

President Zemke, honored students, families, faculty, administrative leaders, staff and friends of Millikin:

I am very honored to be part of this evening as the 23nd distinguished faculty lecturer.

This evening is wonderful occasion when we celebrate accomplishments in scholarship and service of 76 students and even a few faculty members. Thank you Denise for your encouragement as I prepared. You are a tough act to follow because there is no way I can be as eloquent or move as beautifully as you did last year.

I'm not very good at...

giving speeches. This is one speech that I said I would never give. I ask myself, why am I up here? You, of course, might be asking the same question.

I want to thank my family, particularly Carol, for their support and encouragement over many years. I credit any success I have in teaching to my colleagues in chemistry Ed, Randy, Anne, George, all great teachers and great people to work with. They illustrate that community drives excellence. I also want to acknowledge Neil Baird my neighbor on Riverview Ave for over 25 years, retiring this year from 35 years of teaching biology, for his friendship, his quality teaching, and participation in the life of the university. I wish it were he, not me, up here.

Much of what I will talk about comes from collaborations I have with Linda Slagell and Debbie Slayton. I value their friendship and support. Debbie actually took my class, Chemistry X-treme, and then presented a paper, *Chemistry X-treme: to boldly go where no nursing faculty has gone before*, with me last summer at a symposium on

chemistry and nursing at the Biennial Conference on Chemical Education. I was so proud to have Debbie and Cheryl Hilgenberg join George, Anne and myself in presenting papers at a meeting of mostly chemists.

As I thought about what I would say, my first idea was to do chemistry. I love chemistry because of the excitement of the unknown and the thrill of discovery. I thought: perhaps I should perform a reaction that would evacuate the building or make a smoke screen and disappear. If I were asked to give this speech 10 years ago, I might have talked about cation- π interactions in the structure and function of psychoactive drugs. Then I thought I would ask several of my former students what they might say. I believe their stories have not been told as often as the more glamorous alumni stories. I did ask several of them to give their response to the Millikin mission statement and give one piece of advice for you our honored students. I plan to publish these on the chemistry website. I decided, finally, to talk about what I am learning about learning. This will be a very personal memoir based on my experience. Four principles: structure, engagement, nurture, and challenge will be central to what I say. But I also plan to share a response from a 2003 Millikin alum, Adina Boyd.

Where did I get the idea, “I am good at chemistry”? In my youth, encouragement from my parents to read as much as possible directed me. A book my mother gave me, a biography of George Washington Carver, stimulated a love of science. My father built a place in the basement, my lab, where I could explore the wonders of acetylene, sulfur, and potassium nitrate among other things. I almost burned down my

lab. In college, I often noticed portraits of famous alumni filling the walls of the Illini Union. But it was the picture honoring Rosalyn Yalow, Nobel Prize winner in Medicine, that kept my vision for science going. I wanted to do research and perhaps cure cancer along the way. Now as I look back, I see some of these dreams have come true in the accomplishment of former students. These are a few of my former students whose pictures hang in my memory:

Dr. John Hoots: a member of the inventor's hall of fame for his pioneering work on corrosion treatment

Paul Rosteck: recently retired senior scientist at Eli Lilly who played a key role in the development of biotechnology and bioinformatics including the discovery of a gene for breast cancer and the development of human insulin

Dr. Eric Bremer: researcher on therapies to treat brain tumors in children

Sid Smith: developer of technologies that make cell culture and therefore biotechnology possible

Mark Matlock, Vice President for food research at ADM; Mark is leading development of safer fats including the elimination of trans fat from our diet. Mark may have been the only person that was a participant in the first trade fair in the Soviet Union and also the first trade show in Cuba. He has had lunch face to face with Fidel Castro.

Dr. Mary Jane Linton and Amy Kindred Johnson, faculty members at Millikin

Dr. Jon Rebman: curator of botany at the San Diego Natural History Museum and expert in the biodiversity of Baja California who writes of his work as "scientific adventure, excitement towards botany, respect for nature, and overall feelings of peace and purpose".

Dr. Nancy Carter Dopke, assistant professor of chemistry at Mercer University

Dr. Janet Clark, assistant professor of chemistry at St Marys of the Woods teaching after a 10 year career at Exxon Mobil. I guess she took to heart the Phil Mickelson commercial sponsored by Exxon Mobil that we have greater need for science and math teachers than we do professional golfers.

Dr Anne Louise Sumner, scientist at Battelle Research, developer of radically new ways to study the chemistry of the atmosphere

Nicole Tester, completing her PhD in neuroscience studying recovery of locomotor function after spinal cord injury

Dr. Charles Russell, researcher at Saint Jude's Children's Hospital Department of Infectious Diseases, a physical chemist studying viruses.

I am a physical chemist. Physical chemistry is difficult even for chemists to the point that the American Chemical Society sells bumper stickers that proclaim "Honk if you passed P Chem". I sort of enjoy meeting people socially who respond to my revelation that I teach chemistry with "I was never good at chemistry". It is perhaps my only claim to one-upmanship. I take less pleasure at students who use that excuse or the corollary excuse "I was never good at math" for poor performance.

Some of my students are bright, self-motivated students who come to me enjoying chemistry and the challenges it brings before they ever step into my class. Most of these students learn the same way I do. So the strategies I use myself and the ones in standard textbooks are the ones they use naturally. I step back and try not to hinder their development. However, the majority of chemistry students enter my chemistry class are

sure they will not succeed. They have the “I was never very good at” syndrome. What makes things more difficult is that they do not learn the same way I do, nor do they have the same experience with learning that I have had. They are told by society to “follow your passion” which of course is never chemistry. Most of my students are: “the squeamish, the reticent, the fearful, the disorganized, the uninitiated, the overburdened”. My experience working with these students particularly in the last five years has caused me to examine not just teaching the content and practice of chemistry but learning in general. I have come to believe that rather than “following your passion”, you learn best when you learn to make whatever you do your passion. Passion for what you do is not innate; it is learned; it is your education.

Every speech needs an authoritative quote or two. Here is my first one:

“After that they didn’t have much chance to talk. Their earmuffs were back on and they needed to concentrate on the Mandrakes. Professor Sprout had made it look extremely easy, but it wasn’t. The Mandrakes didn’t like coming out of the earth, but didn’t seem to want to go back into it either. They squirmed, kicked, flailed their sharp little fists, and gnashed their teeth; Harry spent ten whole minutes trying to squash a particularly fat one into a pot.

By the end of the class, Harry, like every one else, was sweaty, aching, and covered in earth. Everyone traipsed back to the castle for a quick wash and then the Gryffindors hurried off to Transfiguration.

Professor McGonagall’s classes were always hard work, but today was especially difficult. Everything Harry had learned last year seemed to have leaked out of his head during the summer...

Do you recognize your own learning experience in the pages of Harry Potter? Here is a description of integrated theory and practice if there ever was one. If you haven't had sweaty, aching, and hard work experiences at Millikin, you have missed something in your education.

But you no doubt have experienced the "brain leakage" phenomenon. I used to think of it as a disease of old age. It is. But it is a modern disease of youth too.

Can you imagine a coach telling an athlete that spending 50 minutes three times a week in the weight room and practice would be sufficient preparation for a sporting event? I played the horn in college. What if I played the horn twice a week or worse once a week? For me, teaching chemistry must be a daily activity and the theory or bookwork must be tightly integrated with a doing component, a laboratory.

Tightly integrating theory and practice isn't the current model but it was 200 years ago. Jane Marcet wrote the dominant chemistry textbook in the early 19th century at the beginning of chemistry as a science. I have the 1812 edition of *Conversations in Chemistry*. This early textbook of chemistry is in the form of a dialog between a teacher, Mrs. B and her two students, one who is quick, bright and intuitive while the other, the more interesting of the two, denser, more literal, and yet more inquisitive, sort of like me and Ed. The dialogue is reflection on experiment. Ms. Marcet writes in her preface: "on attending for the first time experimental lectures, the author found it almost impossible to derive any clear or satisfactory information from the rapid demonstrations which are usually, and perhaps necessarily, crowded into popular courses of this kind. But frequent opportunities having afterwards of conversing with a friend on the subject of

chemistry and repeating a variety of experiments, she began to become better acquainted with the principles of that science, and began to feel highly interested in its pursuits.” Modern theorists of learning have restated this. Stanford sociologist, Alfred Bandura writes of his theory of “self efficacy : “A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided.” “In contrast, people who doubt their capabilities shy away from difficult tasks which they view as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue.” You understand and learn when you sense that you are good at the task. Doubt hinders learning while experience coupled with reflection bridges the gap between the two states.

I discovered the theoretical framework for my teaching close to home. Carol, my wife of 39 years is a practicing family therapist currently working toward certification in Theraplay[®] —a therapy that is especially helpful to children and their families. Ann Jernigan and Phyllis Booth, founders of Theraplay[®], developed their ideas starting in the 1960’s as they worked as psychologists in Chicago with the then new Head Start program there. In their book, *Theraplay: Helping Parents and Children Build Better Relationships Through Attachment Based Play* they identify the principles of structure, engagement, nurture, and challenge as “essential” in healthy parent-child relationships. I think they are also four elements of successful learning. **Imagine, learning as play.**

This is how I put these four principles in practice. I believe that content and experience work best when tightly integrated in an environment that encourages engagement. There should be interactions between student and teacher that are interesting, stimulating, encouraging, and, yes, fun. Engagement is a current buzz word from problem-based learning, active learning, to constructivism. But while engagement is necessary, it is not sufficient. Structure, properly implemented is also necessary. I believe that most students need the structure of daily class that includes discussion, application, and assessment in order to succeed. In the words of Theraplay[®]—“structure defines and clarifies experience.” The third principle nurture must also be present. Isn't it funny how some people believe that the “get it or else” philosophy is the gateway to rigor? I think it is the gateway to “I'm not good at...” I believe that if students have a genuine fear of chemistry, those fears must be addressed proactively. Fear is not a motivating factor for success. Instead, nurture should be an integral part of our teaching activities. When teachers take the time to listen, understand, care, and encourage there is a potential to touch students on an emotional level that will facilitate learning. Challenge is the fourth principle. Theraplay[®] describes challenge as “designing activities that encourage taking reasonable risks,” thus encouraging students to stretch their abilities and in so doing experience success, discovering that they are indeed capable. Meeting challenges teaches students that they are competent, able to grow and make a positive impact. Students if we don't challenge you, we fail as instructors. If you don't take challenges we present you because of the excuse: I'm not very good at..., you have lost opportunities for learning and growth.

A letter from Adina Boyd, a 2003 Millikin graduate stimulated me to think about how the four principles of learning can be generalized. Adina is now a graduate student at Rice University working in the field of nanotechnology, the technology that might revolutionize the 21st century like the transistor affected the 20th century. What I am especially proud is that Adina is not only already technically competent in the area, but has presented papers on the ethics of this field at the same time. Imagine, considering ethics at the same time a new technology is developed. I want to share Adina's response to my questions : "What does Millikin's mission statement mean to you" and "what advice would you give to honors students?"

She writes: "I would say that the last element of Millikin's mission statement trumps the others. A personal life of meaning and value forms the context for which professional success will matter and the motivation for democratic citizenship to be pursued. I think that knowing my purpose and values in life, shape my professional goals and give me the character to endure through the times that are difficult. Certainly my experiences at Millikin helped me discover, test, and know what those values are. I also think it's out of my personal values that emerges the desire to care about the world and pursue democratic citizenship.

My piece of advice is to seek, develop, and maintain a community. Community is simply going through life together with others--it's investing in relationships and maintaining friendships. Our culture struggles with an extreme of individuality. In college, most of us experience the greatest degree of community in our lives, when we leave often there is a difficult transition to life apart from that community. Don't be discouraged by it's absence, learn how to build and maintain a new one. The secret to maintaining community is simply love--caring for others as you do yourself. Both times of testing and times of success will be better when they are shared. Success is a hollow victory in a vacuum.

If you don't remember anything I say, which is likely, remember Adina's advice.

This then is the essence of what I am saying. The principles of structure, engagement, nurture, and challenge that help build healthy parent-child relationships and facilitate learning also are essential for building community—the kind of community Adina talked about in her letter to me. Learning happens when we are challenged in a nurturing, engaging, structured environment. And relationships flourish as this experience is shared.

You, Shannon, Tony, Shondra, Erica, Molli, Demere, Bryce, Jeremy, Laura, Katie, Kristi, Brittany, Jennifer, James, Victoria, Lynn, Bryan, Andrew, Melissa, Deanna, Kelly, Melanya, Tanelle, Kyle, Kim, Kelly, Nate, Javier, Ray, Daniel, Jordan, Kathy, Kirsten, Jessica, Courtney, Breann, Dominique, John, Aaron, Tom, Brandy, Beth, Rita, Dharma, Corey and of course Debbie, are good at chemistry.

Thank you