

# Phil Savage

## ... of Penn State

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1 University of Michigan  
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Phil Savage grew up near Monaca, Pennsylvania, 25 miles northwest of Pittsburgh. Neither of his parents had the opportunity to go to college, but they valued higher education and encouraged their children to be diligent in their studies and pursue college, which all did.

His father, who worked in a steel mill, knew that engineering was a good vocation to consider, since the engineers at the mill worked in air-conditioned offices. His mother was more direct and simply asked, “What kind of engineer do you want to be?” Phil earned his B.S. in chemical engineering at Penn State and then a master’s and doctorate at the University of Delaware.

Phil had a variety of jobs while growing up, including delivering newspapers and working in a lumberyard. He also sold Christmas cards door-to-door and extra produce from the family garden to his neighbors. Little did he know that this sales and marketing experience would aid him later in life when he began to “sell” research ideas to potential sponsors and “market” research projects to new Ph.D. students. These various jobs and entrepreneurial forays allowed him to save enough money to pay the tuition for his first year of college.

Phil played baseball every chance he got and, naturally, as a Western Pennsylvania boy, loved the Pittsburgh Pirates. Phil enjoyed listening to Hall of Fame broadcaster Bob Prince



*Even the Nittany Lion was glad to see Elaine and Phil return to Penn State, 2015.*

call the games every evening on KDKA radio. Thanks to collecting innumerable baseball cards and a subscription to *Baseball Digest*, he could quote statistics for players and for many years knew the names of all the players on all the teams. As many young boys in the area, he dreamed of playing for the Pirates, but even by age 10 or so he knew that his playing

time would be limited to pick-up games in the neighborhood, and now, summer recreational softball leagues.

## UNDERGRADUATE STUDIES AT PENN STATE

When Phil was accepted at Penn State, he decided to spend his first two years at one of the commonwealth campuses, Penn State Beaver, so he could save money by living at home. He recalls several excellent teachers there, including Dr. Leo Takahashi in physics and Dr. John Simpson in organic chemistry—who gave Phil a lead about a summer job at nearby St. Joe Minerals, where Phil worked after his sophomore year in an analytical chemistry lab and after his junior year in a hydrometallurgical pilot plant.

Phil met his wife, Elaine, when they were freshmen at Penn State Beaver. Elaine grew up on a dairy farm in Harmony, PA, and she, too, was raised by parents who placed a strong emphasis on family, faith, education, and hard work. Phil and Elaine were in the same Christian fellowship group at the Beaver Campus. They didn't start dating

until they had transitioned to the University Park Campus in State College. As juniors, they were at a Penn State football game with friends when Phil heard Elaine mention that she had not yet been to a Penn State soccer game. A few days later, Phil invited her to a soccer game on campus and from then on they were a couple. Their dates were activities that were inexpensive, as money was tight. They went to free campus sporting events and \$1 movies on campus, took long walks, and occasionally went out for grilled stickies (sticky buns) at the Diner, or to the Penn State Creamery for ice cream cones.

As a student on the University Park campus, Phil did well in his studies and recalls enjoying physical chemistry with Dr. John Lowe and reaction engineering with Dr. Fred Helfferich. During his senior year, Phil had the opportunity to do a year-long research project with chemical engineering professor

Dr. Ron Danner. The project involved drawing molecules on a computer monitor (the cursor was controlled by using two thumbwheels—no mouse yet), optimizing the molecular geometry by minimizing the energy, and then calculating the radius of gyration of the molecule. Phil did this for about 100 different molecules and enjoyed using such sophisticated computer technology. After all, in his senior design class they were still using punch cards and waiting in line to run

them through the card reader at the campus mainframe. The senior thesis Phil wrote is still being used.

Before he graduated from Penn State, though, Phil realized he had to make some plans for his future. He was going to Delaware for graduate school and Elaine was ready to accept a job with a national food service management company and would be in various training programs during the next year. So, rather than go their separate ways, Phil asked Elaine to marry him in April before graduation. The couple decided they would wait a year to marry, after Phil finished his master's and Elaine had her permanent job placement.



*Phil (left) and brother Chris ready to head to the ball diamond, 1969.*

## ON TO NEWARK FOR GRADUATE STUDIES

Phil decided he needed more education to better prepare for a future job in industry so he looked for a master's program where he could get engineering experience while also taking graduate-level courses. The University of Delaware offered just such an internship program at the time, in partnership with DuPont.

In the Engineering Services Division he was assigned to the Heat, Mass, and Momentum Transfer group. For a newly graduated engineer, it was a little daunting at first to design a new heat exchanger or distillation column that he knew would be used in a DuPont plant somewhere in their global enterprise. But this experience, and the superb mentorship of Dr. Allan Jones, gave him the exposure to the practical challenges for which he was looking.

As he hoped, DuPont offered him a job as he was finishing his master's program and he planned to accept the offer. However, when the then-chair of the department, Stan Sandler, heard about this plan, he helped Phil see the advantages of continuing his graduate studies. Being a first-generation college graduate, Phil had no engineers in his family and certainly no Ph.D.s. He took Stan's advice to heart and declined the DuPont offer. Before embarking on the Ph.D. journey, though, he and Elaine married, and they moved to Kennett Square, PA, where Elaine was working. Phil became a member of Mike Klein's research group, where he learned the scholarship of discovery and gained experience in reaction engineering, kinetics, catalysis, modeling, and analysis of experimental data. He especially appreciates all he learned about writing by working on manuscripts with Mike. Although he completed both his master's and Ph.D. work in just a few months beyond four years, Phil also found time for Saturday morning football games across from Colburn Lab, occasional golf outings, intramural softball (of course), and daily noon runs with classmates.

## COMING TO MICHIGAN

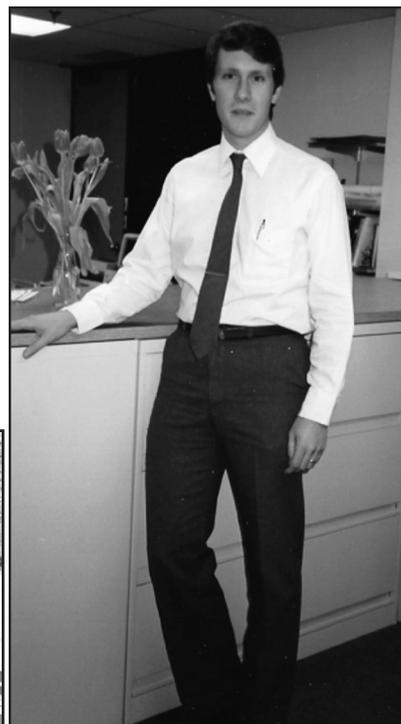
In 1986, as the dissertation defense drew near, Phil interviewed with both companies and universities, including Michigan. A few weeks after his final interview trip, he was ready to accept one of his industrial offers, but Scott Fogler, then chair at the University of Michigan, gave him a call. Scott persuaded Phil to defer the decision and return to Ann Arbor, this time with Elaine, to talk about a position and life as a professor. During that visit, Phil realized that he should take a shot at an academic career.

Phil realized quickly that teaching was of great importance to his department chair. Scott's reaction engineering text had just been published and he emphasized open-ended problems (often from industrial colleagues), active learning, creative problem solving, and the use of computer modules for learning outside of class. Phil says, "This environment was one

where excellence in education was more than talk. I knew developing into an excellent teacher was a clear departmental expectation of its assistant professors." He attended ASEE summer schools early in his career in Bozeman, MT, and in Boulder, CO. He attended workshops hosted by the Center for Research on Learning and Teaching at Michigan and read McKeachie's book, *Teaching Tips*, from cover to cover. He soon started reading *Chemical Engineering Education* and eventually published several articles himself in the journal. Even now, he looks forward to each new issue of *CEE* and *ASEE Prism*.

The day-to-day approach to teaching that Phil adopted when he began his academic career is to be approachable, available, and personable (*e.g.*, having an open-door policy and promptly learning students' names), to make the time in class productive, interactive, and enjoyable, and to focus on concepts. He enjoys asking questions that get at key concepts. "My hope is that over the course of the semester the students will begin to ask themselves questions about concepts. (Why? What if?)," he says. "If they develop this habit it can help ensure that they will be lifelong learners."

This method must have worked for the students because at both Michigan and Penn State they have consistently rated him highly in his faculty teaching evaluations. During his career at Michigan, he received a Teaching Excellence Award from the College of Engineering (twice), the inaugural Rackham Distinguished Graduate Mentor Award, and the Catalyt Award from



Above, Phil as a new assistant professor at Michigan in 1986; he wore a tie each day to avoid being mistaken for a graduate student. Left, Phil's research group at Michigan in 2014.



American Chemistry Council (2001), a national award for excellence in chemical education, and, in 1997, was named an Arthur F. Thurnau Professor, an honor given to a select few tenured faculty at Michigan whose commitment to and excellence in undergraduate teaching has had a demonstrable impact on the intellectual development and lives of their students.

Over the years at Michigan, Phil taught at least a portion of every undergraduate course with the exception of Fluid Mechanics and Process Dynamics and Control. His desire was to teach a course for a few years and then move on to a different course. These regular changes helped to keep the courses fresh. Former chair Ron Larson says, "I very much appreciated Phil's attitude towards departmental teaching and other duties. When asked about what course he was willing to teach, Phil would reply that while he had preferences, he would teach any course to which he was assigned. His teaching is predictably excellent; he always does a great job, earning the high honor of being named a Thurnau Professor."

His classroom teaching was not limited to college students. For 15 years, he and Professor Levi Thompson taught a 3-day course on Reaction Engineering and Applied Catalysis every summer. He also taught a 3-day AIChE course on Reaction Kinetics for the Practical Engineer with one of his undergraduate professors, Fred Helfferich. The two offered this course 30 times over a 10-year period, including in-house offerings for companies such as ChevronPhillips, Eastman Chemicals, Batelle, Phillips Petroleum, and Akzo Nobel

## GRADUATE MENTORING

Phil recognized that teaching and mentoring were among the best ways he could have a genuine impact on others and the profession of chemical engineering. So he invests time to determine the interests and strengths of the students in his research group. He enjoys mentoring and teaching the graduate and undergraduate students in his lab and wants to help them learn to love learning and the quest for answers just as he does.

Phil's current students praise him as an advisor, with one summing it up well by noting "Phil cleverly balances encouraging his graduate students to become independent problem solvers while also providing them with the security of having his help whenever needed. He recognizes the unique goals and needs of each one of his students and tailors his discussions accordingly to achieve either more focus within a project or to encourage more freedom and exploration in research." Other students add that he always makes them feel like he has time to spend with them, whether he was down the hall from their office in the Dow Building at the University of Michigan, or a few states away at Penn State.

Phil's students are well aware that he often responds to a question with a question of his own. As one of his former

doctoral students, Shawn Hunter (Ph.D. '05), now sustainability and new business development leader at Dow Chemical, remembers, "Phil encouraged us to not only bring questions but to also bring answers. You always needed to be ready for a 'well what do you think?' This expectation pushed us to think critically and independently. He was able to teach us important skills that will continue to pay dividends throughout our careers."

Not only does Phil guide his students through their doctoral studies, he also provides them with many examples of how to conduct themselves when they begin their careers. "As a member of Phil's group, I always felt supported yet free to explore. This environment enabled his students to be very productive," says Jennifer Dunn (PhD '04), now energy systems and sustainability analyst at Argonne National Laboratory. "He is still a role model for me over a decade after I left his lab."

Phil has a reputation of being a good listener and attentive to what his students have to say. "I could go to his office at any time, knowing I would find a supportive mentor and have intellectually stimulating conversations that always proved to be productive," says Fernando Resende (Ph.D. '09), now an assistant professor at the University of Washington. "Where I saw a problem, Phil always seemed to see an opportunity. The development and needs of each student were clearly his priority, and his engaged mentorship style has made a significant impact in my own style after I graduated and continued on an academic career." After leaving Michigan, Fernando and his wife, Olivia, decided to name their first child Felipe (the Brazilian Portuguese form of Phillip), in honor of Phil and the impact he had as a mentor for Fernando, which has gone far beyond their research work.

As typical of good teachers, Phil provides students with help in many other areas of life outside the classroom or lab. Elaine recounts a story of a parent of one of his graduate students thanking Phil "for everything he had taught his son while working in his lab but, more importantly, for all the things he taught him that weren't related to chemical engineering, as a role model." It was not the first time she had heard a remark like that about her husband.

Today, Phil says he is proud of all of his students and says, "I follow my students' careers and marvel at what they do once they leave to become scholars and leaders themselves." To date, Phil has mentored 43 Ph.D. students.

## COLLEAGUES

Not only is his open-door policy of great help to his students but the faculty also appreciates it. Even now as department head at Penn State, Phil continues to keep his office door open for students, staff, faculty, and alumni.

Through the years at Michigan, Phil was a sounding board for department chairs and other faculty. He would stop

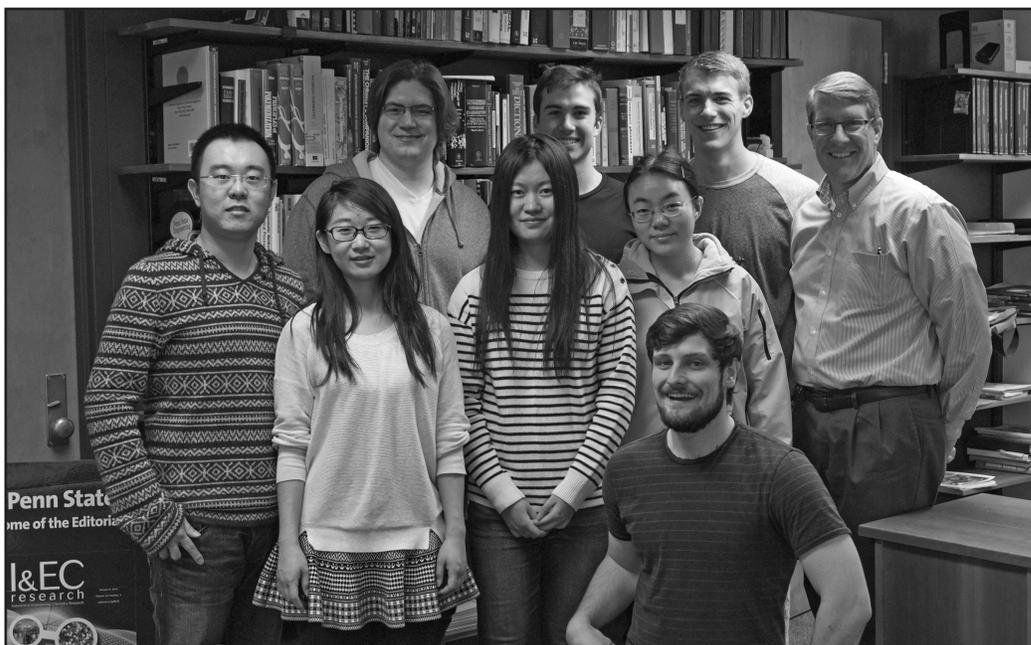
*Phil's Penn State  
research students in  
2016.*

what he was doing and patiently listen and advise whoever stopped by his office. Ralph Yang, the chair at Michigan from 1995-2000, remarks that, "I sought advice from him often when I was chair. He provided me with many insightful suggestions about improving the department and I will always be grateful." Scott Fogler says, "Phil was uncanny in the way he would bring clarity and vision to many unfocused discussions in faculty meetings concerning key issues and the mission of our department. He was not only a mentor to his students but also to his fellow faculty members." Ron Larson commented on Phil's ability to remain objective in the midst of intense discussions with his colleagues. "He always maintained a calm demeanor and had a great sense of humor. He was able to discuss controversial and difficult ideas with grace and fairness."

Phil, of course, took the same characteristics with him to Penn State. The faculty there say he is "cool as a cucumber," "handles pressure well," and "although here only a short time he exhibited a lot of faith in the faculty and quickly built up their trust." A large part of this success has been effected by his open door policy making everyone free to bring their issues to him, by the transparency he provides in terms of the basis of his decision making (e.g., funding available, distribution of resources), and by the establishment and consultation with a number of committees within the department. He has managed to engage essentially all the faculty in the recruiting process. He has also shown a real commitment to the development of the young faculty. He holds a monthly "work lunch" with the assistant professors to which he brings a set of prepared questions as to how things are working and what could make things better.

## RESEARCH – PAST – PRESENT – FUTURE

Phil's Ph.D. research project at Delaware dealt with discovering and then understanding how to convert petroleum asphaltene to lighter, fuel-range molecules. Oil was about \$85/bbl (in today's dollars) when he entered graduate school, but only \$25/bbl when he graduated, so he knew that asphaltene conversion was not an area in which to build a lab as a



new assistant professor. Initially he started with three projects: One was in pyrolysis of heavy hydrocarbons (related to his Ph.D. work), one was in lubricant degradation (to connect with the nearby auto industry in Detroit), and the third was in chemistry related to waste treatment (oxidation in supercritical water was an emerging waste treatment process). The last project was the one that turned out to have the best funding potential, so his lab has focused on chemical reactions in hot, compressed water ever since. This focus also brought with it an opportunity to work on issues related to the environment and sustainability.

Over the years, the applications emphasized in Phil's research have shifted from waste treatment to chemical and materials synthesis (green chemistry) to biomass processing to make biofuels, and now to the food-energy-water nexus. As applications changed with new projects, Phil sought out collaborators who would add the expertise needed to make an impact in the new application. This collaborative approach led to several Michigan chemical engineering faculty members (Levi Thompson, Suljo Linic, Nick Kotov, Bob Ziff, Nina Lin, and Henry Wang) being co-advisors and co-authors on papers with Phil's students, and, of course, being co-investigators on research grants and projects. Phil's research contributions have been recognized by his receipt of the inaugural Michigan Governor's Award for Green Chemistry (2009), the AIChE Sustainable Engineering Forum Research Excellence Award (2014), and the inaugural ACS Energy & Fuels Joint Award for Excellence in Publication (2015).

In 1995, he and his students published a review article in the *AIChE Journal* on reactions in supercritical fluids. It was very well received and has become one of the five most-cited papers published in the journal in the last 25 years. Phil says,



“Writing a review article is a lot like teaching—one takes a large body of information, organizes it, critically assesses it, and then puts that information and knowledge into a form that others, especially newcomers to the field, can use to climb the learning curve.” This good experience with that first review article led to two others. One focused on organic chemical reactions in supercritical water (*Chem. Rev.*, 1999; cited over 1,000 times according to Google Scholar) and the other, with then-Ph.D. student Naoko Akiya, was entitled “Roles of Water for Chemical Reactions in High Temperature Water” (*Chem. Rev.*, 2002).

## PROFESSIONAL SERVICE AND LEADERSHIP

Phil has been an active member of both AIChE and ACS throughout his career, and he has been named a fellow of both organizations. He has chaired the Catalysis and Reaction Engineering Division of AIChE and very recently completed a term as a director for the Environmental Division. He also served as associate editor for the *AIChE Journal* for six years. Within ACS, Phil has served as chair of the Industrial & Engineering Chemistry Division, associate editor for I&EC Research, and in 2014 was named editor in chief. Phil has also been called upon to serve on NRC committees assessing



*Above, Coach Phil reviewing the signs with son Michael, 2005. Left, Phil and his children Bethany, Stephen, and Michael pause during an outing in the Rockies during the ASEE Summer School in 2002.*

the use of supercritical water oxidation to destroy hydrolyzate from chemical weapons neutralization and as an expert reviewer for an EPA report to Congress.

## FAMILY

In 1987, Phil and Elaine had their first child, daughter Bethany. Brothers Stephen (1990) and Michael (1993) followed. When the children were growing up, they participated in music and sports. Elaine helped to cultivate their musical talents and Phil was active in coaching all of his kids in baseball and softball. “With three children,” Elaine says, “it seemed that they had practices or games almost every day of the week.” Of course, to Phil, there was nothing better than spending every evening on a ball diamond.

In addition to their frequent trips from Ann Arbor to visit family in Pennsylvania, the Savages enjoyed summer vacations to many scenic locations along Lakes Michigan, Huron, or Superior, often camping along the way. At least once a year, the whole family would accompany Phil on a trip for a conference. They made cross-country treks to ASEE summer conferences in Montana and Colorado.

When they weren’t traveling for a holiday, the Savages would invite Phil’s graduate students to join them for holiday meals at their home on Bluett Street. His students particularly remember the Thanksgiving dinners at their home. “Phil and his family were always so warm and kind, which really gave us a sense of belonging and community here in Ann Arbor,” says one former student, who also add that Elaine’s cookies are the best!

Cookies also show how Phil and Elaine are really a team in caring for students. As Elaine observed Phil grading midterm

exams during his first semester of teaching, and seeing lots of red ink and the low scores that sometimes emerge on undergraduate engineering exams, she decided that his students needed something positive after taking one of his exams. For the final exam, she sent in a large batch of homemade cookies so that each student could take one as they turned in their exam. This cookie tradition has continued ever since and is still in full force at Penn State. Phil's class in spring 2016 had 202 students, but on cookie day each left with a cookie or two, courtesy of Elaine.

Their local church family has always been a central part of Phil's life and his family's life, and there they formed many lifelong friendships. While in Ann Arbor, Phil served on the elder board and filled other leadership positions as well as teaching adult Sunday School and assisting with the Awana program for children. Elaine served on church staff for several years as the Children's Ministry director. Of course, whether in Kennett Square, Ann Arbor, or now State College, Phil has always played on the church softball team each summer.

## RETURN TO STATE COLLEGE

Phil maintained his connection with Penn State over the years, serving on their Industrial and Professional Advisory Council from 2000 to 2005. Then after 28 years at Michigan he accepted the position at Penn State as the Walter L. Robb Family Chair and Department Head of Chemical Engineering. Before departing Michigan, he was named the Arthur F. Thurnau Professor Emeritus and Professor Emeritus of Chemical Engineering.

Upon arriving in State College he had, of course, the usual transition issues of the actual move, getting to know a new faculty, interacting with a new administration, etc. But there was more than the usual for Phil because the College of Engineering had a new dean, the ABET accreditation team was scheduled to visit two months after his arrival, and a new chemical engineering building was to be designed and built. By the end of 2016 everyone is scheduled to move into temporary space and then, hopefully, two years later be ready to move to the new building constructed on essentially the same footprint as the old building. Needless to say, this created some significant, continuing concerns for the faculty and numerous meetings requiring Phil's attendance and participation. In one of his

early meetings with the department's ABET committee he showed his usual pragmatic self as he asked, "So where do you see the holes in our self-study?" Probably relying somewhat on his experience as an interim department head at Michigan, "he tackled the issues smoothly, with high energy, and excellent perspective" according to the former department head, Andrew Zydney.

Phil has proven to be ready to work with the faculty to try new approaches in terms of teaching techniques, curriculum options, and accreditation procedures, for example. The faculty's support of Phil is exemplified by one member who says, "He has been a strong advocate for the Penn State department in his short time here. He believes in the quality of the program and carries the message to those inside the administration and those in the outside community."

Phil has continued to make time in the classroom a priority at Penn State. He teaches a professional development seminar for juniors each spring, has mentored two student teams for the capstone process design class, has taught a graduate colloquium on communication and presentation skills, and has co-taught graduate reaction kinetics.

Even though Phil must now spend many hours outside the lab and the classroom, he realizes he can still have a lasting impact on chemical engineering students in his role as department head. After all, his career would have turned out very differently if it were not for two key department chairs taking an interest in him and helping him fully consider all of his options. "When I was at Delaware, I likely would never have gone on to get a Ph.D. without the encouragement of Stan Sandler to see that as a viable choice," says Phil. "And I doubt I would have had an academic career if Scott Fogler hadn't encouraged me to give Michigan a shot rather than taking an R&D job in industry."

As his biographers as well as his admirers, the authors are confident that the thousands of students and engineering professionals who benefited from Phil's teaching and mentoring are grateful that he decided to take that shot.

## ACKNOWLEDGMENTS

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