CBE—Life Sciences Education
Vol. 6, 198–202, Fall 2007

Essay

High School Biology Today: What the Committee of Ten Actually Said

Keith Sheppard* and Dennis M. Robbins†

*Long Island Group Advancing Science Education, Stony Brook University, Stony Brook, NY 11794-5233; and †Science Department, Borough of Manhattan Community College, New York, NY 10007

Submitted March 5, 2007; Revised May 17, 2007; Accepted May 21, 2007
Monitoring Editor: James Gentile

This essay describes how in the 1890s the Committee of Ten arrived at their recommendations about the organization of the high school biological sciences and seeks to correct the frequently held, but erroneous view that the Committee of Ten was the initiator of the Biology-Chemistry-Physics order of teaching sciences prevalent in high schools today. The essay details the factors underlying the changing views of high school biology from its "natural history" origins, through its "zoology, botany, physiology" disciplinary phase to its eventual integration into a "general biology" course. The simultaneous parallel development of the "Carnegie Unit" for measuring coursework is highlighted as a significant contributor in the evolution of the present day high school biology course. The essay concludes with a discussion of the implications of the grade placement of the sciences for the future development of high school biology.

INTRODUCTION

A recent article in this journal (Vázquez, 2006) discussed the role played by the Committee of Ten in establishing the grade placements of the various sciences in high school, which ultimately led to biology being taught before chemistry and physics. We agree with Vázquez that the placement of biology before chemistry and physics needs to be reassessed, though we note that the article contains some inaccuracies, especially about the recommendations made by the Committee of Ten. Table 1 in Vásquez (2006, p. 30) is a summary of the final recommendations for the sciences of the Committee of Ten, which includes three errors: 1) The subject of chemistry has been omitted from the table; it should appear as the 12th grade subject in all the courses of study; that is, the Committee of Ten proposed that chemistry be taught last of all the sciences; 2) The classical course of study contains science subjects (astronomy, meteorology, geology, anatomy, physiology, and hygiene) that the committee did not recommend and are not found in the final report; and 3) The 10th grade options for all but the classical course of studies should read physics *and* either botany or zoology and not "physics, botany, or zoology." The Committee of Ten recommendation was that students could either take zoology or botany, but physics was mandatory. An edited version of the table showing only the science subjects is shown in this article as Table 1.

The science subjects included in Table 1, with their grade placements, represent the Committee of Ten's final recommendations. The grade placements of the biological science subjects are particularly salient. Notably,

- "Biology" as a course is absent from the table. In 1893, biology in high schools as a discrete subject did not exist, though there were distinct courses in botany, zoology, anatomy, physiology, and hygiene. Often, these biological subjects were taught in a particular school by different teachers.
- The recommendations about biological subjects actually followed the natural history subcommittee's recommendation that *either* a year of botany *or* zoology be offered, but *not* a combination "biology" course.
- All the biological sciences were omitted from the classical course of study, due to the presence of Greek. The classical course was viewed as the most prestigious at the time and was the course of study most likely to be taken by college-bound students.
- Neither the full Committee of Ten nor the natural history subcommittee recommended that biology precede physics and chemistry. The science subjects in Table 1 clearly

DOI: 10.1187/cbe.07–03–0013
Address correspondence to: Keith Sheppard (ksheppard@notes.cc.sunysb.edu) or Dennis M. Robbins (Drobbins@bmcc.cuny.edu).

show that even if the "Botany or Zoology" option was considered to be "Biology," it was not placed before physics. The Committee of Ten actually recommended "Physics First."

Given the pervasive and erroneous view that the Committee of Ten created in 1893 the "Biology before Chemistry and Physics" order of courses (see, e.g., Roy, 2001; Pascopella, 2003; Vázquez, 2006), it is instructional to review how the Committee of Ten actually arrived at its final recommendations and especially how they interpreted the recommendations made by the natural history and other science subcommittees.

THE COMMITTEE OF TEN

In 1892, the National Educational Association (NEA) organized a committee charged with determining what should be taught in high school so students from different schools would have a more uniform preparation for college (NEA, 1893). The high school subject offerings at the time were chaotic, with different schools and colleges having widely varying requirements and curricula. Charles W. Eliot, who at this time was the President of Harvard, chaired the Committee of Ten. As a precursor to the conference and to supply information for the first meeting, Eliot surveyed 40 prominent schools of the day to determine what subjects were offered (see Krug, 1964; pp. 47–51). The findings revealed that in the sample schools a total of 36 different subjects existed, with 34 of the schools offering some form of natural history (compared with only 28 schools offering chemistry). The subject of "natural history" had wide variation in both the time and number of years allocated to its teaching among the schools of the survey. For example, Kansas City High School offered 630 h of natural history over 4 yr, whereas the Cambridge Latin School in Massachusetts offered natural history for only 48 h over half a year. The Eliot survey did not differentiate between the various forms of natural history.

Evidence about how the biological sciences were distributed in schools at the time has been provided in another study (Stout, 1921). Stout detailed course offerings and grade placements of various subjects in the schools in the North Central Association throughout the late nineteenth century. The grade placements of the various biological sciences were erratic. Physiology was most often taught in the 9th grade. Although botany usually appeared in the 10th grade, it was also frequently found in 9th and 11th grades. Zoology courses were distributed throughout all the grades. There appeared to be no relationship between the grade placements of zoology and botany, nor was the content of the two subjects correlated (Stout, 1921; p. 59).

The Committee of Ten organized nine subcommittees, each devoted to different academic subject areas and which included three science subcommittees: "6. Physics, Astronomy and Chemistry; 7. Natural History (Biology, including Botany, Zoology and Physiology); . . . 9. Geography (Physical Geography, Geology and Meteorology)." (NEA, 1893; p. 5). All of these subcommittees were given the same set of questions to answer: What topics should be studied in high school? How much curricular time should be allocated to each subject? How should each subject be taught and assessed? What were the best methods for teaching subjects? Should the subjects be arranged differently for college-bound students? Each subcommittee responded to these questions and compiled a report, which was submitted to the full committee. The full committee then organized and modified the subcommittees' recommendations as it compiled the final report. One of the major errors made in writing about the science recommendations of the Committee of Ten is the confounding of the subcommittee reports with the final report (Smith and Hall, 1902).

THE NATURAL HISTORY SUBCOMMITTEE

Members of the natural history subcommittee were mainly college professors and included the noted botanists Charles Edwin Bessey and John Merle Coulter. They met six times and produced one of the longer subcommittee reports (NEA, 1893; pp. 138–161). Detailed descriptions of the work in all the subbranches of biological sciences (zoology, botany, and physiology) at each level of elementary and secondary ed-

Table 1. Suggested high school sciences from the report of the Committee of Ten

Year	Classical Three foreign languages (one modern)	Latin-scientific Two foreign languages (one modern)	Modern languages Two foreign languages (both modern)	English One foreign language (ancient or modern)
I	Physical Geography	Physical Geography	Physical Geography	Physical Geography
II	Physics	Physics and either Botany or Zoology	Physics and either Botany or Zoology	Physics and either Botany or Zoology
III		[Astronomy (1/2 year) and Meteorology (1/2 year)]	[Astronomy (1/2 year) and Meteorology (1/2 year)]	[Astronomy (1/2 year) and Meteorology (1/2 year)]
IV	Chemistry	Chemistry [Geology or Physiography] (1/2 year) and [Anatomy, Physiology, and Hygiene] (1/2 year)	Chemistry [Geology or Physiography] (1/2 year) and [Anatomy, Physiology, and Hygiene] (1/2 year)	Chemistry [Geology or Physiography] (1/2 year) and [Anatomy, Physiology, and Hygiene] (1/2 year)

From the Committee of Ten report (NEA, 1893, pp. 46–47; modified: nonscience courses were omitted).

ucation were produced by individual committee members and were shared with the subcommittee. In addition, the subcommittee reached almost complete agreement in answering the questions set by the full committee. Their recommendations included the following:

- That a minimum of 1 yr of *either* botany *or* zoology for high school should be included in the course of studies.
- That a single year of botany or zoology was preferable to a year of study divided between the two; that is, the natural history subcommittee recommended that there should not be a single course known as biology.
- That botany was more appropriate for high school than zoology, because "botanical materials were more easily obtained and were more attractive to students" (NEA, 1893, p. 139). Several subcommittee members disagreed with this recommendation.
- That physiology "may best be pursued in the later years of the high-school course" (NEA, 1893, p. 138). This was the only recommendation the natural history subcommittee made about grade placement of any of the subdisciplines.

The natural history subcommittee made *no* recommendation about the grade placement of botany or zoology. The geography subcommittee similarly made no recommendations about the grade placements for their various subjects (geology, meteorology, geography, and physiography). The only recommendations about specific science grade placements were made in the physical science subcommittee. In this subcommittee, there was disagreement about the placement of physics. The majority of the subcommittee voted to place physics in the senior year, with chemistry in the 11th grade, whereas a minority suggested the reverse placement. In both cases, however, it was the consensus that physics and chemistry should be taught in the last 2 yr of high school (NEA, 1893).

When all the science subcommittees met as a group, they recommended that 25% of all curricular time in high school be devoted to the sciences and promoted the use of laboratory work, but they did not discuss or make any recommendations about the grade placement of the individual sciences.

Some insight into the thinking of the natural history subcommittee can be found from Coulter's writings after the Committee of Ten meetings (Coulter, 1893, 1896). Coulter thought that biological subjects should be taught after the physical sciences in the schools: ". . . to have even an elementary appreciation of plants or animals in their life activities, one must bring to the study at least some elementary conception of the general principles of chemistry and physics . . . I should certainly place the biological subjects late in the course." (Coulter, 1896, p. 69).

THE FINAL REPORT IS COMPILED

The recommendations from the subcommittees for all subjects were compiled by the full Committee of Ten. They noted that collectively the subcommittees had allocated more instructional time than students could follow in certain grades (NEA, 1893, pp. 38–39). To accommodate all the options, the full committee made several initial decisions about the grade placements of the sciences (see Table 2). They followed the physical science subcommittee's recommendation and placed physics and chemistry in the junior and senior years, respectively. Applied geography was placed in the 9th grade, and the option of "botany or zoology" was placed in the 10th grade, so that there would be a science course in every year. These grade placements were arbitrary, and the committee gave no reason for placing "botany or zoology" in the 10th grade. The full committee did follow the natural history subcommittee's recommendation about physiology and placed it in the 12th grade with anatomy and hygiene.

In organizing the subjects to be taught in each grade, the committee placed physics in the 11th grade so that it "may precede meteorology and physiography" (p. 42). In their final recommendations (see Table 1) the committee further moved physics to the 10th grade in all their proposed courses of study (i.e., they placed physics first). Their rationale for this was that because many students at the time did not complete high school, they wished that in the first 2 yr, studies should be selected to be as broad and representative as possible and so "natural history being represented by physical geography, the Committee wished physics to represent the inorganic sciences of precision" (NEA, 1893, p. 48). To accommodate the study of Greek, the "botany or zoology" option was removed from the classical course of studies along with all other science half-year courses.

IMPACT OF THE COMMITTEE OF TEN

Although the Committee of Ten was particularly influential in the history of U.S. education (see e.g., Atkin and Black, 2007), its recommendations were suggestive rather than binding on high schools. Schools, with a multitude of local concerns, often had to make pragmatic decisions about curricular issues. Most notably, schools around the turn of the twentieth century were generally small and found it difficult to offer and staff a variety of the different science classes. The impact that the Committee of Ten recommendations had on the practice in schools was investigated 10 yr after it originally met (Dexter, 1906). The Dexter study reported that in 1906 only 12% of schools actually offered 1-yr courses in botany and zoology, and there was no mention of "general biology" courses. Further, physiology, when offered in schools, was invariably found in the earlier grades. So the Committee of Ten seems to have had little actual impact on the schools. The subsequent development of high school biology was the result of a number of other factors.

Table 2. Summary of Committee of Ten initial science grade recommendations

Year	Courses
First (9th grade)	Applied Geography
Second (10th grade)	Botany or Zoology
Third (11th grade)	Physics [Astronomy and Meteorology]
Fourth (12th grade)	Chemistry [Anatomy and Physiology and Hygiene] [Geology or Physiography]

From the Committee of Ten report (NEA, 1893, p. 41; showing only science subjects).

At the time of the Committee of Ten, a "mental discipline" view of learning prevailed in education. School subjects were valued according to their disciplinary value, measured by how well they developed "mental power" in the learner. Essentially the mind was considered to be a muscle that could be trained by judicious mental exercise. The earlier "natural history" view of biology, with its "study nature not books" approach was replaced by a disciplinary view of science subjects. Botany and zoology fit well into this disciplinary model because the content of the courses was technical and required laboratory work that was exacting and precise. Indeed, Coulter (1893) argued that physiology should not even be considered as a natural history subject, because of its "informational" rather than "disciplinary" nature. When the College Entrance Examination Board was established in 1901, the disciplinary view of subjects was reflected in the subjects that it tested. In 1902 a botany exam was introduced, in 1907 zoology was added, and it was not until 1913 that the first "biology" exam was offered. The disciplinary perspective highlighted the college domination of the science subjects and was unfortunately inappropriate for their target student population. Between 1900 and the 1920, the mental discipline philosophy of learning was heavily criticized and became widely rejected.

Another educational issue that directly impacted the development of biology also appeared at this time. This was the successful attempt to standardize high school curricula through the introduction of an academic credit system. The Committee on College Entrance Requirements (CCER), which met between 1895 and 1899, was charged with implementing the Committee of Ten recommendations (NEA, 1899). A major outcome of the CCER report was the introduction of the idea of a "national unit" for measuring and comparing high school coursework. The national unit, through the actions of the Carnegie Foundation for the Advancement of Teaching in 1909, would become known as the "Carnegie Unit," and it is still in universal use today (Tompkins and Gaumnitz, 1954). The national unit or Carnegie Unit standardized high school courses as 1-yr classes meeting approximately once per day and was a particularly salient administrative development for biology.

Other factors affecting the development of biology included the major demographic changes that were occurring in the country around this time. There was a large increase in immigration, a shift in the population away from rural to urban settings, and major changes in child labor laws, all of which contributed to a dramatic rise in enrollment in high schools. There was an approximate doubling of the high school population every 10 years from 1890 to 1930 (National Center for Educational Statistics, 2003). It was into this environment that "biology" became integrated from its subdisciplines (see e.g., Rosen, 1959; Hurd, 1961; Mayer, 1986; Rosenthal and Bybee, 1988; Pauly, 1991; Sheppard and Robbins, 2006).

In establishing the new "biology," teachers and administrators were reflecting the progressive educational views of the time that favored more general rather than specialized forms of education. There was a rejection of the college dominance of the biological sciences as being abstract and impractical (Rosen, 1959; Hurd, 1961; Rosenthal and Bybee, 1988). High school teachers wrote the new biology texts, and the biology syllabi were adapted to the developmental needs of students who would be in the earlier grades. The content of the course was more practical, was related to everyday life, and included such topics as hygiene, sanitation, and food preparation. This was reflected in the titles of the texts, for example, *A Civic Biology* (Hunter, 1914) and *Biology of Home and Community* (Trafton, 1923). These advances reflected the growing belief that education should be preparation for life not just preparation for college.

From an administrative perspective a general biology course was especially appealing. The 1-yr course fit well with the Carnegie Unit system for administering high school courses. By reducing the number of sciences that were offered, it helped to relieve the congested high school curriculum, made scheduling easier, and made for more efficient use of both time and teachers, and as a single subject biology was more likely to be viewed as an equal to the already well-established physics and chemistry courses.

As such, the "general biology" course that evolved between 1900 and 1920 was particularly well adapted to the education environment of the early twentieth century, and it was dramatically successful. Enrollment in biology grew almost exponentially, so that by 1930 its enrollment had eclipsed that of both chemistry and physics combined (Sheppard and Robbins, 2003). In the face of this competition, botany and zoology as school subjects almost completely disappeared.

The position of biology early in the high school course of studies was thus fixed at a time when its content and methods were vastly different from today. Nobody foresaw the developments that would occur in biology over the next 75 years, so that today the question of the grade placement of biology relative to the other sciences has become an important concern (Biological Sciences Curriculum Study Staff, 2004). If the Committee of Ten were to reconvene to answer the same questions today, there would be no "natural history" subcommittee representing botany, zoology, and physiology, but instead, biochemistry, bioinformatics, ecology, genetics, etc. would be the new domains. Indeed, it would be difficult to adequately represent all areas of modern biology with just 10 representatives. We would suggest that a modern day Committee of Ten would recognize the need for "biology" to adapt to its new educational environment and would recommend resequencing high school biology so that it is studied after introductory physics and chemistry. Also, as an absolute minimum, introductory high school biology should be a 2-yr course—something that the original Committee of Ten did not nor could not anticipate.

REFERENCES

Atkin, J. M., and Black, P. (2007). History of science curriculum reform in the United States and the United Kingdom. In: Handbook of Research on Science Education, ed. S. K. Abell and N. G. Lederman, Mahwah, NJ: Lawrence Erlbaum and Associates, 781–806.

Biological Sciences Curriculum Study Staff (BSCS) (2004). Biology and the Physics First Curriculum: A Symposium Celebrating BSCS's 45th Anniversary, Colorado Springs, CO: BSCS.

Coulter, J. M. (1893). Biology in secondary schools. Sch. Rev. *1*, 141–151.

Coulter, J. M. (1896). Correlation of science studies in secondary schools. Sch. Rev. *4*, 65–69.

Dexter, E. G. (1906). Ten years' influence of the report of the committee of ten. Sch. Rev. *14*, 254–269.

Hunter, G. W. (1914). A Civic Biology, New York: American Book Company.

Hurd, P. D. (1961). Biological Education in American Secondary Schools 1890–1960, Baltimore, MD: Waverly Press.

Krug, E. A. (1964). The Shaping of the American High School, 1880–1920, Vol. 1, Madison: University of Wisconsin Press.

Mayer, W. V. (1986). Biology education in the United States during the twentieth century. Q. Rev. Biol. *61*, 481–507.

National Center for Educational Statistics (2003). Digest of Education Statistics: Table 36. Washington, DC: U.S. Government Printing Office.

National Educational Association (NEA) (1893). Report of the Committee on Secondary School Studies, Washington, DC: Government Printing Office (commonly known as The Committee of Ten Report).

NEA (1899). Report of the Committee on College Entrance Requirements, Washington, DC: Government Printing Office.

Pascopella, A. (2003). Chicken and the egg. District Administration *39*(3), 44–49.

Pauly, P. J. (1991). The development of high school biology: New York City, 1900–1925. Isis *82*, 662–688.

Rosen, S. (1959). The origins of high school general biology. Sch. Sci. Math. *59*, 473–489.

Rosenthal, D. B., and Bybee, R. W. (1988). High school biology: the early years. Am. Biol. Teach. *50*, 345–347.

Roy, K. R. (2001). A district that put physics first. ENC Focus *8*, 21–22.

Sheppard, K., and Robbins, D. M. (2003). Physics was once first and once for all. Phys. Teach. *41*, 420–424.

Sheppard, K., and Robbins, D. M. (2006). Biology first: a history of the grade placement of high school biology. Am. Biol. Teach. *68*, 86–90.

Smith, A., and Hall, E. (1902). The Teaching of Chemistry and Physics in the Secondary School, New York: Longmans, Green, and Co.

Stout, J. E. (1921). The Development of High School Curricula in the North Central States from 1860 to 1918 (Vol. Educational Monograph No. 15), Chicago: University of Chicago.

Tompkins, E., and Gaumnitz, W. H. (1954) The Carnegie Unit: Its Origins, Status and Trends, Washington, DC: U.S. Government Printing Office.

Trafton, G. (1923). Biology of Home and Community, New York: Macmillan.

Vázquez, J. (2006). High school biology today: what the Committee of Ten did not anticipate. Cell Biol. Educ. *5*, 29–33.