SC EDUCATION OVERSIGHT COMMITTEE

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Agenda

Special Panel of the State Board of Education and EOC
Regarding High School Biology Standard H.B.5.

July 29, 2014

10:00 a.m.

Room 501 Blatt Building

Dr. Traci Young Cooper, Chair Elect, SBE
Dr. Rhonda Edwards, SBE
Dr. Danny Varat SBE
Ms. Anne Bull, EOC
Senator Mike Fair, EOC
Mr. Neil Robinson, EOC

Review of Standard H.B.5.

Comments from South Carolina Department of Education

BIOLOGICAL EVOLUTION – UNITY AND DIVERSITY

Standard H.B.5: The student will demonstrate an understanding of biological evolution and the unity and diversity of life on Earth.
(In red is the additional language to be discussed on July 29, 2014)

H.B.5A. Conceptual Understanding: Scientific evidence from the fields of anatomy, embryology, biochemistry, and paleontology underlie the theory of biological evolution. The similarities and differences in DNA sequences, amino acid sequences, anatomical features and fossils all provide information about patterns of descent with modification. Organisms resemble their ancestors because genetic information is transferred from ancestor to offspring during reproduction.

Performance Indicators: Students who demonstrate this understanding can:

H.B.5A.1 Analyze scientific data to explain how multiple lines of evidence (including DNA or amino acid sequences, anatomical and embryological features, fossils and artificial section) are used to investigate common ancestry and descent with modification.

H.B.5A.2 Explain how scientists use data from a variety of sources to investigate, critically analyze, aspects of the theory of biological evolution.

H.B.5A.3 Construct and interpret a phylogenetic tree, based on anatomical evidence, of the degree of relatedness among various organisms and revise the model based on the inclusion of molecular (such as DNA and/or amino acid sequence) evidence.

H.B.5B.Concpetual Understanding: Biological evolution occurs primarily when natural selection acts on the genetic variation in a population and changes the distribution of traits in that population over multiple generations.

Performance Indicators: Students who demonstrate this understanding can:

H.B.5B.1 Critically analyze and interpret data to explain that natural selection results from four factors: (1) the potential for a population to increase in number, (2) the genetic variation among individuals in a species due to sexual reproduction and mutation, (3) competition for a limited supply of resources, and (4) the ensuing proliferation of those individuals that are better able to survive and reproduce in that environment.

H.B.5B.2 Conduct investigations by simulating several generations of natural selection to investigate how changes in environmental conditions may lead to changes in selective pressure on a population of organisms.

H.B.5C. Conceptual Understanding: According to the theory of biological evolution, natural selection results in populations that are adapted to a particular environment at a particular time. Changes in the physical environment have contributed to the expansion, emergence, or extinction of the Earth's species. Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Modern classification of Earth's biodiversity is based on the relationships of organisms to one another.

Performance Indicators: Students who demonstrate this understanding can:

H.B.5C.1 Analyze and interpret data, using the principles of natural selection, to make predictions about the long term biological changes that may occur within two populations of the same species that become geographically isolated from one another.

H.B.5C.2. Construct scientific arguments using data on how changes in environmental conditions could result in (1) the expansion of some species, (2) the emergence of new species over time, or (3) the extinction of other species.

H.B.5C.3. Use models of the current three-domain, six-kingdom tree of life to explain how scientists classify organisms, and how classification systems are revised over time as discoveries provide new evidence.

H.B.5D. Conceptual Understanding: Science is the systematic gathering of information through both direct and indirect observation, and the testing of this information by experimentation with the aim of developing concepts and formulation of laws and theories. Scientific conclusions are tested by experiment and observation, and evolution, as with any aspect of science, is continually open to and subject to experimental and observational testing.

Performance Indicator: Student who demonstrate this understanding can:

H.B.5D.1 Explain how scientists develop theories and laws by using deductive and inductive reasoning in situations where direct observation and testing are possible and also by inference through experimental and observational testing of historical scientific claims. Students should understand assumptions scientists make in situations where direct evidence is limited and understand that all theories may change as new scientific information is obtained.

Science Standards Timeline

January 2012 – EOC initiates cyclical review of science standards; appoints two panels to review existing standards

June 2012 – Based on work of two panels, EOC adopts *Report on the Review of the South Carolina Science Academic Standards* and forwards information to SCDE

February 2013 - SCDE publishes draft standards published and online feedback survey tool designed to get input from educators

May to July 2013 - SCDE revised and edited draft standards per public comments

October 9, 2013 - -State Board gives first reading to standards

November 18, 2013 – Academic Standards and Assessment Subcommittee reviews science standards and public input.

December 9, 2013 – EOC reviews standards and refers standards back to SCDE with suggested revisions.

January 8, 2014 – State Board considers EOC recommendations and makes revisions to the standards. Standards are given second reading and referred back to EOC.

February 10, 2014 – EOC approves all science standards as revised with one exception, H.B.5., High School Biology Evolution Standard

April 28, 2014 - EOC met and voted to recommend to the State Board of Education that the Board consider approving an additional performance indicator, H.B.5C.4 that states that students be able to:

H.B.5C.4. (NEW)

Construct scientific arguments that seem to support and scientific arguments that seem to discredit Darwinian natural selection.

June 11, 2014– State Board of Education took up EOC recommendation on H.B.5. but did not adopt EOC recommendation. Instead Board suggests that a special panel be created with three members of EOC and three members of State Board to see if issues surrounding standard can be found.

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MEMORANDUM

TO: The Honorable Mick Zais, State Superintendent of Education
Mr. Barry Bolen, Chair of the State Board of Education

FROM: Melanie Barton

DATE: April 29, 2014

IN RE: Science Standards

The Education Accountability Act (EAA) as amended requires the State Board of Education and the Education Oversight Committee (EOC) to approve all academic standards and any revisions. As you will recall, the EOC and State Board of Education have mutually approved all changes to the *2005 South Carolina Science Academic Standards* except for one standard, Standard H.B.5 of the Biology 1 course for South Carolina high schools.

On April 28, 2014, the EOC met and voted to recommend to the State Board of Education that the Board consider approving an additional performance indicator, H.B.5C.4 that states that students be able to:

H.B.5C.4. (NEW)
Construct scientific arguments that seem to support and scientific arguments that seem to discredit Darwinian natural selection

I have attached the entire standard and recommended new performance indicator. If I can answer any questions, please let me know.

Attachment

c: Members, State Board of Education
Members, Education Oversight Committee
Mr. Dino Teppara, SCDE
Dr. Cindy Van Buren, SCDE
Dr. Briana Timmerman, SCDE

NSTA Position Statement

The Nature of Science

Preamble

All those involved with science teaching and learning should have a common, accurate view of the nature of science. Science is characterized by the systematic gathering of information through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. The principal product of science is knowledge in the form of naturalistic concepts and the laws and theories related to those concepts.

Declaration

The National Science Teachers Association endorses the proposition that science, along with its methods, explanations and generalizations, must be the sole focus of instruction in science classes to the exclusion of all non-scientific or pseudoscientific methods, explanations, generalizations and products.

The following premises are important to understanding the nature of science.

- Scientific knowledge is simultaneously reliable and tentative. Having confidence in scientific knowledge is reasonable while realizing that such knowledge may be abandoned or modified in light of new evidence or reconceptualization of prior evidence and knowledge.
- Although no single universal step-by-step scientific method captures the complexity of doing science, a number of shared values and perspectives characterize a scientific approach to understanding nature. Among these are a demand for naturalistic explanations supported by empirical evidence that are, at least in principle, testable against the natural world. Other shared elements include observations, rational argument, inference, skepticism, peer review and replicability of work.
- Creativity is a vital, yet personal, ingredient in the production of scientific knowledge.
- Science, by definition, is limited to naturalistic methods and explanations and, as such, is precluded from using supernatural elements in the production of scientific knowledge.
- A primary goal of science is the formation of theories and laws, which are terms with very specific meanings.
    1. Laws are generalizations or universal relationships related to the way that some aspect of the natural world behaves under certain conditions.
    2. Theories are inferred explanations of some aspect of the natural world. Theories do not become laws even with additional evidence; they explain laws. However, not all scientific laws have accompanying explanatory theories.
    3. Well-established laws and theories must
        - be internally consistent and compatible with the best available evidence;
        - be successfully tested against a wide range of applicable phenomena and evidence;
        - possess appropriately broad and demonstrable effectiveness in further research.

- Contributions to science can be made and have been made by people the world over.
- The scientific questions asked, the observations made, and the conclusions in science are to some extent influenced by the existing state of scientific knowledge, the social and cultural context of the researcher and the observer's experiences and expectations.

- The history of science reveals both evolutionary and revolutionary changes. With new evidence and interpretation, old ideas are replaced or supplemented by newer ones.
- While science and technology do impact each other, basic scientific research is not directly concerned with practical outcomes, but rather with gaining an understanding of the natural world for its own sake.

References

Moore, J. 1993. *Science as a Way of Knowing: The Foundation of Modern Biology.* Cambridge, MA: Harvard University Press.

American Association for the Advancement of Science (1993). Benchmarks for Science Literacy: Project 2061. New York: Oxford University Press.

National Science Teachers Association (1997). *The Teaching of Evolution—A Position Statement of NSTA.* Washington, DC.

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McComas, W., Clough, M., & Almazroa, H. (1998). The role and character of the nature of science in W. F. McComas (Ed.) *The Nature of Science in Science Education: Rationales and Strategies* (pp. 3–39) Boston: Kluwer Academic Publishers.

National Association of Biology Teachers. (1987) *Scientific Integrity—A Position Statement.*

—Adopted by the NSTA Board of Directors, July 2000

NSTA Position Statement:

The Teaching of Evolution

Introduction

The National Science Teachers Association (NSTA) strongly supports the position that evolution is a major unifying concept in science and should be emphasized in K–12 science education frameworks and curricula. Furthermore, if evolution is not taught, students will not achieve the level of scientific literacy needed to be well-informed citizens and prepared for college and STEM careers. This position is consistent with that of the National Academies, the American Association for the Advancement of Science (AAAS), and many other scientific and educational organizations.

NSTA recognizes that a century of political controversy has prevented evolution from being emphasized in science curricula in a manner commensurate with its importance. This political controversy has been accompanied by anti-evolution policies, the intimidation of science teachers and textbook publishers, and the general public's lack of understanding about evolutionary theory. Teachers face pressure not only to eliminate or de-emphasize the teaching of evolution, but to introduce scientific misinformation and non-science into science classrooms. This pressure comes from overt advocacy of nonscientific views, such as “creation science,” “intelligent design,” or other forms of creationism, as well as the implicit advancement of those nonscientific views to “teach the controversy” or present “strengths and weaknesses of evolution.” Twisting and abusing core pedagogical principles, such as critical thinking and scientific inquiry is another strategy designed to open science classroom doors to non-science.

Declarations

Within this context, NSTA recommends that

- Science curricula, national and state science standards, and teachers should emphasize evolution in a manner commensurate with its importance as a unifying concept in science and its overall explanatory power.

- Science teachers should not advocate any religious interpretations of the natural world and should be nonjudgmental about the personal beliefs of students.

- Policy makers and administrators should not mandate policies requiring the teaching of "creation science" or related concepts, such as so-called "intelligent design," "abrupt appearance," and "arguments against evolution." Administrators also should support teachers in resisting pressures to promote nonscientific views, to deemphasize or eliminate the study of evolution, or to misrepresent the nature of science and how questions in science are answered by asking students to consider the validity of evolution through a classroom debate.

- Administrators and school boards should provide support to teachers as they review, adopt, and implement curricula that emphasize evolution. Professional development designed to assist teachers in teaching evolution in a comprehensive and informed manner is an essential part of this support.

- Parental and community involvement in establishing and supporting the goals of science education and the curriculum development process should be encouraged and nurtured in our democratic society. However, the professional responsibility of science teachers and curriculum specialists to provide students with quality science education should not be compromised by censorship, pseudoscience, inconsistencies, faulty scholarship, political influences, or unconstitutional mandates.

- Science textbooks should emphasize evolution as a unifying concept. Publishers should not be required or volunteer to include disclaimers in textbooks that distort or misrepresent the methodology of science and the current body of knowledge concerning the nature and study of evolution.

—Adopted by the NSTA Board of Directors, July 2003
Re–adopted, July 2013

NSTA offers the following background information:

The Nature of Science and Scientific Theories

Science is a method of testing natural explanations for natural objects and events. Phenomena that can be observed or measured are amenable to scientific investigation. Science also is based on the observation that the universe operates according to regularities that can be discovered and understood through scientific investigations. Explanations that are not consistent with empirical evidence or that cannot be tested empirically are not a part of science. As a result, explanations of natural phenomena that are not derived from evidence but from myths, personal beliefs,

religious values, philosophical axioms, and superstitions are not scientific. Furthermore, because science is limited to explaining natural phenomena through testing based on the use of empirical evidence, it cannot provide religious or ultimate explanations.

The most important scientific explanations are called "theories." In science a theory is a well-substantiated explanation of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses (NAS 1998). Theories are powerful tools. Scientists seek to develop theories that

- are firmly grounded in and based upon evidence;
- are logically consistent with other well-established principles;
- have been tested in diverse settings and against diverse data;
- explain more than rival theories; and
- have the potential to lead to new knowledge.

The body of scientific knowledge changes as new observations and discoveries are made. Theories and other explanations change. New theories emerge, and other theories are modified or discarded. Throughout this process, theories are formulated and tested on the basis of evidence, internal consistency, and their explanatory power.

Evolution as a Unifying Concept

Evolution in the broadest sense leads to an understanding that the natural world has a history and that cumulative change through time has occurred and continues to occur. If we look today at the galaxies, stars, the planet Earth, and the life on planet Earth, we see that the natural world today is different than in the past: galaxies, stars, planets, and life forms have evolved. Biological evolution refers to the scientific theory that living things share ancestors from which they have diverged; it is sometimes called "descent with modification." Biological evolution also encompasses a range of mechanisms that cause populations to change and diverge over time, and include natural selection, migration, and genetic drift. There is abundant and consistent evidence from astronomy, physics, biochemistry, geochronology, geology, biology, anthropology, and other sciences that evolution has taken place.

As such, evolution is a unifying concept for science. The National Research Council's *Framework for K–12 Science Education* recognizes that there are crucial core ideas in the sciences that "have application across all domains of science" and that should be emphasized in classrooms to "prepare students with sufficient core knowledge so that they can later acquire additional information on their own" (NRC 2012, pp. 30–31). This report concludes that "the core ideas in the life sciences culminate with the principle that evolution can explain how the diversity that is observed within species has led to the diversity of life across species through a process of descent with adaptive modification" (NRC 2012, p. 140). The *Next Generation Science Standards (NGSS)* is based on the *Framework* and also emphasizes evolution as a

unifying concept because of its importance across the disciplines of science. Scientific disciplines with a historical component, such as astronomy, geology, biology, and anthropology, cannot be taught with integrity if evolution is not emphasized.

There is no longer a debate among scientists about whether evolution has and is occurring. There is debate, however, about how evolution has taken place: What are the processes and mechanisms producing change, and what has happened specifically during the history of the universe? Scientists often disagree about their explanations. In any science, disagreements are subject to rules of evaluation. Scientific conclusions are tested by experiment and observation, and evolution, as with any aspect of science, is continually open to and subject to experimental and observational testing.

The importance of evolution is summarized as follows in the National Academy of Sciences publication *Teaching About Evolution and the Nature of Science*: "Few other ideas in science have had such a far-reaching impact on our thinking about ourselves and how we relate to the world" (NAS 1998, p. 21).

Creationism and Other Non-Scientific Views

The National Academy of Sciences observes in *Science, Evolution, and Creationism* that "arguments of creationists reverse the scientific process. They begin with an explanation that they are unwilling to alter—that supernatural forces have shaped biological or Earth systems—rejecting the basic requirements of science that hypotheses must be restricted to testable natural explanations. Their beliefs cannot be tested, modified, or rejected by scientific means and thus cannot be a part of the processes of science" (NAS 2008, p. 43). Because science limits itself to natural explanations and not religious or ultimate ones, science teachers should neither advocate any religious interpretation of nature nor assert that religious interpretations of nature are not possible.

The word *creationism* has many meanings. In its broadest meaning, creationism is the idea that the universe is the consequence of something transcendent. Thus to Christians, Jews, and Muslims, God created; to the Navajo, the Hero Twins created; for Hindu Shaivites, the universe comes to exist as Shiva dances. In a narrower sense creationism has come to mean "special creation": the doctrine that the universe and all that is in it was created by God in essentially its present form, at one time. The most common variety of special creationism asserts that

- the Earth is very young;
- life was created by God;
- life appeared suddenly;
- kinds of organisms have not changed since the creation; and
- different life forms were designed to function in particular settings.

This version of special creation is derived from a particular interpretation of Biblical Genesis. It is a specific, sectarian religious belief that is not held by all religious people. Many Christians and Jews believe that God created through the process of evolution. Pope John Paul II, for example, issued a statement in 1996 that reiterated the Catholic position that God created while simultaneously affirming that the evidence for evolution from many scientific fields is very strong.

“Creation science” is a religious effort to support special creationism through a semblance of the methods of science. Teachers may be pressured to include it or other related nonscientific views such as “abrupt appearance theory,” “initial complexity theory,” “arguments against evolution,” or “intelligent design theory” when they teach evolution. Claims by proponents of these views have been evaluated and discredited based on scientific evidence. These claims have no empirical power to explain the natural world and its diverse phenomena. Instead, creationists seek out supposed anomalies among many existing theories and accepted facts. Furthermore, “creation science” and these other claims do not lead to new discoveries of scientific knowledge. As such, these creationist perspectives cannot be considered science, and have no place in science classrooms.

Legal Issues

Several judicial decisions have ruled on issues associated with the teaching of evolution and the imposition of mandates that “creation science” be taught when evolution is taught. The First Amendment of the Constitution requires that public institutions such as schools be religiously neutral. Because “creation science” asserts a specific, sectarian religious view, it cannot be advocated in the public schools.

When Arkansas passed a law requiring “equal time” for “creation science” and evolution, the law was challenged in Federal District Court. Opponents of the bill included the religious leaders of the United Methodist, Episcopalian, Roman Catholic, African Methodist Episcopal, Presbyterian, and Southern Baptist churches, along with several educational organizations. After a full trial, the judge ruled that “creation science” did not qualify as a scientific theory (*McLean v. Arkansas Board of Education*, 529 F. Supp. 1255 [ED Ark. 1982]).

Louisiana's equal time law was challenged in court, and eventually reached the Supreme Court. In *Edwards v. Aguillard* [482 U.S. 578 (1987)], the court determined that “creation science” was inherently a religious idea and to mandate or advocate it in the public schools would be unconstitutional. Other court decisions have upheld the right of a district to require that a teacher teach evolution and not teach “creation science” (*Webster v. New Lennox School District #122*, 917 F.2d 1003 [7th Cir. 1990]; *Peloza v. Capistrano Unified School District*, 37 F.3d 517 [9th Cir. 1994]).

Courts have applied that same body of law to claims about "intelligent design" (*Kitzmiller v. Dover Area School District*, 400 F. Supp. 2d 707 [M.D. Pa.2005]) and efforts to deviate from a district's approved curriculum to present "the difficulties and inconsistencies of the theory" (*LeVake v. Independent School District #656*, 625 N.W. 2d 502 [Minn. Ct. App. 2001]). Courts have also found efforts to single out evolution for special scrutiny to be inherently suspect, finding that isolating evolution in that way "sends an impermissible message of [religious] endorsement (*Selman v. Cobb County School District*, 390 F. Supp. 2d 1286 [N.D. Ga., 2005] [reversed and remanded for procedural reasons], citing similar statements from *Epperson v. Arkansas*, 393 U.S. 97 [1968], and *Edwards*).

Some legislators and policy makers continue attempts to distort the teaching of evolution through mandates that would require teachers to teach evolution as "only a theory" or that would require a textbook or lesson on evolution to be preceded by a disclaimer. Regardless of the legal status of these mandates, they are bad educational policy. Such policies have the effect of intimidating teachers, which may result in the de-emphasis or omission of evolution. As a consequence, the public will only be further confused about the nature of scientific theories. Furthermore, if students learn less about evolution, science literacy itself will suffer.

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Epperson v. Arkansas, 393 U.S. 97 (1968).

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Additional Resources

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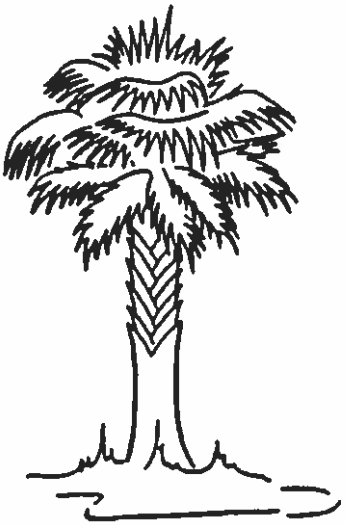
SOUTH CAROLINA
SCIENCE ACADEMIC STANDARDS



South Carolina Department of Education
Columbia, South Carolina

November 2005

BIOLOGY

Standard B-5: The student will demonstrate an understanding of biological evolution and the diversity of life.

Indicators

B-5.1 Summarize the process of natural selection.

B-5.2 Explain how genetic processes result in the continuity of life-forms over time.

B-5.3 Explain how diversity within a species increases the chances of its survival.

B-5.4 Explain how genetic variability and environmental factors lead to biological evolution.

B-5.5 Exemplify scientific evidence in the fields of anatomy, embryology, biochemistry, and paleontology that underlies the theory of biological evolution.

B-5.6 Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory.

B-5.7 Use a phylogenetic tree to identify the evolutionary relationships among different group of organisms.