawing of the Miller-Urey apparatus, or else accompanies it with a caption pointing out that the experiment (though historically interesting) is probably irrelevant to the origin of life because it did not simulate conditions on the early Earth; text includes at least some discussion of other problems in origin-of-life research, and does not leave the student with the impression that scientists are on the verge of understanding the origin of life.

C = includes a picture or drawing of the Miller-Urey apparatus, but the caption does not claim that the Miller-Urey experiment simulated conditions on the early Earth; the accompanying text points out that the experiment fails even if other starting mixtures are used, and does not leave the student with the impression that the experiment (or some variant of it) demonstrated how life's building-blocks formed on the early earth; does not discuss other problems with origin-of-life research.

D = includes a picture or drawing of the Miller-Urey apparatus with a misleading caption claiming or implying that the experiment simulated conditions on the early Earth; but the accompanying text explicitly points out that this was probably not the case (merely listing other gasses, and leaving it to the student to spot the discrepancy, is not sufficient); may leave the student with the impression that the experiment (or some variant of it) demonstrated how life's building-blocks formed on the early earth.

F = includes a picture or drawing of the Miller-Urey apparatus with a misleading caption claiming or implying that the experiment simulated conditions on the early Earth; the text contains no mention of the experiment's flaws, and leaves the student with the impression that it demonstrated how life's building-blocks formed on the early earth.

## Darwin's Tree of Life

Darwin believed that all living things are modified descendants of one or a few original forms. Most biology textbooks show the branching-tree pattern that would result from such "descent with modification," and tell students that it is so thoroughly confirmed by the fossil and molecular evidence that it may be called a "scientific fact." But the fossil record of the "Cambrian explosion" shows that the major groups of animals appeared at about the same time -- a "lawn" rather than a tree; and recent molecular evidence suggests a "tangled thicket" instead of the branching pattern of Darwin's tree of life.

A = explicitly treats universal common ancestry as a theory rather than a fact; clearly points out that the "top-down" Cambrian explosion contradicts the "bottom-up" pattern of Darwinian evolution, and acknowledges the theoretical possibility of multiple origins and separate lines of descent; also mentions problems for universal common ancestry posed by recent evidence from molecular phylogeny.

B = explicitly treats universal common ancestry as a theory rather than a fact; clearly points out that the "top-down" Cambrian explosion contradicts the "bottom-up" pattern of Darwinian evolution, and acknowledges the theoretical possibility of multiple origins and separate lines of descent; but does not mention recent problems in molecular phylogeny.

C = explicitly treats universal common ancestry as a theory rather than a fact; discusses the Cambrian explosion as a problem for Darwinian evolution, but does not mention the theoretical possibility of multiple origins and separate lines of descent.

D = assumes the truth of universal common ancestry without questioning it (and may call it a "fact"); mentions the Cambrian explosion in the body of the text (briefly mentioning it in a note at the end of the chapter, without explaining what it is, is not sufficient), but does not discuss the problem it poses for Darwinian evolution.

F = assumes the truth of universal common ancestry without questioning it (and may call it a "fact"); does not even mention the Cambrian explosion.

## Homology in Vertebrate Limbs

A bat's wing, a porpoise's flipper, a horse's leg, and a human hand all contain bones that are structurally similar. Before Darwin, biologists called this "homology," and considered it evidence for a common design, but Darwin attributed it to a common ancestor. Modern Darwinists have re-defined homology as similarity due to common ancestry, but now homology cannot serve as evidence for common ancestry without arguing in a circle. Many biology textbooks use circular reasoning anyway: We know that two features are homologous because they come from a common ancestor, and we know they come from a common ancestor because they're homologous.

A = defines homology as similarity of structure and position, and explains that this was historically attributed to a common archetype; mentions a biological ancestor as one possible meaning of "archetype," but acknowledges that there are others, and that the concept of homology continues to be controversial; clearly explains out that the two biological mechanisms proposed so far to account for homology (similar genes and similar developmental pathways) are inconsistent with the evidence.

B = defines homology as similarity of structure and position due to a common archetype, and identifies "archetype" with a biological ancestor without explaining that there are other possibilities; points out that the two biological mechanisms proposed so far to account for it (similar genes and similar developmental pathways) are inconsistent with the evidence.

C = defines homology as similarity of structure and position, and cites it as evidence for common ancestry; attributes homology to similar genes or similar developmental pathways, but at least hints that there are problems with the evidence.

D = defines homology as similarity of structure and position, and cites it as evidence for common ancestry; may attribute homology to similar genes or similar developmental pathways, but fails to mention that the evidence does not fit the claim.

F = defines homology as similarity due to common ancestry, then engages in circular reasoning by citing homology as evidence for common ancestry.

## Haeckel's Embryos

Darwin believed that all animals with backbones (including humans) evolved from fish-like ancestors, and he thought the best evidence for this was that the early embryos of amphibians, reptiles, birds and mammals are similar to fish embryos. Many biology textbooks carry drawings (originally by Ernst Haeckel) to illustrate this, and claim that human embryos possess "gill slits." But embryologists have known for over a century that such drawings are false, and that early embryos of amphibians, reptiles, birds and mammals do NOT resemble fish. Human embryos pass through a stage when they have wrinkles in their necks, but they never have "gill slits."

A = does not use misleading drawings or photos, and does not call pharyngeal pouches "gill slits"; points out that vertebrate embryos are most similar midway through development, after being dissimilar in their earliest stages; acknowledges this as an unresolved problem for Darwinian evolution, and considers the possibility that Darwin's theory of vertebrate origins could be wrong.

B = does not use misleading drawings or photos, and does not call pharyngeal pouches "gill slits"; points out that vertebrate embryos are most similar midway through development, after being dissimilar in their earliest stages; acknowledges this as an unresolved problem for Darwinian evolution, but does not explicitly consider the possibility that Darwin's theory of vertebrate origins could be wrong.

C = does not use misleading drawings or photos; points out that vertebrate embryos are most similar midway through development, after being dissimilar in their earliest stages, but explains away this fact in order to reconcile it with Darwinian evolution; may call pharyngeal pouches "gill slits."

D = uses actual photos rather than Haeckel's drawings, but chooses those which best fit the theory; fails to mention that earlier stages are dissimilar, and claims that early similarities in vertebrate embryos are evidence for common ancestry and Darwinian evolution; may call pharyngeal pouches "gill slits."

F = uses Haeckel's drawings (or a re-drawn version of them) without mentioning the dissimilarity of earlier stages; claims that early similarities in vertebrate embryos are evidence for common ancestry and Darwinian evolution; may call pharyngeal pouches "gill slits."

## Archaeopteryx - The Missing Link

Darwin believed that modern species were linked in the past by innumerable transitional forms, but when he published his theory in 1859 those transitional links were missing. The discovery of Archaeopteryx, a fossil bird with reptile-like teeth, helped to persuade many people that Darwin's theory was true, and many biology textbooks still feature Archaeopteryx as the "missing link" between reptiles and birds. Yet paleontologists no longer believe that Archaeopteryx was the ancestor of modern birds, and its own ancestors are the subject of heated controversy. The "missing link" between reptiles and birds, it seems, is still missing.

A = explains that the status of Archaeopteryx as a transitional link between reptiles and birds is controversial; points out that modern birds are probably not descended from it; mentions the controversy over whether birds evolved from dinosaurs or from a more primitive group; points out that the supposed dinosaur ancestors of Archaeopteryx do not appear in the fossil record until tens of millions of years after it.

B = explains that the status of Archaeopteryx as a transitional link between reptiles and birds is controversial; points out that modern birds are probably not descended from it; mentions the controversy over whether birds evolved from dinosaurs or from a more primitive group; but fails to point out that the supposed dinosaur ancestors of Archaeopteryx do not appear in the fossil record until tens of millions of years after it.

C = explains that the status of Archaeopteryx as a transitional link between reptiles and birds is controversial; points out that modern birds are probably not descended from it; but does not mention the controversy over whether birds evolved from dinosaurs or from a more primitive group.

D = presents Archaeopteryx as the transitional link between reptiles (or dinosaurs) and modern birds; does not point out that modern birds are probably not descended from it, but at least hints at the fact that there is a controversy over its ancestry or its transitional status.

F = presents Archaeopteryx as the transitional link between reptiles (or dinosaurs) and modern birds; does not point out that modern birds are probably not descended from it, and does not even hint at the fact that there is a controversy over its ancestry or its transitional status.

## Peppered Moths

Darwin had no direct evidence for natural selection, the principal mechanism in his theory of evolution. Experiments in the 1950s seemed to provide the missing evidence by showing that light-colored peppered moths were more easily seen and eaten by predatory birds on pollution-darkened tree trunks, leaving mostly dark-colored moths to survive and reproduce. Many biology textbooks carry photographs of light and dark peppered moths on tree trunks to illustrate this famous story. Yet biologists have known for over a decade that the story has problems. Among other things, peppered moths don't normally rest on tree trunks, and the textbook photographs have been staged.

A = uses photos of moths in their natural resting places; does not use staged photos of moths on tree trunks (except as illustrations of how the classical story was wrong); clearly discusses unresolved problems with Kettlewell's experiments and the classical story, and points out that these problems raise serious doubts about whether peppered moths provide direct evidence for natural selection.

B = uses photos of moths in their natural resting places; does not use staged photos of moths on tree trunks (except as illustrations of how the classical story was wrong); mentions unresolved problems with Kettlewell's experiments and the classical story, but does not discuss the possibility that peppered moths do not provide direct evidence for natural selection.

C = uses staged photos but clearly explains that they were staged, because moths do not rest on tree trunks in the wild; describes Kettlewell's experiments, but briefly mentions that they and the classical story are now in doubt.

D = uses staged photos without mentioning that they misrepresent the natural situation; but the accompanying text at least hints at the fact that there are problems with Kettlewell's experiments or the classical story.

F = uses staged photos without mentioning that they misrepresent the natural situation; describes Kettlewell's experiments as a demonstration of natural selection, without mentioning their flaws or problems with the classical story.

## Darwin's Finches

Many biology textbooks claim that finches on the Galapagos Islands, whose beak sizes are correlated with the foods they eat, helped to convince Darwin of evolution by natural selection in 1835. But the legend of "Darwin's finches" was actually contrived a century later. Some textbooks also tell students that a slight increase in the average size of finch beaks, observed after a severe drought in the 1970s, shows how natural selection could produce a new species in only two hundred years. But the textbooks fail to mention that the change was reversed when the rains returned, and no net evolution occurred.

A = explicitly points out that the Galapagos finches had little to do with the formulation of Darwin's theory; explains that selection on finch beaks oscillates between wet and dry years, producing no net evolutionary change; points out both that the genes affecting finch beaks are unknown and that hybrids between several species are now more fit than their parents, suggesting that those species may be merging.

B = explicitly points out that the Galapagos finches had little to do with the formulation of Darwin's theory; explains that selection on finch beaks oscillates between wet and dry years, producing no net evolutionary change; points out either that the genes affecting finch beaks are unknown or that hybrids between several species are now more fit than their parents, suggesting that those species may be merging.

C = describes the Galapagos finches as a good example of adaptive radiation (the origin of species by natural selection); but points out both that selection on finch beaks oscillates between wet and dry years and that the finches did not play an important role in the formulation of Darwin's theory.

D = describes the Galapagos finches as a good example of adaptive radiation (the origin of species by natural selection); but points out either that selection on finch beaks oscillates between wet and dry years or that the finches did not play an important role in the formulation of Darwin's theory.

F = describes the Galapagos finches as a good example of adaptive radiation (the origin of species by natural selection); but fails to mention that selection on finch beaks oscillates between wet and dry years, and implies that the finches played an important role in the formulation of Darwin's theory.