

For the attention of the Superintendent of Public Instruction
Arizona Department of Education

15 May 2018

Dear Diane Douglas,

We write on behalf of the Association for Science Education (ASE), the United Kingdom's professional learning community supporting all those involved in science education from pre-school to higher education for over a century.

Because ASE was intimately involved in *Working with Big Ideas of Science Education* (2015),¹ it was with pleasure that we observed that the draft science standards for Arizona took it as one of two foundational documents. Unfortunately, it appears that changes were made to a particular key passage from *Working with Big Ideas of Science Education* that compromises the scientific accuracy and the pedagogical effectiveness of the idea. We are writing to explain these changes and to express our opposition to them.

Among the fourteen Big Ideas is evolution, which, according to *Working with Big Ideas*, may be described as follows:

The diversity of organisms, living and extinct, is the result of evolution

All life today is directly descended from a universal common ancestor that was a simple one-celled organism. Over countless generations changes resulting from natural diversity within a species lead to the selection of those individuals best suited to survive under certain conditions. Species not able to respond sufficiently to changes in their environment become extinct.²

According to documents on the Arizona Department of Education's website, the writing committee proposed to adapt this language as follows:

The **unity and** diversity of organisms, living and extinct, is the result of evolution.
~~All life today is directly descended from a universal common ancestor that was a simple one-celled organism.~~ Over countless generations changes resulting from natural diversity within a species lead to the selection of those individuals best suited to survive under certain conditions. Species not able to respond sufficiently to changes in their environment become extinct.³

Further changes were then proposed during internal review, resulting in:

¹ *Principles and Big Ideas of Science Education* (2010) was developed by ten scholars of science education, including a former chief executive and a former president of ASE, and was published by ASE. *Working with Big Ideas of Science Education* (2015), its successor, was developed by ten scholars of science education, including a former chief executive and two former presidents of ASE, and is distributed in the UK by ASE.

² *Working with Big Ideas of Science Education*, p. 16.

³ <https://cms.azed.gov/home/GetDocumentFile?id=5ab9460f3217e11ee4f2f427>, p. 79; the first sentence appears similarly modified on pp. 4 and 72. Boldface indicates additions; strikethrough indicates deletions.

The theory of evolution seeks to make clear the unity and diversity of organisms, living and extinct, ~~is the result of evolution~~ organisms. Over countless generations changes resulting from natural diversity within a species **are believed to lead to the selection of those individuals best suited to survive under certain conditions. Species not able to respond sufficiently to changes in their environment become extinct.⁴**

It is this version that was put forward for public comment. There are four divergences from the original that deserve comment from ASE.

First, where *Working with Big Ideas* refers to the diversity of organisms as the result of evolution, the writing committee's version refers to the unity and diversity of organisms as the result of evolution. The decision may reflect the approach taken in the National Research Council's *Framework* (2012), the other foundational document of the draft Arizona standards, which takes "Biological Evolution: Unity and Diversity" as a core idea of the life sciences.⁵ ASE has no objections to this change.

Second, where *Working with Big Ideas* explicitly mentions common ancestry, the writing committee's version deletes the sentence altogether. While we are reluctant to second-guess our science education colleagues on the writing committee, we wish to observe that we do not regard common ancestry as dispensable. In the learning progression for the idea of evolution suggested in *Working with Big Ideas*, for example, common ancestry is explicitly included as part of the history of life.⁶ Similarly, the NRC's *Framework* regards evidence of common ancestry and diversity as part of the core idea of evolution.⁷ Whether or not the writing committee's decision to omit common ancestry was taken in order to avoid anticipated objections from those with religious objections to common ancestry, ASE opposes this change and recommends the restoration of the reference to common ancestry.

Third, where *Working with Big Ideas* describes the diversity of organisms as the result of evolution (and where the writing committee's version describes the unity and diversity of organisms as the result of evolution), the proposed standards shift the topic, describing what "[t]he theory of evolution seeks to make clear." This is a remarkable locution, found nowhere else in the standards. It would be rather odd to say "Genetics seeks to make clear how the development and structure of organisms is determined" or "Cell theory seeks to make clear how the basic functions of life are the results of what happens within cells," to offer similar edits of other core ideas in the standards. The intent of the revision is clearly to ensure that the standards are not committed to the scientific legitimacy of evolutionary theory and to license Arizona science teachers to miseducate their students accordingly. This is scientifically misleading and pedagogically inappropriate. ASE strongly opposes this change and recommends the restoration of the original language.

Fourth, where *Working with Big Ideas* (and the writing committee's version) asserts that "changes resulting from natural diversity within a species lead to the selection of those

⁴ <https://cms.azed.gov/home/GetDocumentFile?id=5ab417b63217e11f9482a57e>, p. 78; the first sentence appears similarly modified on pp. 4, 20, 32, 46, and 70. Boldface indicates additions; strikethrough indicates deletions.

⁵ National Research Council, *A Framework for K–12 Science Education* (2012), p. 142; see also p. 162: "Biological evolution ... explains both the unity and the diversity of species."

⁶ *Working with Big Ideas of Science Education*, p. 29.

⁷ *A Framework for K–12 Science Education*, p. 142.

individuals best suited to survive under certain conditions,” the proposed standards instead asserts that such changes “are thought to” lead to such selection. As before, this is a remarkable locution, found nowhere else in the standards. It would be rather odd to say that “All matter in the universe is thought to be made of very small particles” or “Organisms are thought to be organized on a cellular basis and have a finite life span,” to offer similar edits of other core ideas of the standards. The intent of the revision is clearly to ensure that the standards are not committed to the scientific legitimacy of natural selection and to license Arizona science teachers to miseducate their students accordingly. This is scientifically misleading and pedagogically inappropriate. ASE strongly opposes this change and recommends the restoration of the original language.

To summarise, ASE recommends the restoration of the original description of evolution in *Working with Big Ideas*, edited to add “unity and” to the first sentence per the writing committee’s suggestion, and the implementation of whatever further edits are necessary to ensure the consistency of the document. Not doing so would mischaracterize the Big Idea of Evolution and undermine the scientific literacy of Arizona’s students.

As a UK organization, ASE is not ordinarily directly concerned with science education in Arizona; we felt it necessary to weigh in because *Working with Big Ideas* was acknowledgedly so important to the drafting of the proposed Arizona state science standards and because its treatment of evolution was so damaged in the process. But allow us to take the opportunity to say that there is a lot to applaud (if, unfortunately, also some to regret) in the draft standards, and we salute the hard work and good intentions of those who have contributed to them. Whether in London or Phoenix, Birmingham or Tucson, Manchester or Mesa, students deserve our best efforts to ensure that they receive the best science education possible.

Sincerely,



Shaun Reason, Chief Executive, The Association for Science Education



Marianne Cutler, Director Curriculum Innovation, The Association for Science Education



Professor Wynne Harlen, OBE, PhD, Past President, The Association for Science Education



Professor Michael Reiss, Professor of Science Education, Past President, The Association for Science Education



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