



Teaching PSSC Physics: A Remembrance of Things Past

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I was still in grade school in the mid-1950s when America started questioning its scientific, technological, military, and economic status. I will always remember that historic announcement on the car radio in October 1957: “Today the Soviets launched the first artificial satellite.” This amazing achievement by a foreign power only heightened America’s concern about its status as a nation, and perhaps more importantly, about its national security. If we were indeed losing primacy, what could we do to reverse the trend? Educational reform was seen by many as a key element in the reestablishment of dominance.

Prior to the launch of *Sputnik*, some scientists had already begun examining the way America was educating its young, especially in the sciences. Notable among these were physicists Jerrold Zacharias and Francis Friedman, who, along with other colleagues at MIT and leaders of industry, in 1956 formed the Physical Science Study Committee (PSSC). The result was the PSSC curriculum, a new way of teaching physics that was intended to replace rote memorization of facts and formulae with a more logical, experiment-based approach. Written by physicists and science educators, the PSSC program was designed to give students an opportunity to gain an understanding of the physical world by developing relationships between experiment and theory.

The PSSC curriculum was emblematic of a sea change in attitudes that was occurring at the time. Scientists were seeing the education of children as a part of their professional duties, teaching science was being recognized as more than dispensing facts, and the populace was becoming aware of the need to fund and support science education as well as science.

I was touched by the PSSC program in waves. Long before I took high school physics in 1963, my pharmacist father, whom I will always view as a Renaissance man, purchased over three dozen Doubleday Science Study Series books for the two of us to read. I would later learn that the wonderful little books were prepared under the auspices of PSSC. Written by recognized experts in their respective fields, the books made a wide variety of topics in physics accessible and interesting to readers of all ages. I recall my favorites being *Thirty Years that Shook Physics* by George Gamow, *Knowledge and Wonder* by Victor Weisskopf, and *Count Rumford* by Sanford Brown. I still remember how I enjoyed reading them and the profound influence they had on my desire to go into science. I suspect that only my father and my high school physics teacher influenced my career decision more.

As it would turn out, I would not have the opportunity to study PSSC physics until I was first asked to teach it. My high school had not adopted the program and so my study of physics in high school was of the “Dull” variety. Thank goodness my teacher focused on process, as well as content, and taught with enthusiasm.



To say my first encounter with PSSC was challenging would be an understatement! Although I had taken 50 semester hours of physics as an undergraduate, I was not prepared to present the innovative curriculum. My schooling had consisted of lecture followed by confirmation-style labs. Principles presented in class were later verified in the laboratory. The PSSC approach of integrating experiment and theory was foreign to me. So, as is often the case, I learned by teaching.

The first topics presented in the early editions of the PSSC textbooks were the measurement of short time intervals and large and small distances. These subjects were followed by scaling. Since my knowledge of this material ranged from rudimentary to nonexistent, I found myself staying one step ahead of my students, spending hours each night reading and learning. Then, just as I was catching my breath, the text dove right into wave phenomena. The presentation of waves before mechanics was, at least to me, a departure from the usual ordering of subject matter. Just one more surprise for the novice teacher!

That first year I was blessed with a small class of bright and enthusiastic students. As it turned out, we learned our lessons together. Looking back, I would have had it no other way, for it was exhilarating making discoveries as a team.

I think I may have been more amazed than my students the first time we set up the ripple tanks and observed a nodal pattern, something I had only read about in college. Later, an exercise at the end of the chapter on interference suggested a second way students might experience the superposition of waves. The problem asked students to calculate the position of the nodal lines produced by sound emanating from two speakers. We thought, why not try turning this problem into a demonstration? The school's athletic director had a PA system consisting of two horn speakers and an amplifier mounted on a cart that he used at pep rally assemblies. Lo and behold, when a function generator was connected to the sound system, a clearly discernable interference pattern was produced, just as predicted. Students stood transfixed along nodal lines where the sound level was low even though the speakers were blaring. This activity would become a part of my repertoire for the rest of my teaching career.

My students and I found the remainder of the experiments outlined in the PSSC laboratory manual to be as engaging, elegant, and illuminating as those dealing with waves. Students marveled at their ability to measure the width of a human hair using a pair of glass plates. They loved producing ticker tapes representing the motion of an accelerating cart that they pulled with rubber bands. To use the vernacular, their ability to determine the mass of the electron with a "tuning-eye" vacuum tube and a solenoid blew them away! While time prohibited us from performing all 52 experiments, those we did do provided us with a new way of looking at nature.

An homage to PSSC would not be complete without mention of the sometimes inspired films developed for the course. Like the Doubleday books, these films resulted from the efforts of prominent physicists. Recorded in black and white often with rather low production values, many of these films nevertheless remain excellent resources to this day. Certainly, an all-time favorite is Hume and Ivey's "Frames of Reference." Hume's "I don't know about you, but I'm dizzy" quote from the film became a shibboleth for physics teachers and their students at our school. Recalling Eric Rogers' "Coulomb's



Law,” one cannot help but think of Rogers’ “butter gun” analogy or his habit of continually removing and replacing his eyeglasses. His “What did you expect from the inverse square law?” certainly runs a close second when it comes to PSSC film quotes. Who can forget professor Elbert Little’s demonstration of total internal reflection at the MIT swimming pool, Hume and Ivey’s ingenious devices illustrating the laws of probability in “Random Events” or John Shive’s marvelous wave apparatus in “Simple Waves”?

No remembrance of the PSSC film collection would be complete without making mention of “A Million to One.” In this cinema classic, a flea pulls one of E. M. Purcell’s low-friction pucks. The tiny critter not only manages to move the puck, but apparently accelerates it! Needless to say, students love this over-the-top treatment of Newton’s second law.

While the number of schools using the PSSC curriculum has dwindled to a precious few, the impact of this pioneering program lives on. Today’s physics teachers may not realize it, but they and their students continue to be the beneficiaries of this venerable program. First and foremost, the PSSC initiative ushered in a new way of teaching science. More tangibly perhaps, variations on the audio-visual materials and laboratory apparatus produced for the PSSC program continue to be used in present day classrooms.

PSSC physics is certainly alive and well in the hearts and minds of those of us who had the privilege to teach it. I know, for my good friend and colleague Jim Hicks and I have spent hours reminiscing about the curriculum that changed our personal and professional lives.