Malcolm Wells: a Highly Effective Teacher
(A tribute by Jane Jackson, with writings by David Hestenes. Written in 1994, revised in 2008)

Malcolm Wells, expert teacher and founder of Modeling Instruction in high school physics, died on July 20, 1994 at age 63 of Lou Gehrig's disease. Malcolm was not a showman; he was not charismatic; he was a counterexample to the myth of the "born teacher". His expertise came from many years of sustained effort to improve his knowledge and his craft, and also from his collaborative work with a researcher in physics education. David Hestenes was his doctoral dissertation advisor, and as a result of their partnership, Malcolm gave the physics community the modeling method of high school physics instruction. Using this method, his students consistently achieved scores comparable with Harvard University students on the Force Concept Inventory and the Mechanics Baseline test. (The Inventory, written by Malcolm Wells, David Hestenes, and Gregg Swackhamer, is the widely used test for understanding of concepts in mechanics. The Baseline, by Wells and Hestenes, tests for problem-solving skills.)

The story of Malcolm's life's work is fascinating and inspiring, and it is valuable because it shows us what good physics teaching can be, how to become a highly effective physics teacher, and what our profession must do to facilitate expertise in teaching. Malcolm would be glad to have that knowledge disseminated.

Malcolm taught physics and chemistry for most of his career at high schools in Tempe, Arizona. His career got a jump-start by PSSC and Harvard Project Physics teacher workshops, in the Sputnik era. These workshops made a big impact on him, both for their methods and for the camaraderie and support that they generated among participants. He was a "hands on" teacher ever since, wanting to build his own apparatus and looking for simple demonstrations of deep physics. He was one of the first teachers to use computers in the classroom; he wrote his own programs and designed student activities to use computers. He was always on the lookout for new ideas and more effective ways to teach; and he spent long hours of his own time improving his methods. By the early 1980's his course was cooperative inquiry, using his own labs as well as modified Harvard Project Physics labs, the PSSC textbook, and the learning cycle popularized by Robert Karplus, which he had learned thoroughly from Anton Lawson, ASU Professor of Biology, in a university course. This method generated much enthusiasm and capacity for independent investigation in his students.

Since his high school is in the same city as Arizona State University, over the years he took every graduate course offered in science and in education at ASU that was relevant to his teaching. In the early 1980's he approached David Hestenes with the thought of doing a doctoral dissertation on the question of how to establish sound principles for using computers in high school physics. At that time David Hestenes had just written up his modeling theory of instruction, a pedagogy based on modeling as the central activity of physical scientists. David was working with his graduate student, Ibrahim Halloun, on the Mechanics Diagnostic test, a precursor to the Force Concept Inventory.

Malcolm administered the Diagnostic to his high school students and was shocked that they did little better than students who have been taught by traditional lecture/lab methods. He interviewed his students and concluded that his teaching was at fault.

Malcolm then elaborated Karplus’ learning cycle into a modeling cycle. In this method, using the computer as a scientific tool and working with simple lab equipment, students build conceptual and mathematical models of physical systems from their own experimental data and
then apply these models to solve problems.* The physics course becomes the study of a few models, which gives it a satisfying unity. Students’ modeling activities provide them with a natural framework in which to test their ideas and correct their misconceptions in Socratic dialogue with the teacher. The solution to a problem becomes not a number but a model, thus bringing a needed coherence to problem solving.

By the end of his doctoral work (1986-87), Malcolm's students were scoring much better on the Mechanics Diagnostic test. And Malcolm’s students were telling him that he was teaching them how to think!

Malcolm went on to teach the modeling method to colleagues in Arizona in NSF-sponsored pilot workshops from 1990 to 1993. Most teachers who use the method find it more satisfying than traditional approaches, and students do better on the Force Concept Inventory.

His longtime friend and colleague, Wayne Williams, wrote about the workshop: "When I was encouraged to become a part of the first group of Arizona high school physics teachers to be trained in this new program I resisted. After teaching science for 30 years (physics for 20 years) I felt that it was going to be too hard to change my style of teaching.... After talking to Malcolm Wells I was convinced that this new approach would revolutionize the way my students learned physics. Everything he told me about this new approach proved true. Today my approach is completely changed.... If you want students to really learn the basic concepts of physics and at the same time to be excited about coming to their class, then this is the program that every high school in the United States should learn to use. I am thankful that I had the opportunity to learn this program under a master teacher that we all hold in very high esteem -- Dr. Malcolm Wells." Wayne Williams postponed his retirement as a result of that workshop! He used Modeling Instruction in his high school classes enthusiastically. In 1995, Wayne won the NSTA Shell Award of $10,000. Only one K-12 science teacher in the USA is chosen each year for this award.

The modeling method was offered in NSF-sponsored teacher enhancement workshops from 1995 to 2005 for in-service teachers nationwide, as Wayne Williams desired. Workshops continue to be held at ASU and at numerous other universities and school districts nationwide according to wishes of local teachers and college faculty, subject to constraints of available funding.

Malcolm Wells became a highly effective teacher because of his lifelong quest for self-improvement which led to sustained hard work**, and because he had opportunities to work in partnership with a physics education researcher. His support system in the university community was crucial to nourish his quest! Not many high school teachers have such a support system; the physics profession needs to establish widespread institutional mechanisms for lifelong professional growth for high school teachers. One goal of the Modeling Instruction Program is to assist in creating such mechanisms so that many more high school teachers can become highly effective. Our society, our teachers, and our children deserve this. Malcolm showed us the way.

If you’d like to learn more about Malcolm Wells’ implementation of Modeling Instruction, read A Modeling Method for high school physics instruction, by Malcolm Wells, David Hestenes and Gregg Swackhamer (American Journal of Physics, 1995; in pdf at http://modeling.asu.edu. Click on “Research and Evaluation” or on “Modeling Instruction in High School Sciences”).

*Alan Van Heuvelen's work has the same foundation in modeling theory; he had a sabbatical at ASU and worked with David Hestenes. Eugenia Etkina independently developed similar strategies, with the acronym ISLE, while teaching high school physics in Moscow, Russia.
Malcolm was recognized at state and national levels. He was an Arizona Science Teacher of the Year. He was a Presidential Awardee for Excellence in Math and Science Teaching (PAEMST) in 1986. In 1988 he became a Physics Teaching Resource Agent (PTRA).

Malcolm Wells