

Kansas Academy of Science position on teaching evolution in public schools

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The Kansas Academy of Sciences, like all scientific organizations, continues to be deeply concerned about an assault against the teaching of science in public schools, particularly the principles of biological evolution. Several years ago Kansas became a national lightning rod of controversy when the State Board of Education voted to approve science standards that deemphasized the teaching of evolution. The whole debate continues to rear its ugly head across the nation.

Over the last year or more, members of the Executive Committee and science supporters of all stripes have offered testimony at public hearings, written letters, and done all the usual time-consuming steps necessary in our democracy to ensure that science education is strong in Kansas. This position statement is just one small part of that ongoing effort.

This paper includes the position statement of the Kansas Academy of Sciences on the teaching of evolution in public schools and two additional parts. The two additional sections move beyond simply stating a position. The first additional section is for school boards at the local, state, and national levels, and was written to provide a non-emotional argument for why this debate should not be happening in a public school forum at the expense of our public school students. Perhaps it will provide school board members some ammunition to defeat measures designed to undermine science education.

The last part is aimed at helping the non-scientist understand the scientific process in

general. There is not, of course, space in this short essay to lay out all of scientific history and philosophy, and realistically it will not likely change the minds of those who oppose the scientific understanding of evolution because of deeply held personal beliefs, whatever their origin. The section is presented in the hope of helping those who are genuinely confused by the whole issue, and are willing to be intellectually honest enough to seek a deeper understanding.

POSITION STATEMENT

The Kansas Academy of Science is a professional organization of scientists representing all areas of scientific inquiry. Science is the systematic, empirical investigation of the natural world. As a group, the Academy clearly asserts that biological evolution, or descent with modification by natural processes, is a central organizing principle in modern biology. As such, the teaching of evolution should be of paramount importance to state and local boards of education to ensure a well-educated and productive citizenry. The Academy strongly supports education standards and efforts that support the teaching of the predominant scientific theories, particularly biological evolution, and opposes any changes that diminish the teaching of science in general.

MESSAGE TO STATE AND LOCAL BOARDS OF EDUCATION

Thank you. Thank you for your hard work and dedication to the educational future of our children. Yours is the difficult task of balancing complex budgetary concerns,

complying with federal, state, and local guidelines, and making sure that the curricular content offered in schools will ensure that our young people have a solid foundation for life-long learning and will be educated citizens as adults. Agreeing to serve on a BOE is a selfless sacrifice of your time and energy.

From time to time proposals are made to change, or even eliminate, certain subjects in the school curriculum. Evolution is currently a chief example. Arguments against evolution are often made that in the interest of “fairness” we need to present a “complete” picture to our students, exposing them to “alternative” or “competing” theories to biological evolution. However, ideas that involve a supernatural agent are not scientifically testable, and therefore not scientific. Scientific ideas are complex, with technical contributions from many disciplines, and you may be presented with many scientific-sounding arguments in support of one theory over another. So how can you, as a BOE member and likely a non-scientist, choose the best course of action for the educational well-being of our youth?

The fact is that the answer is surprisingly simple. A science school teacher’s job is to present the consensus view of the scientific discipline to students in an age-appropriate manner. Teachers find the consensus views in the articles, text books, and other materials communicated by professional scientists. And professional scientists are united in their acceptance of biological evolution as a powerful, unifying scientific theory.

It is unfair, and even inappropriate, for the BOE or a classroom teacher to be placed in the position of having to decide which of several competing theories in science is the most “correct.” We don’t expect that teachers in other science subjects should take on this task which normally is left to the entire scientific process. Why ask biology teachers to do anything different?

The scientific process continuously tests and evaluates the current prevailing and alternative

scientific theories. Every scientific theory is the best current explanation of natural phenomena, and as such is subject to further testing and refinement. That is the scientific process.

Therefore, the appropriate venue for challenges and changes to any theory is within the halls of academia and the journals of science—in other words, within the dialogue that encompasses the scientific process. Those who argue that the current theory is not correct should take the discussion up in that appropriate venue, not with the local school BOE or science teacher.

So, please strive to ensure that the *prevailing, widely-accepted scientific* theories are taught to our children in science class so that they are properly prepared to be competitive and productive in the future. Do not be seduced by false notions of “fairness,” or weaken your resolve to provide the best science education for our children. Allow the scientific process to do its job as you can do yours. Thank you.

THE SCIENTIFIC PROCESS: THE RATIONALE FOR SUPPORT OF BIOLOGICAL EVOLUTION

Science is a process that provides for an ever-improving understanding of the physical world. A good example of this is the theory of plate tectonics. Many people living today went to school prior to the conception of plate tectonics theory. In studying the Earth they learned the then-current theory of how mountains were formed and why volcanoes erupted. However, those older ideas have since been supplanted by a new theory, plate tectonics, because it has far more explanatory power than older ideas. Now plate tectonics is a central concept in Earth science, taught at every level.

Use of the scientific method has proven to be a powerful tool in learning about and understanding the physical world around us. Every day we enjoy the fruits of scientific discovery as the basis of technology. Science classes tend to have a lot of facts about the world around us, but those facts are only the stepping stones for scientific ideas, not the process of science itself. Science is a process of discovery, a

way of gathering and organizing information into coherent concepts about the world.

The steps of science are familiar, and most people have been introduced to the “scientific method.” Often the method is elucidated as containing the steps of observation, analysis, hypothesis formation, and evaluation of the hypothesis. The method is a guide for systematically framing questions and exploring ideas—a repeated cycle of discovery.

Because information gained in the hypothesis-testing stage can be added to the original data set, the scientific method is self-correcting, and this is among its most powerful attributes. Say we have made observations on a phenomenon that we wish to study. The method helps to guide our actions to form a natural explanation for what we observe, then to devise tests of that explanation. In effect, we seek to disprove our ideas.

After the experiment, if the outcome predicted by our hypothesis is observed, the hypothesis still stands as a possible explanation. If, on the other hand, the expected outcome is not observed, all is not lost. In fact, the potential is there for real progress, because new data has been acquired that did not fit the original hypothesis, allowing for a new, more inclusive hypothesis to be generated that can explain all the observations. In this way the scientific process is cumulative, always adding new bits of knowledge to the pool, and providing self-correcting course changes along our path toward understanding.

Scientists present their results to their peers and to society through a dialogue process in peer-reviewed journals. There the ideas are subjected to critique by other scientists, and suggestions are made and weaknesses and strengths of the new ideas are addressed. Only if the work is a sound contribution to the body of knowledge will it be published. If it has significant flaws, it will not. This provides a checks-and-balances system, and always keeps scientists on their toes.

It recently has been suggested that science is somehow afraid of challenges to cherished theories, that somehow scientists will not admit “alternative” views into the dialogue. Frankly, this is nonsense. Every practicing scientist would relish the chance to “turn the world upside down” with a dramatically better theory. We remember those scientific greats of the past who have done so. Names like Einstein, Newton, and Darwin are household names, all of whom have more “staying” power in our cultural consciousness than the latest pop-star gracing the covers of tabloids.

Science does not shy away from radical ideas—quite the opposite. The fact is that paradigm-altering scientific ideas do not come around often. However, when they do come, they are challenged, tested, and—if proven better than current theories—are ultimately adopted. Do not believe that alternative scientific theories to evolution would threaten a comfortable *status quo*. If those alternate theories were scientific and had any substance they would come to be embraced if they were better than the current theory. No such scientific theories relative to biological evolution, however, exist at present.

Plate tectonics and biological evolution are examples of ideas that were radical when they were introduced and have come to be embraced, now forming the centers of their sciences because they are more satisfying explanations for the world around us. Tectonics comprehensively explains observed phenomena like earthquakes, volcanoes, and the shape of the continents. Likewise, the biological theory of evolution is strongly supported and robust in its power to explain of the attributes and geographic distribution of living organisms.

The observation that species change over time was not Charles Darwin’s novel concept. Observers of nature had previously noted similarities and differences in living things that suggested close relationships and diversification from common ancestors. In other words, noting that species changed over time was the *observation* that Darwin was working to

understand. What was lacking was a clear *explanation of how* species could naturally diversify over time.

Darwin's magnificent contribution was the recognition of natural selection as the process driving the change of living organisms, by which species become highly adapted to their environments. The modern theory of evolution incorporates natural selection and provides a powerful and consistent explanation that unifies all areas of the biological sciences such as ecology, anatomy, systematics, paleontology, genetics, cellular and molecular biology, and biochemistry.

Since Darwin first proposed the idea, the concept of natural selection has been rigorously tested in all the sub-disciplines of biology, and the concept has proven to be a robust unifying theory.

Theories are never complete explanations—they cannot be complete given the nature of scientific discovery. Both plate tectonics and evolution have been, and will continue to be, modified and improved upon from their original conceptions as new data are incorporated into the theories. Indeed, our modern understanding of evolution is significantly different from Darwin's original outline. For example, because of the period in which he worked, Darwin knew little about genetics and inheritance or the fossil record and geologic time. Advances in those areas have refined the original concept, but have not fundamentally altered its grand contribution to science.

The magnificence of Darwin's basic concept of natural selection is that it has held up well as new data are added, that it is applicable across biology as a fundamental principle, and that it is congruent with other areas of science. For example, the patterns of species distributions through space and time are consistent with the changing configuration of the continents as explained by plate tectonics. As such, the elucidation of biological evolution is among humankind's greatest scientific achievements. Evolution should hold a central place in the

teaching of biology at all levels of science education.

The fact that we as a nation are even having a debate about teaching evolution in our science classrooms is evidence of the need to strengthen the public's understanding of science, the scientific process, and what science is not. The scientific method as described above is the tool of choice for unraveling the workings of the physical world around us. Science by definition limits itself to the empirical—that which can be tested, measured, or observed, either with the naked senses or aided by technology. Therefore, the scientific method, by design, cannot address topics which are outside the physical world, namely the religious, esthetic, ethical, and moral realms, and therefore cannot be a threat to those endeavors. Those non-empirical ways of exploring the human experience are not less significant, but we must not allow them to be taught to our children as some twisted definition of science.

Ultimately, the nation's future economic growth and prosperity, and even our national security, depends on how well we educate our children in general, and in science in particular. We must rise to this challenge. If the United States is to remain a world leader in science and technological development our children need the best possible foundation in science. It starts in the best possible science classrooms.

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