Bruce Alberts learned a few lessons along the way as he became one of the most influential leaders in American science.

He learned that "failure is a way of growing wiser."

He learned that "rote learning teaches nothing."

And he learned that a cookbook experiment that merely rehashes the work of others is no way to absorb young people in the excitement of science.
At 73, Alberts is professor emeritus of biochemistry and biophysics at UCSF, and although "emeritus" is supposed to mean he's retired, he hasn't stopped for a minute.

He has a paper-strewn office at UCSF's Genentech Hall on the new Mission Bay campus not far from AT&T Park, but he's often away.

He commutes to Washington for a week or more every month as editor in chief of the internationally prestigious weekly journal Science, where he meets with his staff to determine the publication's peer-reviewed contents, writes many of its lead editorials and plans future issues.

He frequently travels the world: Last week he was in Mexico City keynoting an international conference on "inquiry-based" science education, and a month earlier, he returned from three weeks in Australia and Japan where he attended conferences on "strengthening the world of science and science education."

As President Obama's science envoy to Indonesia, he has made three trips to that country exploring ways to develop research and technology partnerships between American and Indonesian scientists.

**A better way to teach**

But Alberts' passion is education - transforming the plodding routines that mark most science classes today to processes of "inquiry." In Alberts' ideal classroom, teachers would guide students to pose questions about how the world works and then allow them to discover answers for themselves.

"We need to teach students how to think like a scientist," Alberts said. "The facts of science are important, but they aren't nearly as important as the way in which scientific facts are determined. Science is a way of knowing - that's what students need to learn."

Alberts is appalled at the way so many kids are turned off as early as elementary school by their science classes. Many teachers, Alberts mourns, are either too poorly prepared to teach any kind of science or simply won't teach it at all.

"The homework," he has said, "is writing down a bunch of science words and writing
the definition. Who likes that? It’s not science, and it actually turns everybody off from science."

Alberts says what he calls "the miserable No Child Left Behind law" - the 10-year-old federal act once hailed as breakthrough legislation with its standardized tests that promise to prepare kids to live in a science-dominated world - is a disaster.

"It's just about killed any effort at getting kids and science together," Alberts said. "In too many cases principals have told teachers, 'You can't teach science anymore because that isn't counted in the federal rules. You've got to teach math and reading and get our schools' test scores higher.' ... That's horrible."

**Exploring a TV set**

His own love for science - and his commitment to inquiry-based learning - began as a kid with the guts of a television set.

Alberts' eighth-grade teacher in Illinois told the students to choose an invention and explain how it worked. He knew nothing about television, but he looked up everything he could find, poked around inside a set, tested the function of each part, presented his explanation of how it worked, and passed.

"Along the way I remember how impressed I was with the human ingenuity that could create something like a TV," he recalled. "It was a terrific way to teach us."

He carried that view throughout the rest of school and into his career.

College was Harvard, where Alberts started as a premed student, taking all the biology and chemistry he wanted.

"I thought the science was wonderful and easy," Alberts said. "But the lab experience was a complete bore, because all you did was repeat old experiments like working out of a cookbook. You didn't really learn."

By his junior year as a premed student, Alberts was so frustrated by the routine experiments he had to endure that he almost quit - until a scientist named Jacques Fresco, then a postdoctoral fellow under the eminent biochemist Paul Doty, asked him to join Doty's famous lab.
"That was an incredible summer," Alberts said. "I was pretty cocky, because right away I was going to solve a major aspect of the genetic code and I devised a very fancy project to do it."

It failed.

"But I learned from the mistake and ... from that work we published two papers, one in Nature and one in the Proceedings of the National Academy of Sciences."

It was a big score for a mere undergraduate, and the PNAS paper, imposingly titled "The Accommodation of Noncomplementary Bases in Helical Polyribonucleotides and Deoxyribonucleic Acids," bore the proud authorship: "By Jacques R. Fresco and Bruce M. Alberts, communicated by Paul M. Doty."

**A new career**

With that, Alberts dropped all thought of medical school and switched his major. He graduated in biophysics summa cum laude.

After earning his doctorate from Harvard, he joined the Princeton faculty as an assistant professor of chemistry, and almost immediately learned how "cookbook chemistry" could ruin students.

He was teaching thermodynamics, and from his students' very first questions he could see they didn't understand the subject one bit.

"They had just memorized the formulas," he recalled.

He taught the course again with the same students, but this time had them solving questions with their own experiments, and the results stuck.

That's the difference between inquiry-based learning and memorization, Alberts said. With memorization, the subject "leaves you very quickly."

Alberts left Princeton in 1976 after UCSF recruited him. There Alberts earned distinction for his teaching and his successful research into chromosome replication.

In 1993, at age 55, he was elected president of the powerful National Academy of
Sciences, whose 2,200 members are America's leaders in science, engineering and medicine. Its working arm, the National Research Council, provides major investigative reports on virtually every science policy issue that confronts the White House and Congress - from space to the military to public health to education.

He quickly became known as the academy's "education president."

**Setting standards**

He led his colleagues in producing an epochal academy report called National Science Education Standards, a 272-page document published in 1996 that has inspired school boards and teachers around the country to work toward changing the way science and mathematics are taught in the K-12 grades.

"Bruce had essentially decided to make the academy focus on education as soon as he was elected president," said Michael J. Feuer, executive director of the education section of the academy's National Research Council. "He was a remarkable inspiration for developing the new standards for improving science education, and for elevating the quality of research into how children actually learn."

At the end of his first six-year term, Alberts was elected to a highly unusual second term, but with all his influence at the national science academy and his role as editor of Science, Alberts still has had time for San Francisco's education needs - particularly in science.

In this case, his wife, Betty, was the driving force. With all three of the Alberts children in the city's schools, Betty Alberts became active in the PTA, and from that platform she ushered in a drive to bring in much-needed equipment for the science classes.

Naturally, she involved her husband.

Today the Albertses' daughter, with a chemistry degree, is a science teacher in a San Francisco public high school; one son, with an engineering degree, is a computational biologist at the University of Washington; and their other son is an emergency room physician in Fresno.

"We didn't push our kids," Betty Alberts recalled, "but they were all interested in
science, and I began to see how their science classes were so badly deprived, they were starved for equipment.

"I kept thinking, 'this is nuts,' so I appealed to Bruce. I asked him, wasn't there some way we could at least get some test tubes and stuff that your people at UCSF don't need?"

"Sure," Bruce recalled telling her. "We did have lots of surplus equipment lying around, but they were all paid for with government money for scientists who had federal research grants."

New home for surplus
He also knew the scientists didn't need that equipment anymore, so without worrying too much about the rules, Alberts saw to it that surplus plastic gloves, timers, test tubes, pipettes, scales and microscopes were on their way to science classes at San Francisco's Hoover Middle School, which all three Alberts children attended.

Alberts reasoned that schools were government institutions, and as long as the equipment remained public property, there would be no problem. Since then other schools in the city have benefited from surplus equipment from UCSF.

It wasn't only laboratory "stuff" the schools needed, Alberts noticed, but fresh intellectual stimulus as well - in other words, they needed classes that made them dig for answers and exercise their innate curiosity.

He enlisted David Ramsay, then the UCSF vice chancellor for academic affairs, and the two created a program to recruit scientists to teach side by side with the city's public school science teachers. They called the program SEP, UCSF's Science and Health Education Partnership.

This year more than 100 volunteer UCSF students and faculty are working with teachers in San Francisco classrooms to help make science come alive for students from kindergarten through high school.

In one of many talks he gave as president of the National Academy, Alberts saw a day when science would be "taught to all students in the form of 'science as inquiry,' and
in this form ... students are encouraged to struggle with a problem and to discuss it with their classmates before being told the answer."

**A science festival**
That's the future, perhaps, but Alberts is gaining headway in his drive to encourage the public to understand science, and the fun and excitement of discovery and learning.

Last month, SEP organized the weeklong Bay Area Science Festival, which drew more than 70,000 parents and children to scores of events at museums, colleges and high-tech firms and major circus-like events in Hayward, Sonoma and San Francisco.

The festival is being duplicated in San Diego, Philadelphia and Cambridge, Mass. - all financed by a three-year, $3 million grant from the National Science Foundation.

"It's all just wonderful," Alberts said as he surveyed the scene at one of the festival sites he attended with two of his grandchildren last Sunday.

*This article has been corrected since it appeared in print editions.*

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