



Institute for the Study of Secularism in Society and Culture

Science Education & Secular Values

A SYMPOSIUM

BURKHARDT COBERN KEYSAR KOSMIN MILLER PENNOCK

Each year the Institute for the Study of Secularism in Society and Culture (ISSSC) focuses on a particular theme related to its goal, which is to advance in a non-partisan way the academic understanding of the role of secular values and the process of secularization in society and culture. It does this through an integrated program of work in academic research, curriculum development and public education.

For the academic year 2006-07, the ISSSC sponsored faculty fellowships on the topic of “The secular tradition and the foundations of the natural sciences.” (See page 8.)

The culmination of the academic year was a workshop at Trinity College. Leading national experts in science education were invited to present and debate new ideas on some of the current challenges facing science education with the ISSSC fellows and staff. This symposium includes highlights from some of the papers delivered on this topical and controversial public policy issue.

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For those who wish to learn more about science education and secularism, full versions of these papers with their accompanying research findings, full bibliographies and references, along with other essays by prominent scholars, will appear in book form next year under the auspices of the ISSSC.

Visit ISSSC's web site: www.trincoll.edu/secularisminstitute to learn more about its research and activities.



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The Congruence between the Scientific and the Secular

By Barry A. Kosmin

Embedded in a certain concept of modernity is the idea that science is a major building block of the secular worldview and that the progress of science is, de facto, the triumph of the secular worldview. This outlook arises from the close historical, philosophical, and intellectual relationship between the natural sciences and secular ideas and values.

There are indeed many points of congruence between the scientific and the secular, including commitments to reason, skepticism, systematic knowledge, empiricism, and the procedural aspects of scientific methodology—all of which form the basis of a common commitment to the impartial generation of truth. The methodical use of empirical data in scientific research accords with the “worldly” focus of secular ideas and values. The scientific and the secular appeal to the experience of ordinary people under relatively common, and replicable, circumstances.

Modern science is thus properly considered an agent of secularization because of its association with free inquiry and freedom of thought and expression. It also qualifies by virtue of its role in undermining the superstition, ignorance, and belief in magic that so often fostered fear and authoritarianism in human societies.

The Scientific Revolution of the 17th century involved an unprecedented endeavor to secure the autonomy of the scientific enterprise from religious authority. It established core methodologies that investigators use when they experiment, when they confirm what others have done, when they follow through on the processes of not only generating but testing, confirming, and denying knowledge of one sort or another. This cultivation of a naturalistic worldview and a skeptical spirit encouraged believers and non-believers alike to cultivate a new mental habit of demanding good, empirically verifiable reasons for their beliefs and to reexamine the factual basis of moral causes.

It was the proponents of Copernicus’ theory of a heliocentric universe who began using the phrase *libertas philosophandi* (freedom of philosophizing—free inquiry) which eventually found its way into the full title of Spinoza’s famous

Theological-Political Treatise of 1670. Galileo pronounced the fundamental scientific principle that “Two truths cannot contradict each other.”

In 1660, when the famous Royal Society of London was founded, its members asserted that science was based on the principle of testing ideas by experiment, adopting as their motto “*Nullius in verba*,” which loosely translated means, “Take nobody’s word for granted.” They also went on to commit themselves to exclude matters of religion and politics from scientific discussions.

The sciences, in terms of their ethos and organization, can also be viewed as the best example of the triumph of the essentially secular ideas embodied in the French Revolution’s slogan of *Liberté, égalité, fraternité* and its promise of *la carrière ouverte aux talents*—meritocracy.

With its universality, objectivity, and commitment to meritocratic peer review, science seems to admit of egalitarianism and real democracy more than any other area of human enterprise. Its ethos leads to a universalism of good ideas and empirical data that are accepted from whatever quarter they emerge.

Science has an anti-authoritarian tradition based on the concept of self-generated human progress—constantly reforming and refining itself from within without external guidance. In the words of the sociologist Max Weber, science is a secular “vocation” and “scientific work is chained to the course of progress...; every scientific ‘fulfillment’ raises new ‘questions’; it *asks* to be ‘surpassed’ and outdated.”

Today, scientific education and research are commonly viewed as pillars of secular lifestyles and social organizations that, as a matter of principle, reject the authority of any particular religious association or doctrine. Along the lines of Isaiah Berlin’s celebrated distinction between “negative” and “positive” conceptions of freedom, science and secularism can thus be seen as congruent because of their common endeavor to demarcate areas of human action that are “free from” external, particularly religious, authority.

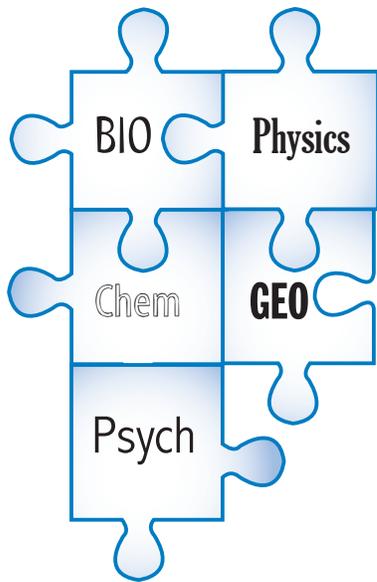
The interplay of science education and secular
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OMG...
Science
is bunk!

It is easy to be indifferent, alienated, or hostile to the scientific enterprise while indulging in the benefits of science-based high-tech industry.

Science Education and Religion: Holding the Center

By Jon D. Miller and Robert T. Pennock



Students need to know how the different sciences are interconnected such that one may not simply choose to disbelieve some particular scientific conclusion in isolation.

Surveys show that there is a high level of agreement among Americans that science and technology have improved the quality of their lives, making them healthier, easier, and more comfortable. There is equally strong agreement that science and technology will provide new opportunities for the next generation.

At the same time, a substantial proportion of American adults—about 30 percent—have significant reservations about the impact of science on their religious faith. Many leaders believe that “modernist” and “materialist” science undermines faith and they want to reinvent science in a form that is not only consistent with but also supports their theistic convictions that man is created in God’s image.

Though in the past this segment of Christian fundamentalists responded by withdrawing from the world, in recent decades their leaders have succeeded in awakening them as a political force. With missionary energy, they have sought to bring about a “renewal” of what they take to be the Christian foundation of the country. One cannot understand the battle that is going on over science and science education in the United States unless one appreciates the views and goals of this large group on the religious extreme.

A 2005 survey found that 43 percent of American adults strongly agreed that 1) the Bible is the actual word of God and is to be taken literally; 2) there is a personal God who hears the prayers of individual men and women; and 3) human beings were created by God as whole persons and did not evolve from earlier forms of life.

The co-existence of this level of fundamentalism with a strong and growing scientific community fuels much of the current controversies over evolution, stem cell research, and other issues about the beginning and end of life. These controversies symbolize a new era of public policy dispute over the control and uses of science and technology.

To give just one example, a leaked internal manifesto from the Discovery Institute speaks of “[t]he proposition that human beings are created in the image of God” and says that “modern science”

denied the objective moral standards that comes from this theistic understanding of nature by putting forward a view of the universe as “ruled by purely impersonal forces.” It blames modern science for everything from moral relativism to modern approaches to product liability and welfare, and offers Intelligent Design (ID) as a “wedge” that will break apart materialist science and “replace it with a science consonant with Christian and theistic convictions.”

The current controversy over evolution illustrates the nature of the ongoing conflict. A majority of American adults indicate that they believe that humans were created as whole persons directly by God and that humans are uniquely different than plants or other animals. This provides an opening that creationists try to exploit to bring people in the middle to their side.

One of the effects of the politicization of evolution for partisan purposes has been increased pressure on local teachers, administrators, school board members, and textbook publishers to either omit any reference to evolution or to include a creationist alternative. Nor is biology the only target. Fundamentalists have also attacked geology and physics, working to remove references to the geological time scale, the age of the earth, the Big Bang, and global warming.

Even more worrisome than the fundamentalists’ attacks upon specific scientific findings is the more general attack upon the very foundations of scientific reasoning. In their quest for a science consonant with Christian and “theistic” convictions, they aim to overturn the ground rules of science so as to recognize explanations that appeal to supernatural beings and powers.

In calling for unscientific “alternative theories” to be taught on a par with well-established scientific findings, they are unfairly promoting views that have not earned their place by surviving the rigors of scientific testing. In requiring students to learn so-called “arguments for and against” scientific theories, they are undermining the evidence-based reasoning that stands behind established science and replacing it with a relativism of empirical knowledge

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The Competition of Secularism and Religion in Science Education

By William W. Cobern

Separation of church and state would seem to be a natural outgrowth of Jesus' command to render unto Caesar what is Caesar's, and to God what is God's. In keeping with this, Christian churches in America have strongly embraced the First Amendment's requirement that "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof."

Americans who reject any notion of the transcendent have, of course, always been happy to join the embrace of this constitutional principle. For them, no-establishment has meant secularization—what modern social thought long considered the culmination of such modernizing forces as urbanization, professionalization, and bureaucratization—and the decay of traditional religion.

In fact, while this process may have rolled forward in Western Europe, it did not in the U.S., where belief in God holds steady, even among scientists. Far from being the touchstone of secularization, no-establishment has been key to American religious vitality.

So vital was Protestant Christianity in the early republic that no-establishment rapidly led to the de facto establishment of a Protestant ethos, especially in public education. During the 19th and early 20th centuries, Protestant cultural hegemony led most states to pass anti-Catholic "Blaine Amendments"—state constitutional provisions prohibiting the use of state revenues for the support of sectarian schools (where "sectarian" was a thinly veiled reference to Catholic parochial schools).

But the de facto establishment could not last forever, and in the middle decades of the 20th century a series of U.S. Supreme Court decisions disestablished it. The most important of these decisions were *Engel v. Vitale* (1962) and *Abington v. Schempp* (1963), which ended legal school-sponsored prayer and Bible reading in public education.

The de-Protestantization of the public square created its own hostile reaction, however, and this in due course put science education back into play as an issue of public controversy.

In the wake of the 1925 Scopes Trial, the teaching of Darwinian evolution largely disappeared from school curricula. Renewed interest in the subject—and science education generally—erupted after the 1959 Darwin Centennial celebration, where it was declared that 100 years without Darwin was enough.

The drought was ended soon thereafter by the National Science Foundation, whose Biological Sciences Curriculum Study made evolution a key feature of its innovative high school biology textbook series. The response came first in the form of "Scientific Creationism," and then Intelligent Design, both of which the courts found in violation of the First Amendment.

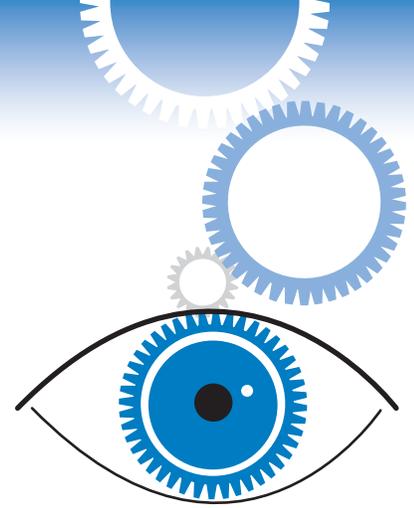
Polling, however, suggests that whatever accommodations conservative Christians may have made to dancing, divorce, the consumption of alcohol, and rock music, their rejection of evolution remains strong. Moreover, religious interests in recent years have been asserted in other science-related areas such as cloning, embryonic stem cell research, and climate change.

That we have arrived at the early years of the 21st century with secularism yet to drive religion from the public square has the likes of Richard Dawkins, Daniel Dennett, Sam Harris, and Christopher Hitchens in the throes of apoplexy. Their recent books*—*New York Times* best sellers all—amount to hysterical pleadings for driving out, once and for all, the religious barbarians from the rightful place of secular intellectuals—the "Brights," as Dennett calls them.

Is there a way forward? There is, but it does not lie with the New Atheist call to arms for a final victory in the American cultural wars. In public education, and especially in science education, we need to differentiate what might be called *methodological* secularism from *philosophical* secularism. Philosophical secularism is antithetical to theism. In American culture, it cannot provide

* Respectively, *The God Delusion*, *Breaking the Spell: Religion as a Natural Phenomenon*, *Letter to a Christian Nation*, and *God Is Not Great*.

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Give students time to explore their own ideas. Science teachers need to ask students if they would like the opportunity to explore their own metaphysical questions. To do so creates an hospitable environment that will open opportunities for learning.

Scientific Literacy in a Postmodern World

By Jeffrey Burkhardt



The ways in which the Science Establishment has attempted to affect the outcome of public debates on battleground issues has not helped, in part because science is often perceived as just another story or belief-system—and sometimes that perception is correct.

For decades, science educators and scientific organizations have lamented the lack of scientific literacy among the American public. The lament reached its tipping point in the early 1990s, when the Science Establishment made concerted efforts to address the problem by way of such initiatives as the American Association for the Advancement of Science's "Science for All Americans" and the National Research Council's "National Standards for Science Education."

These efforts enjoyed some modest success. More importantly, the National Science Foundation showed that the proportion of degrees awarded by American colleges and universities in science and engineering has remained constant (about 35 percent) since the mid-1960s, and that, contrary to anecdotal evidence, U.S. citizens and resident aliens have not been replaced by foreigners in most science and engineering programs in the U.S.

Yet far from disappearing, the worries about scientific literacy have if anything increased in recent years. Why does the Science Establishment still believe that continued and stepped-up efforts are needed?

The heightened distress may have been triggered by the upsurge in support for the teaching of Creationism (or Intelligent Design) in the public schools. But there is more to it than that.

The Science Establishment's original concern with scientific literacy was in part a reaction to the relatively poor showing on standardized math and science exams of American students compared with students from countries like Japan, Korea, and Russia. Increasing Americans' scientific literacy seemed to be necessary to assuring U.S. political and economic preeminence.

In addition there was a sense that, as the National Academies of Science (NAS) put it in a 1996 report, "Scientific literacy is important throughout students' lives as they participate in public policy issues related to technology; as they stay current with advances in areas such as biotechnology, medicine, and space exploration; and especially as they enter an increasingly scientifically based workforce."

The presumption was that more scientifically literate people would come to the right conclusions—and vote accordingly—on questions of, say, automobile emissions, nuclear power, environmental pollution, and so on.

The original impediments to scientific literacy identified by the Science Establishment are the usual suspects in critiques of how American education has generally performed, which boil down to inadequately prepared and overburdened public school teachers and inadequate textbooks, teaching methods, and curricula.

Yet the Science Establishment's "improved education" model of achieving universal (scientific) literacy—and there are several approaches—is based on a couple of dubious assumptions.

The first is that knowledge and understanding of a *specific* set of concepts, or even broad knowledge about science, is required for (according to the NAS) "personal decision making, participation in civic and cultural affairs, and economic productivity." The second is that it is possible to achieve the desired ends, given the values of large numbers of people in the U.S. and across the globe who have no interest in, or use for, the concepts, skills, or understandings being promoted as scientific literacy.

Consider a barber we'll call Ralph. Ralph knows how to cut hair, collect his payment, and make change. He knows how to drive, how to shop, and a myriad of other things. He and his family attend a Christian church every Sunday. Ralph is also active in his community—attends school board and city council meetings, pays attention, and speaks his mind whenever an issue directly affects him or his family.

By all rights Ralph is a functioning, productive member of society. Yet he is knowledgeable of few scientifically based concepts, unless one counts knowing that putting gas in your tank makes the car go and paying your bills guarantees the electricity won't be turned off.

I believe it to be presumptuous to suggest that Ralph is illiterate or ignorant, and that Ralph's life would

be better off if he were more scientifically literate in any meaningful sense. There are a lot of Ralphs in the United States who are living whole, productive lives. Greater scientific literacy may not improve the quality of their lives in any way whatsoever, and may even diminish it. Attempting to change people's values under the auspices of making them scientifically literate raises some important issues.

The goal of the Enlightenment was to substitute Reason for Faith. The idea was to replace religious ways of knowing with objective criteria for what counts as rational thought, rigorous methods for basing knowledge about the world on unwavering evidence, and moral principles based on an understanding of human nature.

Yet at some point, the Enlightenment project ran aground. Religious authoritarianism did not once again fill the void (at least in the West). Rather, we are now left with multiple conceptions of what counts as rational—varied and often contradictory methods for grounding claims about truth, and moral systems based on fear, wishful thinking, or blind adherence to a self-appointed leader.

Neither science nor religion now provides adequate bases from which people can collectively come to grips with many of the problems of our time, and form consensus. “The answer” to any question comes down to whatever value system or “belief set” a given individual or group happens to possess.

Survey data only begin to show the extent to which beliefs and attitudes vary across the America's many subcultures. Certainly, in the superficial business of living, Americans manage mostly to co-exist peacefully. But when something basic to cultural or ethical belief-systems is challenged or threatened, there is no common ground to which “reasonable” people can appeal.

The notion that increasing scientific literacy will improve our individual and collective

quality of life by giving people such a common ground seems misguided. Some studies purport to show that people's attitudes toward a particular issue change with “more information.” National science leaders usually take these studies to mean that, when faced with a contentious issue that scientists have taken a stand on, public attitudes will come to favor the scientists' stance if the public is more knowledgeable about the issue (and the scientific view of it).

But this is not always the case. For example, in the U.S. and around the globe, public attitudes toward genetically modified foods have been shown to grow increasingly negative as more scientific knowledge is provided. This has led to public calls for labeling such foods, despite the Science Establishment's assurances that they are safe.

The ways in which the Science Establishment has attempted to affect the outcome of public debates on battleground issues has not helped, in part because science is often perceived as just another story or belief-system—and sometimes that perception is correct.

Science students, especially at the college level, are inculcated into a particular “moral culture.” While they may learn many skills, gain many answers, and acquire the ability to “produce scientific results,” along the way they are also indoctrinated into an ideology that holds that non-scientific ways of thinking—including those based on “non-scientific” values—are not rational.

Here, it is important to recognize the degree to which there is not something called Science but a host of separate sciences, from high-energy physics to molecular biology to nanotechnology to (even) the various “social” sciences. What binds all these together as “Science” is not that they all practice and teach something called “the scientific method.” Each uses concepts, methods, and tools unique to its discipline in order to generate knowledge unique to itself.

A more accurate answer is socio-historical:

Practitioners refer to their discipline as a science, and their collective practices as Science. They have had Ph.D.s conferred on them by the institutions where they learned their craft. They believe that they—and they alone—have the correct concepts, theories, ontologies, and methodologies to address the objects or phenomena they consider to be their province.

They do, however, defer to each other's legitimacy in their proper realms. So even if they do not agree about what constitutes “the facts” or Scientific Truth, they do possess a common narrative: Members of these groups are entitled to pronounce authoritatively on matters that have “scientific content.” They all seem to believe that answers to questions that have scientific dimensions should at the very least be based on “sound science,” and that not accepting the scientific answer is non-rational.

But this is a self-conferred legitimacy or authority that is precisely what is being challenged (if not ignored) in the larger society. Are the scientific truths emanating from any of the disciplines true (within the limits of the caveat, “pending further study”), simply because a scientific community says so?

In the context of promoting scientific literacy, why should the public defer to Science, even “Sound Science,” on matters that have “scientific content”—say, global warming, abortion, biotechnology—since they are also just as importantly about values? Is science literacy good because scientifically literate people are people who agree with what the scientists say?

There is little doubt that the Scientific Establishment is a powerful force in contemporary society. The amount of resources, human and financial, that the sciences command is huge. Scientific experts are routinely called on by the media, by government, and by corporate entities to pronounce on virtually every aspect of our physical and mental and social lives.

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values has public policy importance in a number of areas—particularly with respect to economic prosperity and geopolitical strength. In the United States, the dream of harnessing scientific progress to the betterment of all citizens arose during the Progressive era in the early 20th century—the heyday of belief in the public school and the birth of the research university.

The Progressive idea of universal education and progress, exemplified in the writings of John Dewey, was predicated on the notion that the form of education that can truly empower individuals is scientific in spirit and principle. It was originally propagated by a coalition of industrialists, public servants, and academicians who believed that science and its universal method of knowledge acquisition could unify the nation and generate economic and social progress.

This vision assumed that science was and should be value-neutral and indifferent to the varied identities and beliefs of an increasingly diverse American nation. The Progressives professed that the “indifference” of science—its disinterested search for truth—was basic to its credibility and strength.

Yet in our time this ideology, which conceives of science as a common good embodying value-neutral knowledge, has come to be disputed by certain communities that feel threatened by the implications of scientific research for their own worldviews.

In the academy, a fashionable relativist and postcolonial outlook belittles the achievements of science and instead valorizes “local knowledge” grounded in indigenous or ancient conceptual categories. More importantly, science has come under challenge from a resurgent religious fundamentalism, which above all seeks to protect young people from being taught scientific ideas that seem to threaten religious beliefs.

Paradoxically, the very triumph of science has enhanced its vulnerability to these forms of “skepticism.” As it has advanced and grown, science has become more complex and harder

for ordinary people to comprehend. In an age when technology is increasingly user-friendly, it is easy to be indifferent, alienated, or hostile to the scientific enterprise while indulging in the benefits of science-based high-tech industry.

The widening gap between the scientific community, as a perceived elite, and much of the general public has gradually eroded the status of science as a common good. Even though most Americans still claim to value science highly and believe it will continue to make their lives better, too many steer clear of it in school.

As a result, the traditional model of science education now appears more elusive than ever before. Although parents recognize that their children’s future depends on a good education, the swell of scientific illiteracy prevents them from assessing with confidence and clarity what actually constitutes a good education.

It is not too much to say that the dream of science for all has become an empty cliché rather than a source of personal inspiration. The result is a mood of ambivalence and confusion among many science educators.

In order to better understand what the educational system is up against, the ISSSC undertook two initiatives in the summer of 2006. One was an academic workshop on “science education and secular values” featuring papers by leading experts in the area of science education and scientific literacy. Abridged versions of three of these papers are included in this supplement.

In addition, the ISSSC sponsored an essay contest for Connecticut high school students. Its rather revolutionary aim was to learn something of what was happening on the ground by directly asking the rising, techno-savvy generation of young people to explain the unpopularity of science among their peers. A short report on what they had to say follows.

Needless to say, science as a model of human

growth and development neither can nor should be immune from scrutiny and debate. Questions inevitably arise.

What is the nature of authority in science? Do problems in science classrooms reflect broader problems concerning the public understanding of science? What level of science literacy is necessary or desirable for the ordinary citizen?

Should our concern be on the inputs (what is taught to students) or on the outputs (what is learned)? Can the teaching of science in institutions of public education be predicated on the assumption that it benefits every student, regardless of his or her cultural identity or personal aspirations? How can the claim to know what benefits other persons, which is either implied or explicitly professed in contemporary treatises on science education, be squared with the ideal of freedom of choice?

It is only appropriate that our authors do not all agree on the answers. ¶

ISSSC Faculty Fellowships, Academic Year 2006-07, for new undergraduate courses at Trinity College on
The secular tradition and the foundations of the natural sciences.

The History of Evolutionary Ideas

Daniel Blackburn, professor and chair of biology

European Exploration and Science, 1320-1700

Sean Cocco, assistant professor of history

Science and Religion

Kent Dunlap, associate professor of biology

Acid Precipitation and Europe: Ethics, Science and Philosophy in Debate

David Henderson, professor of chemistry and director of the environmental science program

that would destroy the empirical methods that make science work.

This problem has become more serious in the context of an increasingly ideological political system in the United States. Until recent decades, science policy in the United States has been largely bipartisan in nature. Both major political parties have jointly supported the creation and growth of major scientific institutions such as the National Institutes of Health, the National Science Foundation, and a network of national laboratories. The war on cancer was a war that both parties endorsed and supported.

But as John C. Danforth, a former Republican Senator from Missouri and an Episcopalian minister, put it in a recent *New York Times* op-ed piece: “By a series of recent initiatives, Republicans have transformed our party into the political arm of conservative Christians. The elements of this transformation have included advocacy of a constitutional amendment to ban gay marriage, opposition to stem cell research involving both frozen embryos and human cells in petri dishes, and the extraordinary effort to keep Terri Schiavo hooked up to a feeding tube.”

To be sure, there are some signs that the era of fundamentalist politics is coming to an end. The defeat of Intelligent Design in a Pennsylvania court in 2005 was so resounding that even leaders of the movement have dropped mention of the term as they try to regroup and rethink their political strategy.

Equally significantly, the 2006 elections brought a series of defeats of candidates for school board, gubernatorial, U.S. Senate and other offices who were known for their anti-evolutionism. In the current race for the Republican presidential nomination, candidates were asked in a debate about their stand on evolution and the three who said they disbelieved in evolution subsequently backpedaled when their answers were taken as evidence of ideological extremism.

Meanwhile, conservative political opinion-

makers from syndicated columnist Charles Krauthammer to the *New Republic's* John Derbyshire have begun publicly questioning the value of anti-evolutionism to conservatism. George Will, for instance, wrote that the school board members who favored ID were “the kind of conservatives who make conservatism repulsive to temperate people.”

It is to be hoped that this trend will continue. If it doesn't, there will be new problems and new challenges for the scientific community generally, but especially for science educators at the pre-collegiate level.

In this environment, science educators face a dual challenge. On the one hand, colleges and universities are expected to produce future generations of scientists and engineers capable of harnessing emerging science for the improvement of the quality of life broadly and to improve the economic competitiveness of each nation. The logic of this task indicates the need to identify talented students early and to provide a quality educational experience through the undergraduate and graduate years and a research or professional career. This is often translated into a “best and brightest” strategy.

At the same time, science educators must take substantial responsibility for the education of future citizens. Traditionally, the education of citizens was thought to be the responsibility of general education and perhaps of a high school civics teacher. Citizenship meant knowing how government works.

But at the beginning of the 21st century, it is clear that the responsibility for preparing future generations of citizens belongs to all educators, including science educators, mathematics educators, social science educators, and teachers of art, letters, and the humanities. An adult who does not understand some basic scientific constructs—the nature of matter and life, the role of DNA, and so on—will have a difficult time understanding public policy issues like global warming.

Those who do not know the history of humans

on this planet may repeat the mistakes of earlier generations. And those who do not understand evolutionary science may not appreciate the significance of their doctor's instruction to complete all the prescribed doses of antibiotics or evolution's important role in agriculture, industry and environmental management.

At the secondary school level, it is essential to abandon the present smorgasbord approach to science and mathematics education and to take seriously the challenge of making every high school graduate scientifically literate. Through a complex tracking system, American high schools provide a minimally credible science education to about a third of students who find their way into an “honors” science course.

Students outside the honors track get primarily 19th-century physics and a little pond biology. What little is taught about the nature of scientific inquiry is superficial at best.

This needs to change. Evolution should be emphasized as the key explanatory framework of biology and as an exemplar of scientific reasoning at its best. Perhaps the forthcoming inclusion of science in the national testing requirement will stimulate more local education leaders to take this responsibility seriously.

Next, we should build upon elements of the educational system that have been shown to work. The American commitment to general education requirements at the baccalaureate level has produced a substantial number of scientifically literate adults—about one in four Americans aged 18 and older.

If every high school graduate were to meet the current minimal definition of scientific literacy, college and university courses could be used to produce even better informed adults for leadership positions in communities, corporations, and government. In the meantime, these college and university courses provide an essential political safety net for our democratic system.

Also, we must remember that most Americans

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will learn most of their science after they leave formal schooling. This observation is not a condemnation of formal education, but a simple recognition that the rapid growth of science and technology throughout an individual's lifetime will necessitate learning a good deal of new science.

This recognition should lead formal educators to re-think the long-term consequences of their curriculum. It should inform adult educators in the media, in libraries and museums, and on the Internet about the need for adult science learning.

Finally, science educators at all levels need to do more to communicate learning about the nature of science and scientific reasoning. If we are to not lose swing voters to missionary creationists, we need to do a better job explaining what real science is and what it is not.

Students need to know how science is different from faith and limits itself to testable hypotheses. They need to know why science may not appeal to supernatural explanations and why it is neutral with regard to metaphysical religious beliefs.

They need to know how the different sciences are interconnected such that one may not simply choose to disbelieve some particular scientific conclusion in isolation. And they need to know the limits of science and when reasoning from the humanities needs to be brought to bear on policy issues.

These and other critical elements about the nature of scientific reasoning should not be thought of as a supplement to but rather as a basic part of the content of a science course. Science will be at the center of many key policy questions and science education cannot fail to prepare citizens to meet the challenges that face us. It is essential that we resist the attempts from the religious extreme to undermine sound science education.

This should not be a partisan issue. For our democratic system of government to continue to work, the center must hold. ¶

a "new 'absolute' language, an Esperanto of postreligious truth."

By contrast, methodological secularism is shorn of all presuppositions of antisupernaturalism. It invites all parties to the public square and serves to facilitate commerce among different kinds of belief.

A person should not be excluded from, say, the public policy debates on funding embryonic stem cell research merely because that person's position was derived from Christian doctrine anymore than one should bar an atheist from the debate because of views derived from philosophical naturalism. Policy debate is one thing, however; school curricula are another.

Methodological secularism can work as a policy for the public schools, but it is not without risk, particularly when it comes to the scientific teaching of origins. The subject of origins is inherently metaphysical. Once it is broached, most students cannot help asking themselves cosmic questions: Why is there *anything* rather than nothing? Why is what *is here*, here the way it is and not some other way?

Because Darwinian evolution offers a mechanism for answering these questions, we quite naturally wonder: Is it a *sufficient* mechanism for what we believe about our world? Isn't something *more* needed? Are our other beliefs *amenable* to evolutionary ones?

In fact, evolution has evoked a range of metaphysical reflections, musings, and conclusions. The evolutionary biologist David Lack, for example, has written, "The true significance of the first chapter of Genesis is to assert that God made the universe and all in it, that He saw that it was good, and that He placed man in a special relationship to Himself."

Science teachers should not ignore such thinking and we certainly should not pretend that such thinking is unimportant to students. Rather, this situation makes the teaching of

origins a very good place for the implementation of methodological secularism.

By this, however, I do not mean the sort of "balanced treatment" that creationists advocated in the 1980s or the "teach the controversy" approach of more recent years. I mean that classrooms need to allow for inevitable metaphysical diversity among students.

To accomplish this within the bounds of law, I propose four rules for implementing methodological secularism in the science classroom.

RULE 1: Teach science, not scientism.

Students and teachers need to understand the difference between science and scientism, the belief in science as a kind of religious system of its own. A science popularizer like Michael Shermer, columnist for *Scientific American*, is not someone to follow. He proudly announces that we are now in the Age of Science and it is "scientism's shamans who command our veneration" and that scientists today are our "premier mythmakers." It makes no sense to brag about scientism and it certainly does no harm to the enterprise of science that we carefully observe its limitations. Indeed, one of the great historical strengths of the natural sciences is that limitations *are* observed; science only addresses questions of a certain kind.

RULE 2: Teach for sound understanding, not belief.

Understanding is critical but belief is not. People do not find all scientific evidence equally persuasive. They may find other evidence more compelling, other authorities more trustworthy. Ignoring these realities is simply counterproductive because it leads students to feel that they are being indoctrinated rather than taught. To disbelieve, moreover, does not bar understanding. Indeed, students are much more open to learning when they are confident that the teacher is not trying to "convert" them. Teachers need to recognize that rejection of evolution does not mean rejection of all of science. Indeed,

there are keen science students who reject the validity of evolutionary theory.

RULE 3: Teach the *evidence*. This rule is simply good science teaching but too often the science curriculum employs what science educator Joseph Schwab called a “rhetoric of conclusions.” The conclusions are needed; i.e., the outlines of the general theory of evolution. Without some introduction to the evidence that scientists adduce in support of evolution, however, student understanding of evolution will be weak. Worse, some students will conclude that evolution is more an ideological stance than an evidence-based scientific theory, which is exactly the message of Young Earth creationists. If we want skeptical students to develop confidence in the scientific soundness of evolution, Rule 2 requires Rule 3.

RULE 4: Give students time to explore their own ideas. We do not need lessons on intelligent design and we do not need to examine facts that some think are facts against evolution. But it makes no sense to ignore ideas that students bring to the classroom that the students deem relevant regardless of what their science teachers think. Science teachers need to acknowledge that this diversity of thought is very likely to exist and to ask the students if they would like the opportunity to explore their own metaphysical questions. To do so creates an hospitable environment that will open opportunities for learning.

With respect to evolution, let students present science-based philosophical and metaphysical positions, including religious ones. If a student wants to report on the “young age” of the earth, fine—but require that student to study the standard evidence used by scientists to date the earth as well. In other words, insist that students consider all evidence, not a selected set.

The rules do open the classroom door to creationism and other sectarian ideas, but the approach is legal since students initiate whatever is brought to class and there is no

hint of coercion or collusion. Openness has a price and it is that ideas running counter to standard science will circulate.

The “closed” classroom does not stop the circulation but only bars it from the classroom. As a result, some students will not seriously consider standard scientific evidence. The closed approach, the philosophical secularism approach, gives us the stalemate and conflict we have today.

Bringing the idea of methodological secularism to the science classroom makes the teaching of controversial subjects such as evolution considerably more complicated than teaching, say, the kinetic theory of gases or about respiration. One simply cannot act as if nothing mattered but the science of the subject.

At the same time, adopting the stance of philosophical secularism is unsound. It turns science into scientism. And it is unworkable in the vast majority of American public schools.

Openness to student-initiated ideas defuses potential conflicts and leaves avenues open for student learning and growth that would otherwise be shut off.

Lincoln biographer Allen Guelzo has written that Lincoln “struggled to be true to the two souls of American culture”: one theistically religious and the other secular, commercial, and enlightened. In Guelzo’s view, these souls “have often been locked in combat, only to withdraw after a brief battering reminds them that in America they have no choice but to co-exist.”

We too in recent decades have been battering ourselves through litigation over what can and cannot be taught at school. It is past time to cease these hostilities and realize that there will not be any clear-cut victory for either side. The optimism of methodological secularism is that we learn to co-exist. ¶

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There is little doubt, also, that science and technology have changed and improved, but sometimes negatively affected our world in demonstrable ways. Americans usually appear to agree that scientists have positively affected our lives and are deserving of trust and respect. So again, the question: Why the continued push for scientific literacy, especially when the public appears as willing as it is to go along with what the Science Establishment appears to want?

It may be that the Science Establishment remains fearful of a decline in scientific capacity or competence that will affect American competitiveness in science and technology. The Science Establishment may be horrified that so many people disbelieve in evolution because this may affect how the rest of the “literate” world perceives the U.S. The Science Establishment may hate the fact that celebrities promote Scientology or Astrology. And, the Science Establishment may be right to be so.

But it may also be the case that if people don’t continue to believe—or don’t come around to believing—that *science is important*, they may be less inclined to support scientific research, endorse science-based policy, or encourage their children to pursue studies in the various scientific disciplines.

The point is that the Science Establishment has a vested interest in scientific literacy. There are good social, economic, political, and even personal reasons for continuing to promote scientific literacy. But we should do so with the understanding that we are asking people to value the things we value.

If they do not, it is not necessarily because they are irrational or ignorant or illiterate. Rather, some of them may simply not wish to adopt the goals and values of the individual sciences or the Science Establishment. An enlightened believer in Truth and the Good is obliged to respect the right of others to believe in Creationism, Astrology, Scientology and the like, even if these are all (scientifically) wrong. ¶

High School Students Speak Out

By Ariela Keysar

A solid grounding in science is widely considered to be crucial for the next generation of American adults. Yet studies show that although students are taking more science courses than in the past—at the prodding of teachers and guidance counselors—they aren't absorbing much. The average science score at grade 12 on the National Assessment of Educational Progress test in 2005 was lower than in 1996, and showed no significant change from 2000.

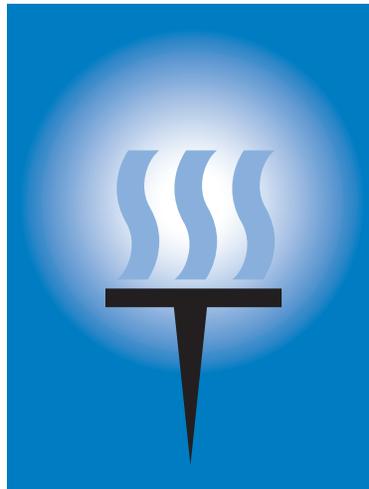
To learn why, Trinity College's Institute for the Study of Secularism in Society and Culture (ISSSC) sponsored an essay contest open to students in all Connecticut high schools—public, private, and religious—whose question was: **Why do so many young Americans today show little interest in science education?**

The contest enabled young people, who are generally not heard from directly on issues of educational policy and practice, to offer insights into the frame of mind of their own generation. Unlike an opinion survey, the essay contest was not intended to gather a representative sample of students' feelings about science education.

Indeed, far from being representative, the 81 students who chose to enter the essay contest were unusually enthusiastic about learning. Many asserted a strong belief in the value of science education. Nonetheless, all of them accepted the premise of the contest, which is that many young Americans show little interest in science education. In answering the question they did not mince words.

A large number placed the blame on students themselves. “[Y]outh have grown lazy and decadent, and refuse to put forth the amount of work necessary to excel in science,” one essayist wrote.

Part of the problem, according to a number of essayists, lies with American culture generally. “Today all that Americans want to do is watch some mindless TV, and play videogames, with stimulus responses every 5-10 seconds,” wrote one. “The problem



with this is that it creates a society with a very short attention span.”

Several blamed their peers for taking technology for granted. Dependent as they are on cell phones, computers, and iPods, young people aren't curious about how they work. As one student observed, “When one can connect to a virtual world with the flip of a switch, the incentive is lost to go out in the backyard and build rockets.”

But few said that students shy away

from science because it conflicts with their religious beliefs. One went so far as to describe science as a way to appreciate the glory of God, writing, “Personally, I find the view science gives us of the universe as intriguing as I do because I love my God, the creator of this universe.”

A recurring theme was the difficulty of science, which was described as “complicated, confusing or intimidating.” According to the essays, today's students expect everything to be “fun stuff.”

Many of the high school students also criticized the way science is taught, emphasizing their desire for more learning by doing. “If there were fewer lectures and more hands-on experimentation and research where students were interactively involved, there would be an increase in science... among students,” one wrote.

Others attributed the lack of interest in science to the belief that careers in science are relatively low-paying. “What do you do with a science degree?” one asked. “There aren't too many people in this world getting rich off the science industry.” Finally, the mass media came in for blame for not providing an appealing image of science and portraying scientists as boring “geeks.”

“Hollywood has portrayed many nerds as lovers of science,” wrote one essayist. “When most people think of a scientist, they think of a man in a white lab coat with hair that is sticking out with electricity going through it holding a beaker that contains a crazy concoction in it. This isn't exactly appealing.” ¶