

OVERCOMING OBSTACLES TO EVOLUTION EDUCATION Open Access

# Kentucky's A-minus defense of evolution

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## Abstract

A recent report from the Kentucky Department of Education summarizes and responds to comments from the public about the treatment of evolution in the Next Generation Science Standards, under consideration for adoption in Kentucky. The responses are assessed, receiving the overall grade of A-minus, and their usefulness as a model for teachers facing similar comments is discussed.

**Keywords:** Teaching evolution; State science standards; Creationism

Once in a while, a government agency produces a document that repays the scrutiny of anyone interested in improving the teaching of evolution. A famous case in point was the notorious disclaimer mandated by the Alabama Board of Education in 1995, which required biology textbooks in the state to contain a sticker warning, 'This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals and humans', and rehearsing a list of familiar and long-ago-debunked objections to evolution. In a speech delivered at Auburn University in Alabama in 1996, Richard Dawkins dissected the disclaimer in merciless detail, describing it, accurately, as manifesting 'ignorance and dishonesty'; a transcript of his speech was published by the Alabama Academy of Science (Dawkins 1997) and again recently in a Darwin anniversary volume produced by faculty at Auburn University (Dawkins 2013). And yet the disclaimer, albeit in a weakened form, continues to be present in the state's science standards.

On 1 August 2013, the Kentucky Department of Education produced a report that similarly repays scrutiny. Unprepossessingly entitled 'Statement of consideration relating to 704 KAR 3:303 Kentucky Core Academic Standards', the report (Kentucky Department of Education (KDE) 2013) summarizes, and responds to, comments from the public about a proposed regulation that would enact the Next Generation Science Standards (NGSS) as the state's science standards. As *The New York Times* observed when the NGSS were issued in their final form, 'The climate

and evolution standards are just two aspects of a set of guidelines containing hundreds of new ideas on how to teach science. But they have already drawn hostile commentary from conservative groups critical of mainstream scientific thinking' (Gillis 2013). The trend continued in Kentucky, where the bulk of the public comments concerned the topics of evolution and climate change. Unlike the Alabama disclaimer, however, the KDE's responses consistently and accurately reflected the scientific community's consensus on evolution.

It is still worth examining the KDE's report in detail. The NGSS will be considered for adoption elsewhere, and even in states that do not consider the NGSS, similar comments are likely to be offered by the public on state science standards, textbooks under consideration for state or local adoption, and even the syllabus and instruction of individual biology classes. Moreover, it is instructive to investigate how the staff at the KDE answered the comments critical of evolution - not only to see where their responses were correct and helpful and where they were not, but also to consider to what extent their responses would be usable by teachers needing to answer similar questions from students, parents, and members of their community. And although the report reflects only the expertise of the staff in one state's department of education, it is encouraging to think that their counterparts elsewhere may be similarly knowledgeable and articulate, especially when they are consulted by teachers facing pressure. In a pedagogical spirit, grades will be assigned.

The public comments critical of evolution are, predictably, categorizable in terms of what have been dubbed the three pillars of creationism. Described as 'the main rhetorical themes used by the creationist movement in the United States', they consist of three claims: '(a) that evolution is a

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theory in crisis, teetering on the verge of scientific collapse and increasingly abandoned by a scientific community unwilling to acknowledge its bankruptcy in public; (b) that the acceptance of evolution is linked, logically or causally, with religious apostasy, moral turpitude, and social decay; and (c) that fairness, objectivity, or a comparable secular ideal dictates that both creationism and evolution - or, in a modern variant arising in response to creationism's failure to survive judicial scrutiny, the "evidence for and against evolution" - ought to be taught in the public schools' (Branch et al. 2010). Although the KDE's document is not organized along these lines, it will be helpful to reorganize the public comments and the KDE's responses to them in accordance with the three pillars.

### **Evolution is a theory in crisis**

#### **Comments**

A commenter stated that the science curriculum should not include Darwinism. (KDE 2013, p. 103)

Commenters stated that evolution is not settled science.

Commenters stated that evolution is not a scientific idea.

Commenters stated that the teaching of evolution misleads students.

Commenters stated that there is not a consensus within the scientific community regarding evolution as the primary mechanism to explain the diversity of organisms. (KDE 2013, pp. 108–109)

#### **KDE's response**

Biological evolution is the fundamental, unifying theory that underlies all the life sciences. It has formed the basis of productive research for over a century. Few scientific theories have had as transformative and widespread impact on their respective fields as has evolution. This is why evolution is universally accepted among professional biology researchers. According to the Association of College and University Biology Educators (ACUBE), knowledge of evolutionary theory is essential for success in every biology course of study. (KDE 2013, p. 104)

There is no significant ongoing debate within the scientific community regarding the legitimacy of evolution as a scientific idea. Inconsistencies and unknown details exist in all areas of scientific research and knowledge. The existence of inconsistencies and unknown factors does not negate the dramatically larger body of evidence supporting the prevailing theories in those areas of research.

The agency has determined that professional scientific bodies and organizations supporting the legitimacy of the concept of biological evolution as a cornerstone of the science of biology include:

[long list omitted]

Educational organizations supporting the legitimacy of the concept of biological evolution as a cornerstone of the science of biology include:

[long list omitted]

In light of the wide, and deep, support for the teaching of biological evolution, the agency has determined that biological evolution should remain an element of the Kentucky Core Academic Standards for Science. (KDE 2013, p. 110–113)

#### **Assessment**

The KDE takes exactly the right approach here. It is not the job of state education administrators to explain in detail why the scientific community is thoroughly convinced of the scientific legitimacy of evolution and the importance of including evolution in science education. Rather, it is their job to recognize that fact and to proceed accordingly. A teacher faced with such objections, whether inside or outside the classroom, might feel it useful or appropriate to review or sketch the evidence for evolution in response, but would also find it useful to follow the KDE's model, since the approach of appealing to the consensus of scientific and educational organizations (as well as to the state science standards) places the responsibility for the decision to teach evolution where it belongs. The lists of scientific and educational organizations cited by the KDE, by the way, are apparently taken from *Voices for Evolution* (Sager 2008), the National Center for Science Education's collection of organizational statements in support of teaching evolution. Full marks to the KDE: 10 points of a possible 10.

#### **Comments**

Commenters stated that evolution is only a theory and is not a fact. (KDE 2013, p. 109)

Over 100 substantially identical emails were received stating an opposition to the continued inclusion of evolution in the proposed standards, characterizing evolution as a theory and not a fact. (KDE 2013, p. 129)

#### **KDE's response**

The agency has determined that, in the scientific and science education communities, a theory is a statement of general ideas that explains many observations of the natural world. In the scientific and science education communities, the word 'theory' is a very precise term that identifies a concept that has great utility in explaining phenomena in the natural world. Ideas only rise to the level of scientific theories if they have withstood scrutiny and are exceptionally useful in explaining a wide variety of independent observations. Any scientific theory can be altered or replaced if the theory cannot adequately explain new observations or new scientific evidence.

In the field of science, facts do not become theories. Rather, theories explain facts. No theory is immune from revision or replacement in the face of new facts. There is a substantial difference between the everyday and conversational meaning of the word ‘theory’, and the scientific meaning of the word. In everyday conversation, an idea is often labeled a theory for the purpose of painting it as little more than a guess. As explained above, the scientific meaning of the term is much narrower. The NGSS employ the scientific meaning of ‘theory’. Referring to biological evolution as a theory, for the purpose of contesting it, does not weaken the acceptance of biological evolution within the scientific and science education communities. (KDE 2013, p. 110)

#### **Assessment**

For decades, scientists (for example, Gould 1981, Gregory 2008) have insisted that in science, a theory is not necessarily conjectural or speculative. Even the creationist ministry Answers in Genesis cautions against the misconception (Answers in Genesis nd). So it is discouraging that calling evolution ‘only a theory and not a fact’ is still widely regarded as a powerful criticism. But it is encouraging that the KDE offers such a clear and accurate rebuttal: theories are not guesses or hunches. It is also praiseworthy that the KDE avoided repeating a faulty response from the National Academy of Sciences, that a theory is ‘a comprehensive explanation of some aspect of nature *that is supported by a vast body of evidence*’ (National Academy of Sciences (NAS) 2008, p. 11, emphasis added). The emphasized phrase is problematic: while theories are often supported by a vast body of evidence, they are not always. Nascent theories (like string theory) and obsolete theories (like caloric theory) are genuinely theories, even though a vast body of evidence is not presently thought to support them. Full marks to the KDE: 10 points of a possible 10.

### **Teaching evolution is religiously, morally, and socially dangerous**

#### **Comments**

Commenters objected to the continued inclusion of evolution in the science standards and stated that the teaching of evolution will lead to a variety of negative social consequences, including the negation of religious belief, the marginalization of students with religious beliefs, the promotion of socialism and resulting genocide and murder, drug abuse, suicide, hopelessness, the limitation of personal freedom, and the belief that might makes right. (KDE 2013, p. 103)

#### **KDE’s response**

Comments regarding the negative societal impact of teaching evolution appear to be based on personal opinion. (KDE 2013, p. 104)

#### **Assessment**

The KDE’s response is understandably succinct. It is likely that the commenters expressed their objections as personal opinions, without attempting to provide any evidence, and as the maxim runs, what is asserted without evidence may be denied without evidence. When faced with such objections from students, parents, or members of the community, however, a teacher might consider engaging the concerns by asking for the evidence, if any, that underlies the objections, and referring the objectors to reliable scholarly literature on the historical development and social influence of evolutionary thought (for example, Bowler 2009) and on the various social phenomena mentioned in the objections. Objections of a religious nature require care to answer, since a teacher should not endorse any particular religious reaction to evolution as authoritative, but it is permissible, and often helpful, for a teacher to suggest resources that reveal the diversity of religious reactions to evolution to someone who might have thought that rejection is the only possibility. Full marks to the KDE: 10 points of a possible 10.

#### **Comments**

A commenter stated that asking educators to teach evolution would violate the educators’ right to exercise their moral and religious beliefs.

A commenter stated that outsiders are imposing the elitist and rich man’s religion of evolution on the families of public school students, taking away the right to worship God. (KDE 2013, p. 103)

#### **KDE’s response**

Evolution is a scientific theory, and is not a religion. Nothing in the NGSS restricts the religious freedom of Kentucky families or educators. (KDE 2013, p. 104)

#### **Assessment**

The KDE’s response is good as far as it goes. But given the references to ‘rights’ with the attendant hint of a possible lawsuit over the adoption or the implementation of the NGSS, it would have been appropriate to observe that such objections already have been the subject of litigation in the federal courts. The decision in *McLean v. Arkansas* commented, ‘it is clearly established in the case law, and perhaps also in common sense, that evolution is not a religion and teaching evolution does not violate the Establishment Clause’ (quoted in Larson 2012, p. 128), and in cases such as *Webster v. New Lenox School District No. 122* and *Peloza v. Capistrano Unified School District*, the courts have found that teachers have no First Amendment rights to teach creationism or to refuse to teach evolution while they are in the public school classroom (Larson 2012, pp. 200–203). A teacher faced

with such objections might want to avoid playing lawyer, however; the objector might instead be politely referred to the attorney who represents the local school district. The KDE's response receives 8 points of a possible 10.

### **It's only fair to teach creationism or 'the evidence against' evolution**

#### **Comments**

A commenter requested that creationism and intelligent design be included in the standards, but through a secular approach, free from supernatural or theological explanations. A commenter stated that it is a good idea to discuss intelligent design from both a secular and a religious viewpoint. (KDE 2013, p. 105)

Commenters requested that intelligent design be added to the standards. (KDE 2013, p. 106)

#### **KDE's response**

The agency has determined that the omission of creationism and intelligent design from the standards was based primarily on overwhelming scientific consensus. The agency has determined that the overwhelming majority of scientists do not consider creationism and intelligent design as scientific theories. Accordingly, their omission from the NGSS reflects the consensus view among professional scientists and science educators. Even if it were possible to reword the basic ideas of creationism to exclude a theological or supernatural creator, or to discuss intelligent design without discussing the identity of the hypothesized designer (thus avoiding the legal objection), those ideas would still lack meaningful scientific support.

Additionally, courts have repeatedly declared unconstitutional the teaching of creationism and intelligent design on the basis that such teaching violates the Establishment Clause of the First Amendment to the United States Constitution. See, for example, *Tammy Kitzmiller, et al. v. Dover Area School District, et al.*, 400 F. Supp.2d 707 (M.D.Pa. 2005) and *Daniel v. Water[s]*, 515 F.2d 485 (6th Cir. 1975).

The NGSS do not attempt to explain the origin of life. Creationism and intelligent design attempt to explain the origin of life. Evolution does not conflict with creationism or intelligent design because the ideas do not attempt to explain the same things. (KDE 2013, pp. 105–106, italics added)

#### **Assessment**

As before, the KDE takes exactly the right approach in appealing to the consensus of the scientific and educational communities that creationism (whether creation science or intelligent design) is not science and is not suitable for the science curriculum. The reference to the case law on teaching creationism is helpful, although the important Supreme Court case *Edwards v. Aguillard* was not mentioned. The last paragraph is problematic. First, whether or not origin

of life research is considered to be part of evolution, it is subjected to the same extrascientific objections, and should be defended in the same way (Branch and Scott 2012). Second, creationism and evolution are in conflict, although the details of the conflict depend on which form of creationism is in question. (The KDE may have been thinking of creation, in the sense of the idea that God created, but that idea is not creationism per se, which involves specific claims about how God created). With the deduction of two points for the confusion in the last paragraph and half a point for the omission of *Edwards*, the KDE receives 7.5 points of a possible 10.

#### **Comments**

Commenters asked that additional revision be made to the Kentucky Core Academic Standards for Science for the purpose of refuting evolution and climate change.

Commenters requested the addition of: epigenetic factors, the improbability of random mutation as a driving factor in genetic change, the ideas of the Altenberg 16 in opposition to evolution, Flavius Josephus' study of the accuracy of scripture, the observations of Moses, the existence of man-made metal spheres in the Precambrian, canopy theory, dynamic decay theory, the hydro-plate theory, research on the effect of solar flares on the earth's magnetic field, and other ideas not contained in the proposed science standards. (KDE 2013, p. 106)

A commenter stated there are non-religious objections to evolution, and cited the works of Cambridge biochemist Douglas Axe, Moeller and Newman, epigenetics, the work of the Altenberg 16, University of San Francisco paleontologist Paul Chien, and others. He asked that students be taught alternative scientific explanations to evolution and to reject the proposed standards related to evolution. (KDE 2013, p. 113)

#### **KDE's response**

The NGSS include only ideas that are widely supported within the scientific and science education communities and represent core disciplinary ideas that have wide utility for students. The agency has determined that many of the ideas proposed for inclusion are not widely recognized. In scientific fields as large as biology and paleontology, there are many thousands of individuals engaging in research. It would be virtually impossible for scientists to agree upon every minute detail of every scientific concept. The fact that a small number of scientists present ideas contrary to the widely accepted scientific consensus does not automatically give their ideas equal weight and credibility. If those ideas gain wide support within the scientific and scientific education communities, it is more likely that they will be included in future revisions of the Kentucky Core Academic Standards for Science. Only scientific ideas are eligible for inclusion in science standards. A number of the ideas



suggested for inclusion (canopy theory, for one example) are not accepted as scientific theories by the scientific community and are, accordingly, not included.

...The agency has determined that the ideas of evolution, included in the standards, reflect the consensus of the overwhelming majority of scientists. There is no longer scientifically significant debate on the role of evolution in the modern study of biology. This is evidenced by the omission of the suggested ideas from the *Framework for K–12 Science Education*, published by the National Research Council of the National Academy of Science(s). The *Framework* represents core knowledge in the biological sciences. The exclusion of the suggested theories is evidence that those theories are not components of core biological knowledge, and are peripheral to science education.

The NGSS include only ideas that are widely supported within the scientific and science education communities and represent core disciplinary ideas that have wide utility for students. The agency has determined that many of the ideas proposed for inclusion are not widely recognized. If those ideas gain wide support within the scientific and scientific education communities, it is more likely that they will be included in future revisions of the Kentucky Core Academic Standards for Science. (KDE 2013, p. 114)

#### Assessment

The KDE takes exactly the right approach. With the exception of the reference to 'the effect of solar flares on the earth's magnetic field', which is presumably relevant to climate change rather than to evolution, the proposed additions are all apparently intended to undermine the treatment of evolution. It would be unrealistic to expect staffers at the KDE to be able to assess the scientific merits of the proposed, rather eclectic, set of additions themselves. Rather than providing a detailed discussion of the additions individually, the KDE appropriately appeals to the consensus of the scientific and education communities on what belongs - and what does not belong - in a science curriculum.<sup>a</sup> Including the proposed ideas would misrepresent the scientific standing of evolution as well as the scientific standing of the ideas themselves. A teacher faced with such objections should take the same approach, not assuming any personal responsibility for the decision not to teach the objector's pet theory. Full marks to the KDE: 10 points of a possible 10.

So what is the overall assessment? As graded here, the KDE's report receives a total of 55.5 points of a possible 60, which works out to a grade of 92.5% - a solid A-minus. The Kentucky Board of Education was presumably also impressed, or at least satisfied, with the defense of the NGSS's treatment of evolution, since it voted, on 8 August 2013, to approve the report. Governor Steve Beshear decided to adopt the NGSS - but it is still possible for the state legislature to override his decision (Wynn 2013). In a

column for the *Louisville Courier-Journal* commenting on the NGSS, the chair of the Kentucky Senate Education Committee complained that there is 'no factual evidence' of speciation - 'to suppose that it happens is counter to the beliefs of many Kentuckians', he explained (Wilson 2013). In the meantime, the KDE's report stands as a useful - if not perfect - model, not only for state educational administrators elsewhere but also, with requisite changes to correspond with their different situations, individual teachers, of how to respond to the pillars of creationism.

#### Endnotes

<sup>a</sup>For the sake of completeness, here is a brief discussion. The proposed additions relevant to evolution are of two sorts: ideas that have been broached in the scientific literature but are not generally accepted by the scientific community, and which are often misrepresented by creationists as challenges to evolution as such, and ideas that are not scientifically credible at all.

In the first category are the reference to 'epigenetic factors', presumably a hint that evolutionary theory needs to be substantially revised to account for heritable epigenetic changes, as argued by, for example, Lamb and Jablonka (2005); the reference to the 'Altenberg 16', which was a gathering of scientists in Altenberg, Austria, in 2008 to discuss the broadening of the modern evolutionary synthesis (Pigliucci and Müller 2010), which was misleadingly sensationalized as a challenge to evolution (Pigliucci 2010, pp. 99–103); and the reference to 'Moeller and Newman', presumably a reference to a book edited by Müller and Newman (2003), which (like the Altenberg 16) explores the prospects of broadening the modern evolutionary synthesis.

'Cambridge biochemist Douglas Axe' is a scientist who previously held a postdoctorate position at Cambridge University but now directs the Biologic Institute, which is closely associated with the Discovery Institute, the *de facto* institutional home of intelligent design creationism. Axe's publications include both articles in the legitimate scientific literature and articles in the Biologic Institute's house journal *BIO-Complexity*, which is not regarded as part of the scientific literature (Branch 2010), so it is unclear in which category the proposed addition of Axe belongs.

The rest of the proposed additions are in the second category. 'University of San Francisco paleontologist Paul Chien' is not a paleontologist but a marine biologist with no publications in the paleontological literature, who was long involved in efforts to recruit Chinese paleontology to the cause of intelligent design creationism (Forrest and Gross 2004, pp. 49–66). The reference to 'the improbability of random mutation as a driving factor in genetic change' is a stock creationist canard contravened by decades of scientific research. The reference to 'Flavius Josephus' study of the accuracy of scripture' is obviously

irrelevant to biology. The reference to the ‘observations of Moses’ is to a self-published work (Ephraim 2007) by a relentlessly self-publicizing creationist who regards himself as ‘the leading expert on the book of Genesis’. The reference to ‘man-made metal spheres in the Precambrian’ is presumably to the Ottosdal spheres, which, though Precambrian, are not artificial (Heinrich 2008). The reference to ‘canopy theory’ is to a young-earth creationist idea about the source of the water in Noah’s Flood; the reference to ‘dynamic-decay theory’ is to a young-earth creationist idea about the earth’s magnetic field; the reference to ‘the hydro-plate theory’ is to a rival young-earth creationist idea about the source of the water in Noah’s Flood: none possesses any scientific credibility whatsoever.

#### Competing interests

The author declares that he has no competing interests.

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