

## Beyond Gray Boxes: Making History of Science Integral to the Teaching of K-12 Science

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In her [essay](#) in the January 2009 HSS *Newsletter*, Michelle Klosterman highlights the general lack of history of science in American K-12 science classrooms. Despite greater emphasis on the inclusion of such material recommended by national standards developed by both the AAAS and the National Research Council, science classroom instruction is typically devoid of the history of science.

Ms. Klosterman describes four obstacles to the successful incorporation of historical subjects in the science classroom: (1) the limited time teachers have to engage the students in actual instruction, (2) concerns about standardized testing and the relative lack of history on such exams, (3) student motivation, and (4) a lack of resources, both material and intellectual. She suggests that modifying teacher-education programs to instruct pre-service teaching candidates on the history of science and giving these teachers guidance on how to include history successfully is necessary for the long-term survival of history as a part of the de facto science curriculum.

It is our view that historians of science have a unique opportunity, and perhaps some degree of responsibility—both of which have been under emphasized in the professional practice of our field—to engage two very different, yet extremely important audiences: K-12 science teachers and, indirectly, the students they teach. Such engagement must certainly involve pre-service teacher education programs, as Ms. Klosterman has suggested, but it can, and should, include a variety of other endeavors. These efforts must address the needs of current science teachers as well as future teachers, utilize history of science in a way that supports science teaching while still being responsible to the history itself, and provide concrete tools for teachers to take into the classroom.

While national standards have incorporated historical perspectives as an essential part of a comprehensive science education, history of science still remains largely marginalized. Regardless of the authoritative character of the national standards cited and the standing of the authors and publishing organizations, the standards are not binding documents. It is still the responsibility of each state to determine the curriculum for its students, and consistency regarding history of science is lacking. The standards of some states, such as Indiana, include detailed expectations for student learning of the history of science. On the other hand, some states take an approach similar to that of California, in which history of science is essentially limited to a handful of names attached to key ideas in science in such a way that history of science could be assessed with a simple matching quiz.

A quick survey of typical high school science textbooks reveals the inclusion of history of science in nearly all of them, focusing on significant episodes, typically those emphasized in the national standards. This history, however, is found not in the main body of text, but in the margins or as superadded topics, separated in gray boxes, easily ignored by teachers and students alike. There is rarely any effort to incorporate historical topics directly within the

text, and the message is clear: these topics can be ignored without harming a student's science education.

These problems are sometimes compounded further by oversimplification, sometimes to the point of distortion. For example, the Indiana biology standards indicate that students will be able to

*[e]xplain that after the publication of *The Origin of Species*, biological evolution was supported by the rediscovery of the genetics experiments of Austrian monk Gregor Mendel, by the identification of genes and how they are sorted in reproduction, and by the discovery that the genetic code found in DNA is the same for almost all organisms.*

While this certainly describes the current view of evolutionary theory, at least as it is described in standards and textbooks, it masks any hint of the well-known controversies that arose when Mendel's work was rediscovered. Also gone is any sense that the process of science has been anything other than clean and obvious in its development over time. Do not let the weak texts and mandates deceive, however. As our experience demonstrates, active teachers are interested in history of science and its use in the classroom. This June, the History and Philosophy of Science Program at Notre Dame will be hosting the biennial meeting of the International History and Philosophy of Science Teaching Group as well as its fifth Summer Program for Secondary Science Teachers, giving teachers the opportunity to study topics in the history of science and explore ways to utilize it in their own classes. In presentations at the National Science Teachers Association national conference, as well as at statewide science teacher meetings in Indiana and Illinois, we have spoken to several hundred teachers on the use of history of science in secondary classrooms. Teachers are interested. But interest alone is not enough.

For history of science to emerge from its gray boxes, it must be seen as an avenue for teaching science content. In the current educational climate, we have barely made strides in this direction. With the expansion of standardized testing and concerns over the performance of American students on exams like the Trends in International Mathematics and Science Study, teachers are under tremendous pressure to ensure that their students understand the course content. The time constraints indicated by Ms. Klosterman make it even more difficult for teachers to incorporate history of science. If, however, the history of science is used as a way to teach science content, it is no longer additional material relegated to gray boxes, but a key part of the science classroom. It is our contention that history of science can be used in such a manner to support the understanding of the relevant sciences; it is more than just history of science - it is part of science.

If historians of science want their field to leave gray box marginality, experts in our field must come together on equal terms with experts in educational theory and classroom practice both to design new materials and to create new accessible pedagogical frameworks. And, importantly, we believe that pre-service and in-service teachers alike must be targeted.

We cannot approach educators empty-handed, however. Teachers need to have immediate access to materials that incorporate history of science in meaningful ways if they are to see our appeals as legitimate. Ultimately, historians of science should be involved in textbook writing while advocating for the inclusion of more nuanced history of science in state science standards and acting as resources for curriculum committees from the local to national levels. In the meantime, however, we must develop supplementary materials to complement current

textbooks. Even single lesson plans can help teachers incorporate history of science into their classroom with a minimum of difficulty.

Collaborative efforts to affect teaching practice must, of course, be two-way and must extend beyond the walls of the academy. Any experienced teacher will tell you that the high school science classroom is very different from the college classroom - and often different from the science classes in which these teachers were trained. Many teachers remain justifiably skeptical of suggestions from experts who have rarely, if ever, "gotten their hands dirty" in the classroom. Experienced, successful teachers need to be included in the development of new approaches to help ensure suitability and usefulness, as well as to help make these new approaches more palatable to educators. According to the National Science Education Standards, "[t]he challenge of professional development . . . is to create optimal collaborative learning situations in which the best sources of expertise are linked with the experiences and current needs of the teachers." Who better to help teachers with incorporating history of science than those with the most expertise? And who better to impact the way we communicate to audiences beyond our own disciplinary boundaries than by consulting those who "translate" on a daily basis.

Our own senior colleagues have suggested we could use help in translation anyway. In the [June 2008 issue of \*Isis\*](#), education is suggested as an important area in which historians of science can wield significant influence. Maienschein and Smith claim that "[i]t is not useful to individuals, to the field, or to the profession for historians of science to retreat to their secure studies and preach about the importance of our field. It is not valuable to dismiss popular histories of science that get the details 'wrong' but sell volumes, nor to sit in our tenured positions and complain that discussions of policy about climate change or creationism do not take the history seriously." We contend that these words apply not merely to history of science texts written for a trade audience but to the K-12 educational environment as well.

There is some encouraging news. Aside from the work of ourselves and our compatriots at Notre Dame, several teacher training programs have successfully included history of science as a key component of the educational process, most notably the UTeach program at the University of Texas-Austin. There are hundreds of other colleges and universities that prepare future teachers, each of which could be a place for fruitful and impactful collaboration, were such efforts proposed. By exposing young educators to the history of science and its significance to the classroom, historians can have a lasting impact on these budding professionals and the students they will eventually teach.

The history of science is already part of the K-12 curriculum for many students, often dressed up as the "nature" of science. The need for expertise in history of science is real and pressing; we need to look no further than the continued furor over the teaching of evolution for evidence. But biology classrooms are only the most obvious places for the insertion of the history of science. Ms. Klosterman concludes that "until more practical methods of incorporating history in science instruction are offered, and possibly even required, we will lose the true conceptual understanding of science, the scientific enterprise, and the significance (or insignificance) of our cultural heritage." We concur. But we disagree with the implication that education programs can instigate this change on their own.

It is our assertion that the onus is on we historians of science to extend a hand to colleagues in colleges of education and in the classroom. We must work together not only to create practical

methods and materials for instruction, but also to develop a greater appreciation among educators for the history of science and its significance to our cultural heritage. After all, the goal of science education should be to teach students about science, not simply about a collection of facts and theories that this enterprise called science has generated and textualized. Our students will become citizens in a nation and world in which science and technology are already ubiquitous, and in which new problems and opportunities will arise. By preparing teachers to approach science in less rigid and restricted ways, we are giving students a chance to learn and understand science beyond the textbook facts, equipping them to become responsible and thoughtful citizens. Some historians have already undertaken this effort, and they are to be commended and supported, but there is still much that can be done. Thousands of teachers and millions of students can be reached by new collaborations, and it is our view and experience that even our own work as scholars can be changed for the better by the new perspectives such collaborations entail.

If, on the other hand, trained historians of science are either unwilling or uninterested in working with teachers and education programs, history of science will remain at risk of oversimplification and distortion, tucked away in dismissible gray boxes.

The national benchmarks are part of Project 2061.

<http://www.project2061.org/publications/bsl/online/index.php?home=true>

[http://www.nap.edu/openbook.php?record\\_id=4962](http://www.nap.edu/openbook.php?record_id=4962)

<http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx>

<http://www.cde.ca.gov/BE/ST/SS/documents/sciencestnd.pdf>

<http://dc.doe.in.gov/Standards/AcademicStandards/PrintLibrary/docs-science/2006-science-biologyi.pdf>, B.2.4 (p. 6)

National Research Council, National Science Education Standards (Washington: National Academies Press, 1995; 5th printing, 1998), 58.

Maienschein, J. and Smith, G., "What Difference Does History of Science Make, Anyway?" *Isis* 99 (2008): 318-321.

Further information: [Douglas Allchin's teacher resource for history of science](#)

[Archives](#) of *HSS Newsletters*