Key Proposed Changes to Kansas Science Standards
Proposed deletions are shown in Blue Font (sometimes underlined)
Proposed additions are shown in Red Font
Standards to be retained unchanged are shown in Black Font
Explanatory text is shown in Bold Green Font

1. **Delete the following introductory rationale for subjecting evolutionary theory to accepted educational and scientific standards of critical analysis:**

Rationale of the State Board for Adopting these Science Curriculum Standards

We believe it is in the best interest of educating Kansas students that all students have a good working knowledge of science: particularly what defines good science, how science moves forward, what holds science back, and how to critically analyze the conclusions that scientists make.

Regarding the scientific theory of biological evolution, the curriculum standards call for students to learn about the best evidence for modern evolutionary theory, but also to learn about areas where scientists are raising scientific criticisms of the theory. These curriculum standards reflect the Board's objective of: 1) to help students understand the full range of scientific views that exist on this topic, 2) to enhance critical thinking and the understanding of the scientific method by encouraging students to study different and opposing scientific evidence, and 3) to ensure that science education in our state is "secular, neutral, and non-ideological."

From the testimony and submissions we have received, we are aware that the study and discussion of the origin and development of life may raise deep personal and philosophical questions for many people on all sides of the debate. But as interesting as these personal questions may be, the personal questions are not covered by these curriculum standards nor are they the basis for the Board's actions in this area.

Evolution is accepted by many scientists but questioned by some. The Board has heard credible scientific testimony that indeed there are significant debates about the evidence for key aspects of chemical and biological evolutionary theory. All scientific theories should be approached with an open mind, studied carefully, and critically considered. We therefore think it is important and appropriate for students to know about these scientific debates and for the Science Curriculum Standards to include information about them. In choosing this approach to the science curriculum standards, we are encouraged by the similar approach taken by other states, whose new science standards incorporate scientific criticisms into the science curriculum that describes the scientific case for the theory of evolution.

We also emphasize that the Science Curriculum Standards do not include Intelligent Design, the scientific disagreement with the claim of many evolutionary biologists that the apparent design of living systems is an illusion. While the testimony presented at the science hearings included many advocates of Intelligent Design, these standards neither mandate nor prohibit teaching about this scientific disagreement.

2. **Remove from the mission statement a goal that reasoned decisions be informed.**

Kansas science education contributes to the preparation of **all** students as lifelong learners who can use science to make **informed and** ~~-~~reasoned decisions that contribute to their local, state, national and international communities.

3. **Remove the prohibition on teaching dogmas:**

Nothing in science or in any other field of knowledge shall be taught **~~dogmatically.~~** ~~as~~ as absolute knowledge.

A dogma does not claim to be absolute knowledge. It is a tenet, doctrine or orthodoxy that simply may not be challenged whether it is true or not. This change would support the teaching of materialistic evolutionary theory as a dogma even though its truth has not been established and is otherwise scientifically controversial.

4. **Remove the blue marked provisions that describe science as an open-ended endeavor that seeks to allow the evidence to lead to explanations. The proposed changes marked in red below replace the current objective and open-ended definition of science with a dogmatic one that allows only materialistic explanations of the cause of change, including the origin of life and its diversity.**

NATURE OF SCIENCE

Science is a systematic method of continuing investigation that uses observations, hypothesis testing, measurement, experimentation, logical argument and theory building to lead to more adequate explanations of natural phenomena. **Science does so while maintaining strict empirical standards and healthy skepticism. Scientific explanations are built on observations, hypotheses, and theories. A hypothesis is a testable statement about the natural world that can be used to build more complex inferences and explanations. A theory is a well-substantiated explanation of some aspect of the natural world that can incorporate observations, inferences, and tested hypotheses.**

Scientific explanations must meet certain criteria. Scientific explanations are consistent with experimental and/or observational data and testable by scientists through additional experimentation and/or observation. Scientific explanation must meet criteria that govern the repeatability of observations and experiments. The effect of these criteria is to insure that scientific

explanations about the world are open to criticism and that they will be modified or abandoned in favor of new explanations if empirical evidence so warrants. Because all scientific explanations depend on observational and experimental confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core theories of science have been subjected to a wide variety of confirmations and have a high degree of reliability within the limits to which they have been tested. In areas where data or understanding is incomplete, new data may lead to changes in current theories or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest. Science has flourished in different regions during different time periods, and in history, diverse cultures have contributed scientific knowledge and technological inventions. Changes in scientific knowledge usually occur as gradual modifications, but the scientific enterprise also experiences periods of rapid advancement. The daily work of science and technology results in incremental advances in understanding the world.

The next change shown in red is proposed to be inserted as a substitute for the current discussion shown in blue above. It should be noted that the proposed change seeks only natural or materialistic explanations rather than more adequate ones. When one asks what is the origin of life, only one answer is permitted - a natural or material cause. It is this philosophy that effectively embargoes criticisms of evolution and any discussion that teleology may play a role in the natural world.

Science is a human activity of systematically seeking ***natural*** explanations for what we observe in the world around us. Throughout history people from many cultures have used the methods of science to contribute to scientific knowledge and technological innovations, making science a worldwide enterprise. Scientists test explanations against the natural world, logically integrating observations and tested hypotheses with accepted explanations to gradually build more reliable and accurate understandings of nature. Scientific explanations must be testable and repeatable, and findings must be confirmed through additional observation and experimentation. As it is practiced in the late 20th and early 21st century, science is restricted to explaining only the natural world, ***using only natural cause.*** This is because science currently has no tools to test explanations using non-natural (such as supernatural) causes.

This change should be read in the context of the next proposal for changing the existing high school indicator that describes the limits of scientific knowledge. The change would limit scientific knowledge to knowledge about changes produced only by material causes.

STANDARD 7: HISTORY AND NATURE OF SCIENCE GRADES 8-12

Benchmark 2: The student will develop an understanding of the nature of scientific knowledge.
Standard 7, BM 2,

1. understands scientific knowledge describes and explains the **natural** physical world in terms of matter, energy, and forces. Scientific knowledge is provisional and is subject to change as new evidence becomes available.

   a. Additional evidence can lead to further confirmation, revision and refinement, or rejection of previously accepted explanations.

   b. Science that is truly open-ended, and that allows evidence rather than preconceptions to guide explanation is the strongest and allows for constant refining and improvement of its explanations.

   b. The core theories of science have a high degree of reliability within the limits to which they have been tested and their scope of applicability.

   c. The open-endedness of science is its greatest strength and allows for constant refining and improvement of our explanations.

The difference between current 1b. in blue above and proposed 1c in red, relating to the open-endedness of science is that blue b describes what it should be while red c gives an opinion that science presently meets this standard. But the proposed changes, which seek to close minds to anything other than a material cause, would add a preconception that would render science not "open-ended" as to origins. This change would effectively contradict that opinion.

5. Remove language from the introduction that softens an otherwise dogmatic discussion of how change occurs and that alerts the teacher to the fact that answers to a number of key questions remain unanswered by current scientific knowledge.

Patterns of Cumulative Change
Accumulated changes through time, some gradual and some sporadic, account for the present form and function of objects, organisms, and natural systems. The general idea is that current forms and functions have arisen from previous forms or materials. An example of cumulative change is the formation of galaxies, explained by cosmological theories involving (among other theories) gravitation and the behavior of gasses, and the present diversity of living organisms, which the biological theory of evolution, or descent with modification of organisms from common ancestors, **seeks to explain**. The present position of the continents is explained by the theories of continental drift, which involves plate tectonic theory, fossilization, uplift and erosion. Patterns of cumulative change also help to describe the current structure of the universe. **Although science proposes theories to explain changes, the actual causes of many changes are currently unknown (e.g. the origin of the universe, the origin of fundamental laws, the origin of life and the genetic code, and the origin of major body plans during the Cambrian explosion).**

6. **Remove language designed to soften a dogmatic statement in middle school science that the theory of evolution does explain the diversity of life through gradual changes of characteristics of organisms over many generations .**

Evolution grade 5-7, Std 3, BM 5, Teachers Notes

The theory of biological evolution **is an explanation** of how gradual changes of characteristics of organisms over many generations **may have** resulted in variations among populations and species.

7. **Add a limitation on the kinds of biases and preconceptions that students should evaluate in reaching a conclusion. By limiting the preconceptions to personal ones, the student is not led to consider that institutional biases (such as the assumption that only material causes are allowed to explain the origin of life and its diversity) can also affect how data are interpreted.**

Grade 8-12, Standard 1, BM 1, Science is inquiry, Indicator 4(c):

4. • actively engages in conducting an inquiry, formulating and revising his or her scientific explanations and models (physical, conceptual, or mathematical) using logic and evidence, and recognizing that potential alternative explanations and models should be considered.

c. evaluates personal preconceptions and biases with respect to his/her conclusions.

8. **Eliminate an indicator that aids student understanding of scientific methods for testing historical hypotheses, which form the core explanations of forensic science, archeology, much of geology, anthropology and evolutionary biology.**

Grade 8-12, Standard 1, BM 1, Science is inquiry, Indicator 6:

6. understands methods used to test hypotheses about the cause of a remote past event (historical hypothesis) that cannot be confirmed by experiment and/or direct observation by formulating competing hypotheses and then collecting the kinds of data (evidence) that would support one and refute the other

a. Formulate multiple hypotheses about a singular historical event and develops a ”best current explanation” of what caused the event, such as the cause of a fire or death.

b. Predict the kinds of circumstantial evidence that one would observe under each hypothesis.

c. Collect evidence and draw an inference as to the best explanation and whether the evidence fits either hypothesis. Explains why either explanation cannot be entirely validated by a laboratory experiment.

9 **Eliminate information regarding the lack of a known material cause for the sequence of genetic letters that provides the content of biological information:**

Benchmark 2: The student will demonstrate an understanding of chromosomes, genes, and the molecular basis of heredity.

" • 1. understands that living organisms contain DNA or RNA as their genetic material, which provides the instructions that specify the characteristics of organisms.

b. Sequences of nucleotides that either determine or contribute to a genetic trait are called genes.

c. The sequence of the nucleotide bases within genes is not dictated by any known chemical or physical law.

10 Eliminate information that seeks to provide students with a more comprehensive understanding of evolutionary theory, including details about its postulates and areas **that engender scientific controversy.**

STANDARD 3: LIFE SCIENCE – The student will develop an understanding of the cell, molecular basis of heredity, biological evolution, interdependence of organisms, matter, energy, and organization in living systems, and the behavior of organisms.

Benchmark 3: The student will understand the major concepts of the theory of biological evolution.

1 understands biological evolution, descent with modification, is a scientific explanation for the history of the diversification of organisms from common ancestors.

a. Biological evolution postulates an unguided natural process that has no discernable direction or goal.

b. The presence of the same materials and processes of heredity (DNA, replication, transcription, translation, etc.) is used as evidence for the common ancestry of modern organisms.

c. Patterns of diversification and extinction of organisms are documented in the fossil record. Evidence also indicates that simple, bacteria-like life may have existed billions of years ago. **However, in many cases the fossil record is not consistent with gradual, unbroken sequences postulated by biological evolution.**

d. The distribution of fossil and modern organisms is related to geological and ecological changes (i.e. plate tectonics, migration). There are observable similarities and differences among fossils and living organisms.

e. The frequency of heritable traits may change over a period of generations within a population of organisms, usually when resource availability and

environmental conditions change as a consequence of extinctions, geologic events, and/or changes in climate.

f. The view that living things in all the major kingdoms are modified descendants of a common ancestor (described in the pattern of a branching tree) has been challenged in recent years by:

i. Discrepancies in the molecular evidence (e.g., differences in relatedness inferred from sequence studies of different proteins) previously thought to support that view.
ii. A fossil record that shows sudden bursts of increased complexity (the Cambrian Explosion), long periods of stasis and the absence of abundant transitional forms rather than steady gradual increases in complexity, and
iii. Studies that show animals follow different rather than identical early stages of embryological development.

2. understands populations of organisms may adapt to environmental challenges and changes as a result of natural selection, genetic drift, and various mechanisms of genetic change.

a. Genetic changes occur only in individual organisms. **New heritable traits may result from new combinations of genes and from random mutations or changes in the reproductive cells. Except in very rare cases, mutations that may be inherited are neutral, deleterious or fatal.**

b. Natural selection and genetic drift occur within populations or organisms.

c. Variation among individuals in a population allows individuals to respond differently to environmental challenges.

3. understands biological evolution is used to explain the earth's present day biodiversity: the number, variety and variability of organisms.

a. Separate populations within a species may become sufficiently different enough that new species develop. This process is called speciation.

b. Changes in inherited traits accumulate in populations.

c. Historically only a small percentage of species have survived to modern times.

d. Whether microevolution (change within a species) can be extrapolated to explain macroevolutionary changes (such as new complex organs or body plans and new biochemical systems which appear irreducibly complex) is controversial. These kinds of macroevolutionary explanations generally are not based on direct observations and often reflect historical narratives based on inferences from indirect or circumstantial evidence.

4. • understands organisms vary widely within and between populations. Variation allows for natural selection to occur.

a. Heritable variation exists in every species.

b. New heritable traits result from new combinations of genes and from mutations or changes in the reproductive cells.

c. Variation of organisms within and among species increases the likelihood that some members will survive under changing environmental conditions.

d. Times, populations, or entire lineages become extinct. One effect of this is to increase the differences between the surviving lineages.

5. understands that the primary mechanism of evolutionary change (acting on variation) is natural selection.

a. Favorable heritable traits are more advantageous to reproduction and/or survival than others.

b. There is a finite supply of resources available for offspring; therefore not all survive.

c. Individuals with beneficial traits generally survive to reproduce in greater numbers.

d. Favorable heritable traits tend to increase in the population through time if the selective pressure is maintained.

6. understands biological evolution is used as a broad, unifying theoretical framework for biology.

a. Organisms are classified according to the rules of nomenclature, and are given scientific names.

b. The behavioral, physical, and genetic characteristics upon which these classifications are based are used as evidence for common descent.

c. Natural selection, genetic drift, genomes, and the mechanisms of genetic change provide a context in which to ask research questions and help explain observed changes in populations. **However, reverse engineering and end-directed thinking are used to understand the function of bio-systems and information.**

7. explains proposed scientific explanations of the origin of life as well as scientific criticisms of those explanations.

Some of the scientific criticisms include:

a A lack of empirical evidence for a "primordial soup" or a chemically hospitable pre-biotic atmosphere;

b. The lack of adequate natural explanations for the genetic code, the sequences of genetic information necessary to specify life, the biochemical machinery needed to translate genetic information into functional biosystems, and the formation of proto-cells; and

c. The sudden rather than gradual emergence of organisms near the time that the Earth first became habitable.

11. Delete information regarding the fact that science is used by parents to promote the health of their families and that it affects decisions the culture makes about bioethics

Benchmark 1: The student will develop an understanding that science is a human endeavor

1. demonstrates an understanding of science as both vocation and avocation.

Science is used by researchers to develop new medicines and by parents to promote the health of their families.

3. recognizes the universality of basic science concepts and the influence of personal and cultural beliefs that embed science in society.

Decisions the culture makes about bioethics and the use and extraction of natural resources are significantly impacted by scientific knowledge.

12. Delete historical information about the way science has been abused to advance controversial programs affecting human life and dignity.

1. demonstrates an understanding of the history of science.

a. Modern science has been a successful enterprise that contributes to dramatic improvements in the human condition. **Science has led to significant improvements in physical health and economic growth; however, modern science can sometimes be abused by scientists and policymakers, leading to significant negative consequences for society and violations of human dignity (e.g., the eugenics movement in America and Germany; the Tuskegee syphilis experiments; and scientific justifications of eugenics and racism).**

b. Science progresses by incremental advances of scientists or teams of scientists. **In addition, it progresses by critical analysis of: 1) properly collected data; and 2) existing theories and hypotheses, which can lead to major new scientific advances (e.g., relativity, plate tectonics, quantum theory, biological evolution).**

c. Some advances that are fundamental and long-lasting include: Copernican revolution, Newtonian physics, relativity, geological time scale, plate tectonics, atomic theory, nuclear physics, biological evolution, germ theory, industrial revolution, molecular biology, quantum theory, and medical and health technology.