

# Icons of Evolution

## A Critical Review

by Tony J. Hiatt  
HASTI 2003

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### Introduction

Wells identifies the following as the set of examples most people, including most biologists, give as evidence for Darwinian evolution because these were the examples used in their biology books.

- The Miller-Urey Experiment
  - Darwin's Tree of Life
  - Homology in Vertebrate Limbs
  - Haeckel's Embryos
  - Archaeopteryx – the Missing Link
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### Introduction Continued

He then says,

“These examples are so frequently used as evidence for Darwin's theory that most of them have been called "icons" of evolution. Yet all of them, in one way or another, misrepresent the truth.”

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### This Review Has Three Purposes

- Summarize Wells' claims for each icon and his “10 Questions to ask your biology teacher.”
  - Summarize the responses from the scientific community to each icon.
  - Provide teachers with ideas, lessons and resources for providing their students with the background for answering Wells' questions themselves.
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### Dealing With “Icons” in the Classroom

A pre-emptive approach is always preferable to a rebuttal approach. Provide your students with experiences that they can draw upon to answer Wells' questions before they are even asked.

A strong background in the nature of science is essential. This means going well beyond the over-simplified coverage of the scientific method found in most texts and using activities that are student-centered and are designed to simulate the nature of science.

Stay informed. Textbooks are often out of date and do contain mistakes.

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### ICON # 1 Miller-Urey experiment

**Slide 6:** [Figure of Stanly Miller's reflux apparatus]

Question to ask your biology teacher # 1. Why do textbooks claim that the 1953 Miller-Urey experiment shows how life's building blocks may have formed on early Earth – when conditions on the early Earth were probably nothing like those used in the experiment, and the origin of life remains a mystery?

Wells also claims

- That there was free oxygen in the primordial atmosphere that would have prevented this model from working.
  - The RNA world hypothesis was proposed to salvage the Miller-Urey failures
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### The Scientific Response

- Wells is attempting to confuse the issue. The origin of life and the evolution of life are two separate issues.
  - This experiment is presented in some texts more for its historical significance than its technical accuracy.
  - Subsequent research modifying the set-up to better reflect prevailing wisdom still provides significant results.
  - Wells' claim of free oxygen in the primordial atmosphere was based on outdated and misrepresented research. He is taking advantage of an old debate about whether the amount of free oxygen was “low” (.25 - .5%) or “significant” (1-2%) even though levels up to 2% would not preclude the origin of
  - His claim that the “RNA World” hypothesis was proposed to salvage the Miller-Urey Hypothesis is baseless since this would represent a later step in the process and not a replacement explanation for the formation of life's building blocks.
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## Addressing Icon # 1 in the Classroom

- Emphasize the difference between the origin of life and the evolution of life. Concede that the former is much more speculative but that evolution can easily accommodate any origin of life model, including theistic ones.
- Stress that there are multiple mechanisms for the spontaneous formation of organic building blocks
  1. Miller-Urey type Models
  2. Submarine vents
  3. Chemicals dissolved in water
  4. Minerals in porous rocks or clays
  5. Extra-terrestrial sources
- “Creating Coacervates” activity from ENSI-SENSI found at [www.indiana.edu/~ensiweb/lessons/coacerv.html](http://www.indiana.edu/~ensiweb/lessons/coacerv.html). Students simulate conditions that show the formation of life-like structures from relatively simple materials.
- “Deep Time” web activity at [www.pbs.org/wgbh/evolution/change/deeptime/index.html](http://www.pbs.org/wgbh/evolution/change/deeptime/index.html)  
This interactive time-line includes some of the evidence for the primordial conditions of Earth and helps put Wells’ “oxygen issues” to rest.

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## Icon # 2 Darwin’s Tree of Life and the Cambrian Explosion

**Slide 9:** [Figure of Cambrian sea bed]

Question to ask your biology teacher # 2. “Why don’t textbooks discuss the “Cambrian Explosion,” in which all major animal groups appear together in the fossil record fully formed instead of branching from a common ancestor – thus contradicting the evolutionary tree of life?”

Wells claims that the fossil record and molecular evidence does not support Darwin’s “Tree of Life” because:

- The Cambrian explosion suggests the sudden appearance of major animal body plans in direct conflict with Darwin’s “gradualism.”
- There was no evidence of multicellular life until “just before” the Cambrian Explosion.
- Phylogenetic trees based on DNA evidence are problematic.
- Molecular clock evidence for the common ancestor of all animals is inclusive.

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## The Scientific Response

- Darwin’s use of the word “gradual” meant ‘stepwise’ and not necessarily ‘slow.’
- Modern evolutionary theory does not require slow accumulations of changes particularly in the evolution of body plans (Hox genes).
- The period of time Wells refers to as “just before” the Cambrian actually represents 40-70 million years.
- Major groups not included in the Cambrian Explosion are insects, amphibians, reptiles, birds and mammals.
- The “Tree of Life” is about evolutionary relationships, not timing.
- Textbooks DO discuss the “Cambrian Explosion.”
- Wells’ argument for the failures of phylogenetic trees is based on quoting scientists out of context about methodological problems while ignoring these same scientists’ conclusions and avoiding examples of its wide success.
- Even though there have been some discrepancies in the molecular clock results they all agree on a common animal ancestor at the very least 160 million years prior to the Cambrian Explosion.

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## Addressing Icon # 2 in the Classroom

- Tree of Life Web Site  
<http://tolweb.org/tree/phylogeny.html>
- ENSI Web activities that involve using molecular data to construct cladograms and phylogenetic trees.  
[www.indiana.edu/~ensiweb/evol.fs.html](http://www.indiana.edu/~ensiweb/evol.fs.html)
- Molecular Connection activity  
[www.pbs.org/wgbh/evolution/educators/teacherstuds/pdf/molecular\\_connection.pdf](http://www.pbs.org/wgbh/evolution/educators/teacherstuds/pdf/molecular_connection.pdf)

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## Icon # 3 Homology in Vertebrate Limbs

**Slide 12:** [Figure of homologous vertebrate forelimbs]

Question to ask your biology teacher # 3: “Why do textbooks define homology as similarity due to common ancestry, then claim that it is evidence for common ancestry – a circular argument masquerading as scientific evidence?”

Wells says that “Homology” is used as both evidence for evolution and to determine evolutionary relationships.

He argues that this is a circular argument disguised as science.

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## The Scientific Response

“Wells oversimplifies a complex system into absurdity instead of trying to explain it properly.” He “ makes the classic error of confusing the definition of homology with the diagnosis of a homologous structure, the biological basis of homology with a procedure for discovering homology.” – Alan Gishlick

Initially “Homology” contributed to the “evidence for evolution” but once evolution became well established by an abundance of corroborating evidence, homologies could be used to help construct phylogenetic trees or cladograms.

In modern evolutionary biology however, molecular evidence is used to establish the relationships and homologies are seen as the result of expression of similar genomes in the phenotypes of the related organisms.

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## Addressing Icon # 3 in the Classroom

- Forelimb bone homology coloring exercise  
[http://www.pbs.org/wgbh/evolution/library/03/1/pdf/1\\_031\\_02.pdf](http://www.pbs.org/wgbh/evolution/library/03/1/pdf/1_031_02.pdf)
- Focus some discussions on the most revealing of all homologies, vestigial structures.
- Obtain various skeletons (models would do) of common organisms for comparison.
- Emphasize the difference between homologous structure and analogous structures
- Fossil Find Activity that relies on skeleton drawings and homology to reconstruct a pterodactyl skeleton.  
<http://www.indiana.edu/~ensiwweb/lessons/gr.fs.fd.html>
- Blocks and Screws” activity on adaptations, imperfections and contrivances at  
<http://www.indiana.edu/~ensiwweb/lessons/bl%26scr.html>

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## Icon # 4 Haeckel’s Embryos

**Slide 15:** [Figure of Haeckel’s embryos]

Question to ask your biology teacher # 4: Why do textbooks use drawing of similarities in vertebrate embryos as evidence for common ancestry – even though biologists have known for over a century that embryos are not most similar in their early stages and the drawings are faked?

Wells points out that the embryo drawings shown here were actually faked by the German biologist Ernst Haeckel in order to exaggerate their similarities.

He claims that Haeckel’s drawing and the claim that "ontogeny recapitulates phylogeny“ was rejected by scientists over a hundred years ago but his drawings still show up regularly in biology textbooks as evidence for evolution.

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## The Scientific Response

Even though Wells identifies his own expertise in biology as embryology, his argument here rests almost entirely on the Haeckel drawings and he virtually ignores volumes of modern embryological research that supports evolutionary theory.

Even though Haeckel’s drawings were exaggerated (probably a better description than ‘faked’), his basic claim remains valid, that the earlier stages of vertebrate embryos are more similar than later ones and the more recent a shared common ancestor, the more similar their embryological development.

Haeckel’s drawings are seldom if ever still printed in biology textbooks and when they are, they are there for historical reasons or as an example of the human fallibility aspect of science.

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## Addressing Icon # 4 in the Classroom

- Vertebrate embryo coloring activity.  
[http://www.pbs.org/wgbh/evolution/library/04/2/pdf/1\\_042\\_03.pdf](http://www.pbs.org/wgbh/evolution/library/04/2/pdf/1_042_03.pdf)
- Video from *NOVA*: "Odyssey of Life," the segment captures on film the shared ancestry of animals with backbones.  
[http://www.pbs.org/wgbh/evolution/library/04/2/1\\_042\\_02.html](http://www.pbs.org/wgbh/evolution/library/04/2/1_042_02.html)
- Summary of some of the evidence for common ancestry from embryo studies.  
<http://www.talkorigins.org/faqs/comdesc/section2.html#ontogeny>

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## Icon # 5 *Archaeopteryx*

**Slide 18:** [Figure of *Archaeopteryx*]

Question to ask your biology teacher # 5: Why do textbooks portray this fossil as the missing link between dinosaurs and modern birds even though modern birds are not descended from it, and its (sic) supposed ancestors do not appear until millions of years after it?

In Addition Wells claims textbooks portray the *Archaeopteryx* as the ‘missing link’ between dinosaurs and birds even though:

- No feathered dinosaur fossils earlier than *Archaeopteryx* have yet been found.
- The *Archaeorapter* fossil was a fraud.

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## The Scientific Response

- The whole concept of a “missing link” results from a complete misconception of how evolution works.
- Wells confuses the issue using a typical creationist strategy of clouding the difference between an ancestor and an intermediate form.
- He further confuses the issue by referring to proposed relatives from another side branch of the family tree as ancestors.
- With a “bushy” model of evolution and a fossil record that is incomplete, the claim of no feathered dinosaurs earlier than *Archaeopteryx* is irrelevant.
- Wells is attempting to create another “Piltdown Man” type conspiracy by bringing up the completely unconnected and irrelevant *Archaeorapter* fraud (apparently trying to take advantage of the similarity in the names).

## Addressing Icon # 5 in the Classroom

Emphasize the difference between intermediate forms, ancestors and relatives while reinforcing a “bushy” model for evolution instead of a “step-ladder” model using some of the following resources.

Whale of A Change Activity at <http://www.pbs.org/wgbh/evolution/educators/teachstuds/unit3.html>

For an extended version of this activity see [www.indiana.edu/~ensiweb/lessons/whale.ev.html](http://www.indiana.edu/~ensiweb/lessons/whale.ev.html)

- Transitional Vertebrate Fossils FAQ at <http://www.talkorigins.org/faqs/faq-transitional.html>
- *Archaeopteryx* FAQs at <http://www.talkorigins.org/faqs/archaeopteryx.html>
- ZoomDinosaurs.com discussion on the relationship between Dinosaurs and birds including discussions of feathered dinosaurs. <http://www.enchantedlearning.com/subjects/dinosaurs/Dinobirds.html>

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## Icon # 6 Peppered Moths

**Slide 21:** [Figure of peppered moths]

Wells also says,

Question to ask your biology teacher # 6: Why do textbooks use pictures of peppered moths camouflaged on tree trunks as evidence for natural selection – when biologists have known since the 1980s that the moths don’t normally rest on the tree trunks, and all the pictures have been staged.

- In one study the light moths did not recover after air pollution was reduced.
- Lichens are not always present on the tree surfaces.
- Industrial melanism in ladybird beetles does not follow the same pattern.
- Kettlewell relied only on staged experiments to conclude that bird predation caused the changes.

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## The Scientific Response

All six of Wells’ claims are either wrong or irrelevant.

- Wells fails to mention that since the study he cited was completed, the light moth has in fact recovered.
- He seems to forget that it is the color of the background that matters whether lichens are present or not.
- There is no reason to assume that another species would respond to a selective pressure the same way the moths did. Their respective responses are limited to the genetic variations (raw materials) available.
- The moths do in fact rest on the trunks of trees at least some of the time (see next slide) but in reality it is irrelevant what part of the trees the moths rest on.
- Kettlewell did use staged experiments to test his hypothesis of bird predation (so what) but the statistical results of a release/recapture experiment and direct observation in the wild also supported that inference.
- Of course the textbook photos were staged. What researcher has the time to waste standing around and waiting for two contrasting forms of the moths to land in the right condition? The pictures are simply illustrations to show the contrasting forms, they are not the evidence.

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[Figure of two circle graphs:]

“Natural Resting Locations of Peppered Moths”

“Resting Locations of Peppered Moths Found Near Traps”

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## Addressing Icon # 6 in the Classroom

There are many activities that allow students to simulate the peppered moth story or other similar examples of natural selection. Some use paper cut-outs of moths distributed on various kind of backgrounds, some use toothpicks of different colors and others use various foods or candies. A few sample activities can be found at <http://www.indiana.edu/~ensiweb/evol.fs.html>.

Check out one of Well’s primary sources with your students to see how he misuses the source.

Majerus, M. E. N. (1998). *Melanism: evolution in action*. Oxford ; New York, Oxford University Press, pp. xiii, 338. *Link:* <http://www.amazon.com/exec/obidos/ASIN/0198549822>

Use this update from Miller and Levine when teaching about Peppered moths.

<http://bioocrs.biomed.brown.edu/Elephant%20tuff/Chapters/Ch%2014/Moths/Moth-Update.html>

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## Icon # 7 Darwin’s Finches

**Slide 25:** [Figure of Darwin’s Finches]

Question to ask your biology teacher # 7: Why do textbooks claim that beak changes in the Galapagos finches during a severe drought can explain the origin of species by natural selection – even though the changes were reversed after the drought ended, and no net evolution occurred?

Here Wells references a portion of a 20 year + research project of Peter and Rosemary Grant who have been studying the medium ground finch on Daphne Major.

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## The Scientific Response

- On page 54 of “Icons” Wells says, “This booklet is not talking about decent with modification *within* a species, because no one ever questioned that anyway.” In light of this statement, I find it interesting that Wells has issues with peppered moths and the Grant’s work on Darwin’s Finches since these changes are clearly decent with modification within a species.
- The main point of the Grant study and others is that micro-evolutionary changes can be observed to occur at rates much faster than previously thought and much faster than is needed to account for the macro-evolutionary change found in the fossil record.
- Wells focuses on the fact that the finches in Grant’s study reverted back and seems incapable of conceiving of environmental changes that are permanent or at least long term (like ice ages) instead of oscillating.

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### Addressing Icon # 7 in the Classroom

#### The Beak of the Finch

- This book is a beautifully written chronicle of more than three decades of study of evolution observed firsthand among the Galapagos finches. By Jonathan Weiner [New York: Vintage Books, 1999].
- Darwin’s Finches activity found at <http://www.pbs.org/wgbh/evolution/educators/teachstuds/unit4.html> gives students an opportunity to work with and analyze some of Peter and Rosemary Grant’s actual data.
- Scientific American Frontiers episode titled “Voyage to the Galapagos” has a good segment about the medium grand finches of Daphne Major.
- “What Darwin Never Saw” activity at <http://www.indiana.edu/~ensiweb/lessons/vid.wdns.html>

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### Icon # 8 Four-Winged Fruit Flies

**Slide 28:** [Figure of *Drosophila*]

Question to ask your biology teacher # 8: Why do textbooks use fruit flies with an extra pair of wings as evidence that DNA mutations can supply raw materials for evolution – even though the extra wings have no muscles and these disabled mutants cannot survive outside the laboratory

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## The Scientific Response

- This example is only rarely found in books and Wells only references one book in which he found it.
- He seems to acknowledge the weakness of this particular icon when he fails to include it in the textbook evaluation criteria on page 249 of “Icons.”
- When this illustration is used it is to show how genes can reprogram parts of the body to produce novel structures that may in fact provide new material for evolution. These mutant flies are an excellent example of one way mutations can provide variation for natural selection to work on.

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### Addressing Icon # 8 in the Classroom

This alleged “Icon” is Wells’ feeble attempt to incorporate standard creationists rhetoric about mutations. His desperate attempt is illustrated by the completely absurd question he asks on page 192. “If our developmental genes are similar to those of other animals, why don’t we give birth to fruit flies instead of human beings?”

Providing your students with the molecular genetics needed to understand the nature of mutations should be more than enough to counter this one.

Help your students better understand the homeobox genes using the short video clip at [http://www.pbs.org/wgbh/evolution/librar/03/4/1\\_034\\_04.html](http://www.pbs.org/wgbh/evolution/librar/03/4/1_034_04.html)

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### Icon # 9 Fossil Horses and Directed Evolution

**Slide 31:** [Figure of horse phylogenetic tree]

Here Wells takes exception with textbooks that have replaced the traditional illustration showing the linear progression from Hyracotherium to modern horses with ones showing a more branching or bushy one like the one shown here.

He seems to be suggesting that this is part of some conspiracy to convince readers that horse evolution is undirected. He apparently wants people to believe that the evolution of horses was directed.

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## The Scientific Response

- The misconception of evolution being “directed” or “goal oriented” has been fostered by over-simplified illustrations that implied linear sequences of evolutionary change.
- The branching or bushy diagrams much better reflect prevailing wisdom and more importantly, the fossil record.
- The linear “icon” of horse evolution is designed to illustrate how micro-evolutionary changes can accumulate to result in macro-evolution.
- It is interesting that here Wells is willing to abandon his objection to macro-evolution as long as it appears directed.
- Wells seem to realize the weakness of this icon as it fails to make neither his textbook evaluation criteria nor his “10 Questions to Ask Your Biology Teacher.”

## Addressing Icon # 9 in the Classroom

Fossil Horses FAQs

<http://www.talkorigins.org/faqs/horses/>

Fossil Horse Cybermuseum

<http://www.flmnh.ufl.edu/natsci/vertpaleo/fhc/firstCM.htm>

Avoid the use of simplified diagrams showing apparent linear evolutionary sequences. They lead to the misconception of evolution being goal driven or directed when the fossil record is really much more complex. Reinforce the “bushy” nature of evolution.

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## Icon # 10 From Ape to Human The Scientific Response

**Slide 34:** [Figure of linear human evolution]

Question to ask your biology teacher # 9: Why are artists drawings of ape-like humans used to justify materialistic claims that we are just animals and our existence is a mere accident – when fossil experts cannot agree on who our supposed ancestors were or what they look like?

- Wells seems to get completely away from his primary premise that these icons are common in textbooks as he is not able to identify a single text with this icon. He also does not include this icon in his textbook review criteria.
  - I was only able to find satirical comics of this icon (usually Gary Larson’s) and the one from the “Big Daddy” propaganda tract shown on the previous slide.
  - Wells contradicts himself on two previous icons:
    1. He objected to the discussion of the fraudulent Haeckel embryo drawings being discussed in textbooks but seemed to take issue with the fact that the Piltdown Man hoax is NOT being included.
    2. He advocates using the linear horse evolution sequence since it suggests directed evolution but opposes the use of a hominid linear sequence because he finds ape to human evolution unpalatable even as directed evolution.
- (continued on next slide)

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## The Scientific Response

- His reference to the lack of hominid fossils from 5-10 m.y.a. is absurd since most of human evolution plays out in the last 5 million years.
- He virtually ignores the significant hominid fossil finds of the last 20 years.
- By emphasizing the Piltdown Man hoax, he seems to be implying that no fossil hominid finds can be accepted as reliable.
- He uses a standard creationist strategy of suggesting that healthy scientific debate equates to a theory in crisis. If so, almost all science is in crisis.

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## Addressing Icon # 10 in the Classroom

Try some activities from The Evolution Project’s unit on Human evolution found at

<http://www.pbs.org/wgbh/evolution/educators/teachstuds/unit5.html>

There are many good human evolution activities at

<http://www.indiana.edu/~ensiweb/evol.fs.html>

Look under the heading “Human Evolution Patterns” where you will find:

- Hominoid Cranial Comparison
- Chronology Lab (ML)
- Comparison of Human & Chimpanzee Chromosomes
- Molecular Sequences & Primate Evolution
- Footsteps in Time (ML)
- Classroom Cladogram of Vertebrate/Human Evolution
- A Cladistic Exercise Using Primates

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## Who Is Jonathan Wells?

**Slide 38:** [Pic. of Jonathan Wells]

The biography in his book mentions his PhD in biology from the University of California. It might cause one to conclude that he has come to reject Darwinism as a result of his study of biology.

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## More About Wells

What is missing from the biographical information in his book can be found at [www.tparents.org/Library/Unification/Talks/Wells/O-Toc.htm](http://www.tparents.org/Library/Unification/Talks/Wells/O-Toc.htm).

Wells is a member of the Unification Church and a devoted follower of the founder, the Reverend Sun Myung Moon (whom they call the “Father”).

Wells writes,

“Father’s (Moon’s) words, my studies, and my prayers convinced me that I should devote my life to destroying Darwinism.....When the father chose me to enter a PhD program in 1978, I welcomed the opportunity to prepare myself for battle.”

Not exactly the opened minded scientist you may have thought he was.

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Selected Quotes About Wells and “Icons”  
Evolution does not stand or fall on whether a high school book simplifies an example of natural selection. Eugenie C. Scott National Center for Science Education

In his book, Wells alleges the scientific community is orchestrating a worldwide conspiracy to cover-up evidence that casts doubt on evolution so it can continue some sort of aversive agenda. If that sounds crazy, that is because it is. Don Michael

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## Quotes Continued

Well’s thesis is that biology textbooks misrepresent classic, but flawed, examples that purport to support evolutionary concepts. Because these examples are wrong, Wells infers that there must be no evidence for the concepts themselves. He does not attempt to find better examples, nor does he show how the examples could be explained more correctly. He also does not explain that coverage in most pre-college textbooks is necessarily brief and usually simplified. His job is to sow doubt in the minds of those who do not know the examples or concepts first hand.

Kevin Padian and Alan Gishlick Univ. Of Cal & NCSE

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## Quotes from scientists referenced to in “Icons”

Creationists such as Jonathan Wells claim that my criticism of these experiments (peppered moths) casts strong doubt on Darwinism. But this characterization is false. All of us in the peppered moth debate agree that the moth story is a sound example of evolution by natural selection. My call for additional research on the moths has been wrongly characterized by creationists as revealing some fatal flaw in the theory of evolution.....It is a classic creationist tactic to assert that healthy scientific debate is really a sign that evolutionists are either committing fraud or buttressing a crumbling theory. In reality, evolution and natural selection are alive and well, with new supporting evidence arriving daily.

Jerry A. Coyne  
Professor of Ecology and Evolution  
The University of Chicago

To one outside the field he passes as a scholar, complete with Ph.D. Unfortunately, Dr. Wells is intellectually dishonest. When I first encountered his attempts at journalism, I thought that he might be a woefully deficient scholar because his critiques about peppered moth research was full of errors, but soon it became clear that he was intentionally distorting the literature in my field..... Perhaps it might be kinder to suggest that Wells is simply incompetent, but I think his errors are by intelligent design.

Bruce Grant  
Professor of Biology  
College of William and Mary

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## Book Resources

For an up-to-date and comprehensive overview of evolution:

Evolution: The Triumph of an Idea

By Carl Zimmer

For a scientific response to various forms of creationism:

Finding Darwin’s God

By Kenneth Miller

For a teacher’s guide to the creation/evolution controversy:

Defending Evolution

By Brian & Sandra Alters

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## Other Reviews of Icons

In the *Quarterly Review of Biology*, Review by Kevin Padian & Alan Gishlick vol 77(1):33-37, March 2002 (PDF 5 pages; **excellent overview and background**):

<http://www.journals.uchicago.edu/QRB/journal/issues/v77n1/770103/770103.web.pdf>

Responses to Jonathan Wells' "Ten Questions to Ask Your Biology Teacher"

[http://www.ncseweb.org/resources/articles/7719\\_response\\_to\\_jonathan\\_wells3\\_11\\_28\\_2001.asp](http://www.ncseweb.org/resources/articles/7719_response_to_jonathan_wells3_11_28_2001.asp)

In *TalkOrigins*: "Icons of Obfuscation" by Nic Tamzek: <http://www.talkorigins.org/faqs/wells/>

Icons of Anti-Evolution: <http://www.nmsr.org/iconanti.htm>

CSE review of “Icons” <http://www.ncseweb.org/icons/>

You can find most of the above and more linked at <http://www.indiana.edu/~ensiweb/lessons/icon.cr.htm>

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