

Biology Textbooks— Whose Business?

Joseph D. McInerney

"The immediate answer is obvious: biology textbooks are everybody's business."

In his extraordinary book, *The Growth of Biological Thought*, the renowned evolutionary biologist Ernst Mayr (1982) poses this deceptively simple question: "If one wanted to characterize modern biology in a few words, what would one say?" That is precisely the question that faces the classroom teacher and the curriculum developer in planning courses and in writing textbooks for high school biology. We must "characterize modern biology in a few words" for young people, many of whom will have no further formal exposure to biology.

Mayr, who answers the question for professional biologists, has the benefit of having constructed important pieces of modern evolution theory. Those of us with more modest skills—and the equally important task of answering Mayr's question for high school students—call on the workhorse of education, the textbook.

The American Association for the Advancement of Science (AAAS) has sponsored a series of symposia entitled "Biology Textbooks: Whose Business?" The immediate answer is obvious: biology textbooks are everybody's business. That is absolutely appropriate for two reasons. First, because the biology curriculum is a piece of American general education, we should all be concerned that biology textbooks fulfill the objectives of that larger process. Second, because an understanding of biology is central to the preservation of the quality of life into the future, we had best be concerned that our students, who will shepherd the planet into the 21st century, understand basic, enduring biological principles and their relationship to human welfare.

Consider the scope and complexity of the task of educating our students for life in the 21st century; it involves approximately 40,000 biology teachers and millions of students in 16,000 public school districts

Joseph D. McInerney is director of the Biological Sciences Curriculum Study, The Colorado College, Colorado Springs, CO 80903. Since joining the BSCS staff in 1977, McInerney has worked primarily on programs in human genetics education and on education and science, technology and society. McInerney is co-chair of the National Association of Biology Teachers/National Science Teachers Association Biology Test Committee.

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and numerous private schools. Most Americans applaud the cultural pluralism and diversity inherent in the educational system and assert that diversity should be manifest in the curriculum, to wit: there should be no "national curriculum."

No biologist should question the value of diversity. I submit, however, that the assertion that we do not have a national curriculum in biology is a snare and a delusion. If one examines the 30-plus textbooks currently available for high school biology, one finds little diversity in the way the discipline is presented to students, in the instructional strategies, or in the demands the materials make on students—or on teachers, for that matter. One may find a few new ancillaries such as a teacher's resource book, a student study guide, or black-line masters. Unfortunately, those interesting side bars have little impact on the content of the textbook itself; indeed, they often do little more than reaffirm its instructional orientation.

(The growing importance of ancillaries requires a brief comment. On first examination, ancillaries may appear to be the publishing industry's equivalent of neutral mutations, minor variants that are not subject to selective pressure and that therefore do not affect survival—in this case, reproductive success in the form of additional printings, or, better still, new editions. Already, however, these extras are becoming the grist for natural selection as adoption committees evaluate the free materials that accompany the program and ignore the main program itself. Publishers, of course, exploit this, perpetuating what the Association for Supervision and Curriculum Development (1985) has called the tendency to "evaluate the sizzle and not the steak.")

The lack of diversity in biology textbooks indicates that we do have a national curriculum in biology. It is not overt, nor does it exist by force of government mandate. It results instead from the inherent power of those who control the development of materials. The question, then, obviously becomes: "Who does control this development?" The data indicate that it

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is largely publishers. Indeed, in the “elhi” market, “the 20 largest (publishers) control more than 75 percent of sales” (Apple 1985). Furthermore, that small group of publishers produces tightly-controlled, in-house books that ensure the homogeneity we find in text materials.

Publishers, however, claim that they simply respond to regional and national needs and that teachers actually determine the content and orientation of textbooks. “We just give them what they want” is the publishers’ common refrain. One has to question the validity of the statement, given that advertising, giveaways and even the internal structure of the publishing industry (Apple 1985) promote the status quo. But let us take the publishers’ assertion as true. The presence of approximately 30 books, most of which are strikingly similar in their approach to biology, must then be taken as the publishing industry’s equivalent of convergent evolution— independently-evolved analogies, developed by some two dozen publishers in response to similar selective pressure in various populations.

That would not be all bad if the convergence had been toward excellence, toward a representation of biology that has a solid conceptual framework; toward teaching strategies that promote inquiry and thinking; toward materials that incorporate the best new knowledge in cognitive science; toward a consensus on what constitutes useful, worthwhile knowledge; toward instruction that presents biology in relationship to other sciences and in relationship to the way modern science is done (Hurd 1986); and, last, toward content that prepares students for their roles as citizens who will live the majority of their lives in the next century.

Unfortunately, recent reviews published by AAAS (1985) and People for the American Way (Moyer and Mayer 1985) demonstrate that the convergence has instead been toward mediocrity; toward pedestrian representations of biology that are guaranteed to offend no one (Rosenthal 1984); toward low-level intellectual skills; toward ever more information for its own sake; toward unquestioning adherence to questionable readability formulas (Armbruster, et al. 1985); and toward content that has little relevance to individual or societal concerns (Hurd 1986). The following examples, taken from reviews of four different textbooks in the AAAS’ special issue of *Science Book and Films* (AAAS 1985) devoted to biology textbooks, illustrate the point:

This text places heavy emphasis on the vocabulary of biology, and nearly all of the review questions are written for the lowest level of thinking skills. . . . There are few investigations or suggestions that would involve students in the higher skills of analyzing, synthesizing, and evaluating information.

The big ideas of biology are lost in a sea of minutia, and the processes of science are totally absent, with labs serving no other purpose than confirmation of the text. The text is pedestrian at best, downright inaccurate at worst.

Evolution is described in a single chapter with minimal integration of evolutionary thinking into the rest of the text. Other controversial subjects are generally ignored—abortion, birth control, implications of human population growth, implications of genetic engineering.

Neither the study questions nor the labs require the student to think or discriminate. The student doesn’t have to solve a problem for the answers or formulate some conclusion from data collected—those labs are exercises only. . . . The overhead master dwells almost exclusively on structure and terminology of organisms. . . . These materials are appropriate for traditional biology teachers who want to teach high school biology using the same approach and biology subject matter they may have experienced as college or university majors.

Consider Ernst Mayr’s question once more. Would the books represented in the foregoing reviews help students understand that there is not “a single biological discipline that does not have major unsolved problems” (Mayr 1982), that there is a conceptual framework for biology that has its roots in genetics and evolution, or that progress in biology affects individuals and society directly?

There are, to be sure, a number of bright spots and reasons for optimism among the reviews. Generally, however, the news is not good, and the implications are even worse when one considers that “the curriculum in most American schools is not defined by courses of study or suggested programs, but by one particular artifact, the standardized, grade-level-specific text . . .” (Apple 1985). In fact, researchers estimate that elementary and secondary students spend 70-95 percent of their time in the classroom working with text materials (Muther 1985).

The Context for Change in Biology Textbooks

Hurd (1986) has written that “the central problem (in science education) is the gap between the existing school curriculum and the demands of living in a

science- and technology-driven society." The trends in textbooks that are evident in the various reviews were inappropriate 25 years ago. Now, they are dangerously miseducative as well, because students who do not understand the role of science and technology in modern society will be disenfranchised from important public policy decisions.

Given its centrality in the educational process, one might be tempted to focus only on the textbook in instituting change. The status of textbooks is, however, merely a symptom of a much larger problem—the inappropriateness of our current approach to learning. If anything has emerged from the current calls for educational reform, it is a renewed understanding of the complexity of the educational system within which the curriculum and the textbook operate. Attempts at remediation that focus on only one aspect of this system therefore will find the reformers well rebuked by Garrett Hardin's enduring edict of ecological thinking: "you can't do just one thing." Indeed, the most insightful writing about educational reform has recognized first that wholesale change is necessary, and second that change must be derived from within the system, not imposed by outside authorities (Hurd 1986; National School Public Relations Association 1986; Komoski 1985).

Those who follow the publishing industry closely are convinced that the trend toward safe, in-house books will continue, because there is no inducement for publishers to change their current approach to textbooks. In fact, there is a substantial barrier to change, because any alteration in successful products jeopardizes profits (Apple 1985; Muther 1985).

Furthermore, the trend toward the purchase of even the largest publishing houses by major conglomerates such as Raytheon and Gulf and Western will only reaffirm the status quo. Decisions about biologic content and instructional strategies will reside in fewer corporate hands, none of which will risk pulling the strings required to introduce some diversity or innovation into a well-cultivated, static market. One does not require a crystal ball to predict that any new corporate consensus will force convergence on the newly-developed science requirements in the most populous states. The current assertion that we do not have a national curriculum in biology, already questionable, will then become completely implausible.

Promoting Change

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ness, and if reform is in the best interest of education, we all have an obligation to provide the inducement for change. What might the various constituencies in education do to help promote change in biology textbooks?

1. *Teachers* must show that they are willing to accept a change in textbooks, a change that will concentrate on major concepts, on inquiry, and on instruction that illustrates the personal and social implications of science. They must convey this to publishers so that publishers recognize it as a need. In addition, as Costenson and Lawson (1986) have noted, if administrators do not understand the importance of the changes being proposed, then teachers have a "duty to instruct the administration in the proper use of inquiry in the classroom and to acquaint them with the data that show it to be a superior approach to teaching."
2. *Colleges and universities* have an important role to play. Before teachers can act as advocates for reform they must understand its rationale and must understand as well the reasons for selecting textbooks that are more than encyclopedic listings of facts with no conceptual framework. Here, we may lay some of the blame at the doorstep of our colleges and universities, whose biology departments turn out teachers who are sometimes long on content but short on conceptual understanding (Moore 1985; Holmes Group 1986). Such teachers end up teaching the way they were taught; encyclopedic texts are comfortable and familiar to them.

John Moore (1985) is correct when he writes that "one must know a great deal to be able to say properly very little." Well trained science teachers will not feel compelled to "cover" the text, although doing so gives the impression of having conveyed much important knowledge. They will prefer instead to illustrate the dozen or so major themes of biology, using appropriate content. But to do so requires more knowledge than it takes simply to assist students with unending lists of terminology.

On the more practical side, prospective biology teachers should be trained during their undergraduate preparation to evaluate textbooks properly. In addition, they should be introduced to the process of textbook adoption so that it is not foreign to them once they begin teaching.

3. *Administrators* must provide a climate in their schools and districts for reform of science education. Administrators should beware the temptation to use badly designed standardized tests that assess students' acquisition of trivial knowledge. Such tests do not measure the ability to understand major concepts or to use knowledge once it is acquired; their use can perpetuate the use of

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poor textbooks. Furthermore, student performance should not be measured by tests that have no relationship to the stated goals of a curriculum. Administrators should provide the necessary time and training for textbook adoption committees to do the work necessary to select programs and materials that are clearly related to district-wide objectives.

4. *Curriculum developers* have an obligation to help create and define the need for a new approach to biology education. It is incumbent upon them to work with competent scientists, specialists in learning theory, and classroom teachers to produce materials that are workable in the classroom, that promote learning, and that present worthwhile information. Much of what we now ask students to learn is not worth knowing; it was not worth knowing in the early 1960s and it is not worth knowing now. Project 2061 (the year of Comet Halley's next visit), currently underway at AAAS, is addressing the issue of what constitutes worthwhile knowledge in the various disciplines of science. The results of that project should be quite helpful to curriculum developers.

Those involved in curriculum development must translate the results of such projects into workable textbooks, keeping in mind the goals of the curriculum and of education in general. Last, curriculum developers must insist on the right to present biology and its personal and societal implications free from the pressure of censors who champion one cause or another.

5. Every major report on educational reform issued during the past three years has stressed the role of *parents* in establishing and sustaining an atmosphere of excellence in the schools. The authors of a recent study that compared the mathematics achievement of Taiwanese, Japanese and American children (Stevenson et al. 1986) conclude that the clear superiority of Japanese and Taiwanese children is in large measure attributable to the active involvement of parents in the educational process.

Parents should examine and evaluate the textbooks their children use, and they should question why and how the textbooks were selected: what were the criteria?; do they have any relationship to district-wide curriculum goals; were those charged with the selection seduced by the "sizzle"? Parents must, however, assess instructional materials against sound educational objec-

tives, not against an antediluvian hit list of religious and political biases. Indeed, parents should insist that the textbooks their children use are honest representations of biology, free from the irrational influence of single-issue censors.

6. Finally, *publishers* must demonstrate a commitment to change in biology textbooks. Publishers, of course, are in business to make money, and change means a risk of financial failure, especially when the marketplace is so narrowly defined. Publishers have the right to make money. If, however, it is true that publishers determine the national curriculum in biology, they have an obligation to exercise their influence in a responsible manner.

It is not enough simply to wait for "needs" to be expressed. If publishers are to profit from the educational system, they must become true partners in the process, not simply purveyors of products. They must help with the reform of science education by promoting innovation through activities that produce change in the system. This might start with the production of better textbooks, but it should also encompass training for teachers by educators and biologists rather than by sales people.

If we are to ask that publishers take some risks in promoting reform, they must know that their efforts will not go unrewarded. We in education must let the publishing industry know that we are willing to embrace change, that we are willing to take some risks in the classroom, and that administrators are willing to provide that freedom.

The National Science Foundation is developing new policies that provide inducements for publishers to become involved early in the development of curricula. Perhaps this is an opportunity for educators and scientists to acquaint publishers with the need for reform and to make them true partners in the process. One hopes these policies will encompass as well the large scientific supply houses, reservoirs of knowledge that extend beyond the provision of glassware and live organisms. The personnel in these institutions have much to offer in terms of the conceptualization of laboratories that truly promote inquiry and that are not simple exercises in verification.

One cannot discuss the role of publishers without commenting on the issue of controversial materials in textbooks. Although no one begrudges publishers the need to attend to the reali-

ties of the marketplace, there is a problem when market considerations result in continuous capitulation to censors whose irrational demands do severe damage to the integrity of the biology we present to students. When that happens, we must all demand remedial action, as has happened recently in California (Marshall 1986).

Students need to understand the personal and social implications of rapid progress in biology. Teachers who do not address these issues, for whatever reason, abdicate their responsibility as educators, for an understanding of the social context of science is central to scientific literacy in contemporary society (Prewitt 1983).

We impress upon our students that the penalty for lack of diversity in the biological world is extinction. They must learn as well that the penalty for lack of diversity in ideas and values is repres-

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sion of the intellect at best and extinction of the intellect at worst. We must not abide those who seek to restrain for narrow ideologic reasons what our students may learn. They would have students turned into unthinking sheep, the more easily to be herded and cajoled and, ultimately, shorn of the individuality that is spun into the many and varied hopes, dreams and ideas that are the source of all that is good about this country. We in science education have an obligation to convey to administrators, parents and textbook publishers that such repression is simply unacceptable. Publishers who sacrifice quality science and education to the demands of vocal, irrational minorities do not deserve the support of the scientific or educational communities.

The discipline that we are charged with interpreting for students—that is, our answer to Ernst Mayr's question—raises controversy as a matter of course. Consider genetic engineering, prenatal diagnosis, population growth, the biologic effects of nuclear power, nuclear war, the biologic basis of behavior, and evolution. To present these topics only in their scientific context is to leave students with a sterile interpretation of biology, one that has little personal impact and no utility. To ignore the implications of modern biology is to hide our heads in the sand. The winds of scientific and technologic progress, however, will strip away even the last grains of insulation and we will stand with our students, exposed and unprepared for the future, having failed to fulfill our most im-

portant obligation as educators.

As we move from *talking about* educational reform to *implementing* educational reform, we must look carefully at all aspects of the educational system. The textbook is only one component of that system, but its far-reaching, enduring impact on American education requires that we pay close attention to its quality.

The curriculum reform movement of the 1960s brought to biology textbooks changes that many viewed as daring and innovative. Still others thought the changes did not go far enough. The various national reports on the status of education tell us that it is time to renew our collective commitment to innovation. We must all embrace the challenge.

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