

HISTORY OF DEVELOPMENT OF CALIFORNIA SCIENCE CONTENT STANDARDS

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California K-12 Education — Background. California currently is roughly 40th out of 50 in spending per student. Its students in one national examination in mathematics were near the bottom of the 40 states tested. And until recently (when reduction of class sizes in grades K-3 was mandated by the legislature), California's average class size had become among the largest in the country. Some would cite the famous Proposition 13, which limited the increase in property taxes (which support schools) as the source of these bad numbers; others would point to a changing demography in California. But all agree that California K-12 education is not the leader it used to be. One indicator is how common it has become to find the children of professionals attending non-public schools.

Despite these trends, California has been the site of several leading initiatives in the field of pre-college science education. Here are a few examples:

- * The partnership between Caltech and the Pasadena Unified School district (CAPSI — Caltech Pre-College Science Initiative) is a nationally recognized science education program that involves an intimate cooperation between scientists and Pasadena's 22 elementary schools.
- * The NSF has funded an extension of CAPSI to 12 other large school districts throughout the state, and at least one of these (El Centro) is now receiving NSF funds to extend the program to several small districts in its own area (along the Mexican border), the poorest area in the state.
- * The Science and Health Education Partnership between the University of California San Francisco Medical School and the San Francisco Unified School District is another renowned program.
- * The San Diego area has a number of school districts that are leading the way in reform and has an exemplary collaboration between technology-based businesses, academia, and local school systems.
- * Hewlett-Packard, which is based in Palo Alto, is heavily involved in supporting science education wherever in the state or nation it has a significant presence. The Bay Area Schools for Educational Excellence (BASEE) project in eight school districts on the peninsula is just one example.

In all these efforts, the science education programs employ the hands-on, inquiry-centered approach called for in both the National Science Education Standards of the National Research Council and the Benchmarks for Science Literacy of the AAAS.

Developing Science Standards in California — The Process. In 1995, the legislature authorized a Commission for the Establishment of Academic Performance and Content Standards (the "Academic Standards Commission"), a 21-member body charged with creating new "world class" standards for both content (i.e. what should be taught) and performance (i.e. how it should be assessed) — standards which school districts would not be required to adopt, but with which state approved textbooks and statewide tests would be "aligned". The Academic Standards Commission would include 12 members chosen by the Governor, the Superintendent of Public Instruction and six of her appointees, and one appointee by the State Senate and one by the State Assembly.

Since its formation, the Academic Standards Commission (ASC or "the Commission") has led the development of standards in reading and language arts, mathematics, science, and history and social science. In each case, a particular committee of the Commission and its staff have led the process; for the science standards, the committee has been the Science Committee which consists of 12 members, seven of whom were originally appointed to the Commission by the Governor. The current committee is a mix of active and retired business people, four teachers, a scientist, the state Superintendent of Public Instruction, a school administrator, and a member of the Hoover Institution.

Neither the Commission nor its appropriate Science Committee writes standards by themselves. Rather, they hire consultants; they provide them with guidelines; they meet and discuss with them, often giving them very specific directions; they receive, modify, and publicize the several drafts the consultants help prepare; and they receive input from experts and the public and oral presentations and public hearings and Commission meetings and in written submissions. Although the Science Committee and the Commission have enormous influence and are ultimately responsible for the standards that are produced,

the nature and quality of the standards also depend to an important degree on the nature and quality of the consultants.

The result of this process, a Proposed Final Draft, is then presented to the California State Board of Education (CSBE or "the Board of Education"), which holds one set of hearings, makes its own changes, and then adopts what becomes the California Standards for that subject area.

The CSBE currently has 10 members, all appointed by the Governor, and one vacancy. For some time, this group has been seen by many as very political. Its summary rejection of the mathematics standards that had been developed under the direction of Academic Standards Commission and were in alignment with the standards of the National Council of Teachers of Mathematics, got national attention. For many, this rejection made the political nature of both the Board and its process even clearer.

This process for the math standards also had significant influence on the development of the science standards. The membership of the Science Committee had substantial overlap with that of the Mathematics Committee; the Science Committee entered the science standards process still shocked by the math standards experience; and many decisions during the science standards process were colored by the expectation that the Board would not hesitate again to override Commission recommendations. One example: an instruction to the consultants, voted by a majority, was rescinded when Commissioner Evers (a gubernatorial appointment) said that if it were followed, he would submit an alternative "minority" report to the Board. To avoid that outcome and its possible consequences, behind-the-scenes negotiations then led to new instructions to the consultants, thus overriding the original vote.

Selection of Consultants for the Science Standards. In 1997, the selection of consultants for the science standards started in the traditional manner, with a Request for Proposals, but it ended in a complex political game, abetted by a press campaign that characterized the choice as one between scientists, who were for high standards, and "educrats," who were for "dumbing down" the curriculum. Here is a simplified description of what happened..

In response to the initial RFP, two proposals were received:

- * One proposal came from the Science Coalition, a group headed by Dr. Bonnie Brunkhorst, Professor of Geology and Professor of Science Education at California State University, San Bernardino (CSU-SB). The proposal included a number of prominent scientists with experience in K-12 science education and several nationally known leaders in science education with abundant experience writing local, state, and national standards. It also included Dr. Burton Richter, Nobel Laureate and Director of the Stanford Linear Accelerator, as adviser to the consultant team and offered Dr. Bruce Alberts, president of the National Academy of Sciences, as an adviser to the Commission. The financial agent would be CSU-SB.
- * The other proposal came from the Associated Scientists, a group headed by Dr. Stan Metzenberg, a new Assistant Professor of Biology at California State University, Northridge (CSU-N). This proposal, which had no work plan, no budget, and no institutional affiliation (it was not submitted through CSU-N), listed only Metzenberg himself as the "authority to bind the vendor".

Not surprisingly, it was announced that the CSU-SB would be awarded the contract. And the differences were not just the professionalism of the proposal and the educational experience of the Science Coalition. There was also a fundamental difference of educational approach: whether the primary goal was the understanding of science concepts or the rote knowledge of science facts, students learning to do science or teachers and textbooks drilling science into students, students loving science and eager to study science or students fearful of science and hating to take science.

At this point there was much protest from the Associated Scientists, both formally to the Commission and through information fed to the press. It was advertised that three Nobel Laureates, one of whom was the highly-respected, venerable (87-year old), California-based Dr. Glenn Seaborg, would write the standards *for free*. (It was later determined privately that Dr. Henry Taube and Dr. Dudley Herschbach, the other two Nobel Laureates, had been asked merely if they would help review standards

when written, to which they had agreed.) The press, including the national press, took up the theme — \$178,000 for a bunch of Cal State San Bernardino educators or \$0 for three Nobel Laureates?

The Commission were then informed that their selection criteria had been incorrectly applied in rating the CSU-SB proposal. New proposals were requested, but this time the Associated Scientists had a copy of the Science Coalition's first-round proposal. In this second round, the Associated Scientists could list, as part of their team, 10 Nobel Laureates (recruited in the same way as before). The Science Coalition, forced to play the Nobel Laureate game, had four (physicists Richter and Dr. Douglas Osheroff, who actually reviewed standards drafts, and chemists Taube and Herschbach, who in the second round agreed to be on both proposals). They also had eight members of the National Academy of Sciences committed to their internal review process.

The evaluation still rated the Science Coalition higher on the majority of grounds, but the smaller budget of the Associated Scientists (roughly \$168, 000 lower — a number to be compared with the \$40 billion spent on K-12 public education in California annually) gave them a slightly higher overall rating.

On January 27, 1998, the Commission asked both Drs. Brunkhorst and Metzberg to serve as consultants to the Commission. They were expected to seek guidance from their colleagues. A balance of sorts had been reached.

A New Player Enters the Fray. The very next day, Governor Wilson appointed Dr. Glenn Seaborg, one of the three original Nobel Laureates associated with the Associated Scientists, to fill a vacancy on the Commission. The Commission's chairperson immediately appointed Seaborg to chair its Science Committee, the group that would set the guidelines and lead the development process. Seaborg, in turn, appointed his former student and long-time protégé, Dr. Rollie Otto, to be "facilitator" of the effort of the two teams. The balance was gone.

Henceforth, Seaborg played a dominating role, at one time even insisting that the periodic table be introduced to children, not in high-school (where the national documents have it), nor in the 5th or 3rd grade (where the compromised final draft has it, at complete odds with the national documents and the findings of cognitive psychology), but in the 1st grade. To gain his approval of the final standards, numerous compromises were made, although in the end, Seaborg abstained on the vote for the final proposal. Among other things, he was particular unhappy that the proposal failed to specify a grade-by-grade program at the high-school level, with biology, chemistry, and physics in grades 9, 10, and 11 respectively, and earth science as an option in grade 12 (California presently requires only two years of high-school science for graduation). During a short break in that final meeting, Seaborg said in a group discussion "I'll fight this to the end." It is expected that Seaborg will make good on this promise, and the Board of Education will accept his direction.

The Development of Standards. Three "preliminary drafts" of the Standards were developed. For each, there was an interplay of writing by teams from the two groups with meetings with the Science Committee and/or the entire Academic Standards Commission, and opportunities for the public and experts to submit statements, and make presentations at short and sparse public hearings, and for some to comment at Commission meetings:

- * Launching the development of the standards. In contrast to the *Benchmarks for Science Literacy* and the *National Science Education Standards*, much of the initial draft of the California Science Standards was written in three days by roughly thirty people in a suite of hotel rooms near the Los Angeles International Airport. The Science Coalition team consisted of both scientists and science educators with one thing in common — a long-term commitment to and understanding of K-12 science education and the approach embodied in the documents of the National Academy of Sciences and the AAAS. The Associated Scientists had a greater number of scientists, but few with any extensive experience in K-12 science education, and, to no one's surprise, there were no Nobel Laureates.
- * The preliminary first draft. After eight more weeks and much work by core groups from both teams, the first draft was submitted to the public. Written statements were accepted for two

weeks after which public hearings were held in San Diego, Riverside, Pleasanton, and Eureka. In each of these, roughly three hours were available for comments on the science standards and speakers could have three or five minutes.

- * The preliminary second draft, for which the eight weeks of discussion and revision in refining the first draft were reduced to three, showed significant improvements over the first draft, reflecting much of the input received from the public. Now, the public was given only nine days to submit written statements and/or prepare short oral statements for one of two public hearings, held simultaneously and in only two venues, Sacramento and Burbank.
- * The preliminary final draft, which showed major retrenchments from the preliminary second draft, was refined and changed in a similar process but this time it lasted less than two weeks. The result of this work was not open to public comment before it was adopted by the Committee and Commission.
- * The public hearings on this draft before the State Board of Education will be held, with two weeks notice, the last week in August -- at a time when many who care will be vacationing far away.

The significance and impact of all the input received by the Commission, both written and oral, is very unclear. No adequate instrument for input at public hearings was ever developed by the staff, and no systematic data analysis was ever made of all this input. Instead, qualitative summaries were presented to the Commissioners that Dr. Brunkhorst and her team members believe grossly distorted the relative weights of different kinds of testimony. Other sets of input (expert invited reviews, public individual written comments sent directly to the Commission, focus group reviews, and public comments at Commission meetings) were similarly never analyzed.

An interesting footnote: When Drs. Metzberg and Brunkhorst came to later work sessions with some of their team members, Brunkhorst brought mostly science Ph.D.'s who are either prominent scientists, national, state, or local leaders in science education, or both, while Metzberg — leader of the team that got everyone's attention by promising Nobel Laureate involvement — brought only teachers.

Final Votes. The Preliminary Final Draft was approved by the Academic Standards Commission with the abstention of Dr. Seaborg (and one other member, who was reported to need more time to review all details). This draft is now on the desks of the California State Board of Education, almost the same Board that less than a year ago threw out the mathematics standards and replaced them with ones that by-passed the lengthy development and review processes established by the Commission. Before the Board votes on the science standards, there will be one final opportunity to submit comments and to speak at one of six hearings, in different parts of the state. As of this writing, the locations and dates have not been announced.

Responsibility for Performance Taken from Academic Standards Commission. As its name implies, the Commission also had responsibility for developing a plan to assess student performance. In fact one Commission member, a professor of education at Stanford, had already begun to develop ideas in this direction when the Governor informed the Commission that assessing performance would no longer be their responsibility. Exactly how this will be done has not been announced by the Governor's office, but those involved in any form of education know that if the assessment isn't aligned with the instruction, it is the instruction, not the assessment, that will change.

Role of the Press and the Public's Perception. To the casual reader of the California press, the choice between the two consultant groups was a no-brainer: a bunch of educrats doing the job for \$178,000 or a bunch of Nobel Prize winners doing it for free; a dumbed-down set of fuzzy standards, or a list of science facts that any college graduate would be proud to know.

This could not have been further from the truth. Aside from Dr. Seaborg, who was well positioned to have his way, it was the scientific community and K-12 science education that largely lost, the traditionalists who largely won. *Rather than calling for an approach to teaching that might reverse the*

dismal performance of California students, the proposed California standards simply ask that the present approach be made even worse.

This is an important story, but none of the prominent newspapers really covered it. The conflicting goals of the different approaches to science education, the evidence for each, the supporters of each, and the intensely political maneuvering behind the scenes have all been missed. And the Op-Ed pages have distorted the issues at best, totally misrepresented them at worst. Attempts to correct the wrong impressions, to have as an op-ed piece a shortened version of the enclosed statement by the president of the National Academy of Sciences (who is also a renowned Bay Area scientist and a leader of the effort to improve science education in San Francisco), were rejected by three of the state's leading newspapers.

While people who care have been grossly misled, the development of the California Science Content Education has been hijacked, and California's science education is about to take a giant step backward.