

I find great satisfaction in identifying areas of improvement, but I truly feel fulfilled when I can resolve these issues to create effective organizations, knowledgeable people, solid experimental results, and improvements in society. As a professor of chemical engineering, I will channel my passion for problems solving to educate our future leaders and develop practical techniques that can reduce the impact of chemical processes on the environment

### **Campus and Community Initiatives**

I became a resident assistant to create a supportive environment that would assist students in becoming happy, successful, and socially aware citizens. To encourage inclusion, I designed and led a discussion on interracial dating where residents shared their personal stories and came to better understand their neighbors' hardships. To assist those struggling academically, I planned monthly chemistry review sessions before chemistry exams with 10-20 residents each time. Seeing the students grasp abstract concepts during these sessions made tutoring one of my favorite hall activities. This involvement taught me that exchanging knowledge and viewpoints helps bring diverse people together and motivated me to become a professor to further facilitate the exchange of ideas and beliefs.

During both my years as a resident assistant, I devoted time to educating students about environmental stewardship. I founded and led a group of environmentally driven residents who changed the community's attitude about energy consumption. Our efforts reduced electricity usage by 5% and earned us the "Most Environmental Hall" award at █████ University each year. This leadership experience encouraged me to take the initiative to lead projects that I feel passionate about.

I was actively involved in the American Institute of Chemical Engineers (AIChE) since I entered the engineering department and became its Webmaster in 2012. The website was severely underutilized, so I asked about a dozen members what they wanted in the website. With their input, I improved the website so much that the department chair started to use the website to attract prospective students.

I joined █████ to help promote environmental sustainability and assumed the role of Vice President of Finance for █████ in 2012 when the organization ran an annual deficit of over 50%. After presenting a sustainable financial plan to the other officers, we implemented budget cuts and innovative fundraising which terminated our three year deficit. This change enabled █████ to continue to implement sustainable solutions while remaining financially sound. My positions in AIChE and █████ showed me the tremendous value of receiving criticism constructively and having a common vision when collaborating.

In college, many students engage in risky behavior, so I searched for fun, innovative ways to encourage safety. During my 6<sup>th</sup> semester, I performed an interpretive dance titled *Addiction* which conveyed the harmful effects of drug use, and I gave my final materials presentation on an improved material for condom construction to allow more open conversations about taboo topics. From these experiences, I learned that innovation often has resistance, and understanding the resistance is necessary to positively impact the community with new ideas.

This semester, I am helping restructure an engineering communication course to focus on hydraulic fracturing and its potential environmental impacts. I enjoy finding ways to integrate multiple ideas into questions to remind students of ethical issues while asking them about other topics. As a teaching assistant in graduate school, I look forward to improving undergraduates' education and enhancing my ability to prepare and implement lesson plans effectively.

To help the surrounding community, I joined the planning team of █████, an event that brings students from neighboring, low-performing elementary schools to the university to teach and

excite them about science. My freshman year, I obtained corporate sponsorship and assisted in managing the event. I gradually assumed more responsibility until I coordinated planning and implementation in fall of 2012. I was overwhelmed with joy when I saw future scientists guessing what seeds birds eat by their beak shape and future engineers designing structurally-sound toothpick towers. During my involvement, I came to understand the effort necessary to organize community service projects and realized the great impact these events can have on others. In graduate school, I plan to continue to encourage science education in disadvantaged communities through school volunteer programs.

I also participated in numerous community service activities where I provided the vital work necessary to implement positive change but did not have the time and opportunity to lead projects. These include [REDACTED], where I answered prospective student questions; [REDACTED], where I demonstrated scientific experiments to future engineers; [REDACTED], where I prepared plots for the first community garden on campus; and [REDACTED], where I volunteered to feed the homeless. Getting involved in my community improved my mood and enhanced my ability to work and study effectively. I look forward to volunteering with organizations that improve the lives of my city's residents during and after graduate school.

### **Research Experiences and Results**

[REDACTED] – [REDACTED] – *March 2012 - May 2013*

In March 2012, I started working under [REDACTED]. His research on [REDACTED] inspires me because it utilizes process engineering to solve environmental issues. My projects focused on studying how [REDACTED]. Understanding their formation is essential to finding methods to mitigate the production of these compounds and to further reduce the net environmental impact of carbon capture.

During the summer of 2012, I designed experiments to study the effects of various compounds on the [REDACTED] of piperazine. I prepared amine solutions, conducted reactions inside pressure vessels, and analyzed samples using HPLC and anion chromatography to study reaction kinetics. For isolation of important reaction variables, I helped develop a new method for running reactions using a second buffer. From the kinetic data, I discovered a rate law and found a suitable reaction mechanism. To help other researchers and industries apply my findings, I created a kinetic model that predicts [REDACTED] rates at various conditions used in carbon capture. I published the results in [REDACTED] Journal.<sup>1</sup>

I then started to look at how other amines resist or accelerate the formation of [REDACTED]. After receiving guidance from group members on which amines to study, I carried out experimental design, implementation, and analysis of the amine degradation on my own. In this screening process, I refined the experimental design method to reduce the number of experiments while keeping parameter uncertainties low. This extra efficiency allowed me to screen reaction rates for a wide range of amines. From my analysis, I determined that electron density around the amine group generally reduces reactivity, and found amines that lowered the reaction rate by ten times the rate of piperazine, a standard secondary amine for carbon capture. The results from this work culminated in an honors thesis completed in May 2013.<sup>2</sup> In these projects, I did a majority of the experiments and analysis while my graduate mentor and [REDACTED] answered my numerous questions and provided essential guidance to improve my analysis and experimental techniques. They gave me the freedom to choose important reaction conditions, design experiments, analyze the data, and present the findings. My research will help guide the choice of solvent for amine

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1 [REDACTED]

2 [REDACTED]

scrubbing to minimize carcinogen formation. These projects improved my ability to design research projects, analyze data, and write manuscripts, and I thoroughly enjoyed helping advance human understanding of this environmental process.

██████ – ██████ – *Summer 2013*

To gain a better understanding of how environmental concerns affect the refining industry, I took an internship with ██████ as an environmental engineering intern. I researched a new EPA regulation and how it would affect process units. This internship gave me a better understanding of refinery needs which I will use to discern the research problems that will have a large impact throughout industry.

██████ – ██████ *University – Fall 2013*

I decided to conduct a research project at the ██████ University to improve my ability to collaborate with cultures throughout Asia and expand my areas of expertise. I joined ██████'s group and am currently developing and implementing a method for enzyme ██████ using ██████ to improve activity and recyclability of enzymes. I developed skills in performing biological assays related to cell growth and enzyme extraction as well as techniques to form and modify silica nanoparticles, self-assembled membranes, and aerogels. By the end of my research, I will have formed and characterized new methods for enzyme immobilization. This work can be applied to reduce the manufacturing ecological footprint by lengthening the life and recyclability of enzymes. I hope to apply my improved understanding from this lab to develop innovative solutions in process engineering.

Conducting research in Asia improved my global understanding of what chemical engineers do and how research practices vary in different cultures. I hope to conduct part of my Ph.D. research in Europe through opportunities like the Humboldt foundation's German Chancellor Fellowship to improve my ability to communicate and collaborate with diverse people.

### **Future Goals**

My extracurricular experiences taught me how and when to change the status quo to bring about positive change in people's lives. My research experiences showed me the joy and potential obtained through discovery and motivated me to pursue a Ph.D. By actively searching for improvements in the process industry, I hope to develop innovative ideas that will reduce the impacts of industrial production on the environment.

To achieve this career goal, I will pursue a Ph.D. in chemical engineering focused on sustainable processes. The guidance from top researchers in my Ph.D. program will increase my understanding of the best research methods and accelerate my ability to solve environmental processing problems. In graduate school, I look forward to improve my teaching abilities through teaching assistantships and volunteering with students in underperforming schools.

After completion of the Ph.D. program, I plan to pursue a chemical engineering faculty position. In this position, I will improve processing technology to reduce its environmental footprint and motivate the next generation to find purposeful work by integrating social justice issues into my courses.

I appreciate the NSF reviewing my application. Obtaining the Graduate Research Fellowship would give me greater flexibility to align my research with my passion for environmental improvements in process engineering and allow me greater freedom to pursue teaching and outreach opportunities.