

# New Perspectives

*Grand Challenge Scholars Program Portfolio*

Grand Challenge: Make Solar Energy More Affordable

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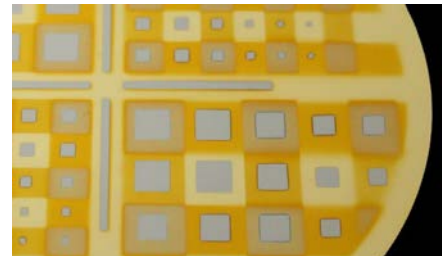
Olin College of Engineering, Class of 2013

*This portfolio is submitted in partial fulfillment of the Olin Grand Challenge Scholars Program requirements.*

## Grand Challenge Project - Make Solar Energy More Affordable:

### University of Minnesota ECE REU – Multilayer Solar Cell Research

Based on various predictions, the globe will run out of the fossil fuels that are the backbone of today's society somewhere between 2020 and 2200. Everything for simple heating and lighting to advanced computers for medical treatment require power in ever increasing quantities. These facts have sparked my interest in renewable energy.



*Candidate tunnel junction materials sputtered on a gold plated wafer.*

Solar technology is still at a point where it needs work in both increasing efficiency and decreasing cost. During the summer after my sophomore year, I worked in a research lab looking to develop feasible multilayer solar cells, which would provide greatly increased efficiencies compared to the current technology on the market. My work was in a specific focus – characterizing candidate materials to serve as the junction between each of the collector layers. In my work, I researched the premise for multilayer solar cells, which take advantage of very specific material properties for each junction of the cell. The majority of my research was performing experiments with two materials selected as candidates for the tunnel junctions. The tunnel junctions need a specific band gap, high opacity, and other electrical and optical characteristics to function properly. Along with exploring these constraints, I also experimented with various methods of material deposition in order to determine if faster or less expensive methods were able to produce the desired characteristics. At the end of my summer position, I was able to make clear recommendations to the team regarding the most promising next directions to explore.

Spending a summer in research was enlightening. As an engineer, I want to make things happen. As a student, the longest real projects I have contributed towards have an iteration cycle of about a year. In the real world, new technologies don't just appear magically on some timeframe that dictates when the next big breakthrough happens. That is why working towards the engineering grand challenges is so important. Spending months of time experimenting allowed me a much better view (and much greater respect) for those who contribute their talents towards research. While I had learned by the end of the summer that the research setting wasn't a great fit for my talents, I am dedicated towards improving solar energy.

It's not about doing what I *want* to do – the path to solving an engineering grand challenge such as making solar energy more economical is not always predictable. For me, solving grand challenges is about making real progress and being open to new paradigms. The grand challenge of solar energy absolutely needs the support of research scientists in the lab, but in today's society it also needs the support of governments, industry, and the public. As an engineer with a diverse background, I am confident that I will continue to contribute towards this challenge, both in creating the technology that can change the world, as well as helping cultures to embrace the new technology. The engineering grand challenges are truly that – *grand challenges* – and any focused effort, no matter how technical, helps move the world forward.

## Interdisciplinary Experience: Olin College

Olin has only been a short time in the making, but has already made a lasting impact around the world. The programs that I have participated in at Olin have also opened my eyes to so many different opportunities and challenges that I see the world in a very different light than I did four years ago. Everywhere I go I am looking for ways to improve the world around me, not for myself, but so that society can benefit and continue to create. Without every single person on the earth today, this planet would be a very different place. We can make predictions about what the next big breakthrough will be, but Olin has taught me that we cannot just wait for it to happen.

What does it mean to be interdisciplinary? It's the opportunity to take a course in mechanical prototyping techniques even though I am majoring in electrical and computer engineering – it might not directly inform my work, but it inspired me to think about designs in new way. It's the opportunity to chat with a chemistry professor (who I have never had for class) in the dining hall about misinformed modeling assumptions for a seemingly simple problem assigned to first year students. It's the thrill of working on a team to build a large carbon-fiber composite structure using techniques that we invented ourselves, and learning from the input of every single person standing in the room (female and male, first year and senior) as we make decisions about how to move forward.

In short, interdisciplinary experience is the valuable challenge to view the world through a different lens. As I have learned from my work (and play) at Olin, and specifically many activities highlighted here as part of my GCSP experience, this doesn't mean just different engineering lenses. Olin has opened my eyes to value all of the work around me, from the technological breakthroughs to the comparatively simple roof over my head. To me, interdisciplinary experience is not about an individual doing a lot of different things – it's about knowing enough and having enough different lenses for a problem to collaborate with informed experts from any field to make the impossible into reality. Olin has given me many new lenses for the world, and I expect to collect more as I continue through my career.

## Entrepreneurial Experience: User Oriented Collaborative Design (UOCD)

At face value, entrepreneurship is the development of a product from idea to market (and beyond), but to do entrepreneurship well, there is so much more than meets the eye. My entrepreneurial experience at Olin has manifested itself in many ways, but the one guiding theme for all of my experiences has been the desire and drive required to satisfy needs and values of people.

Humans are extremely diverse - between the activities we participate in, clothes we wear, food we eat, language we speak, and individual thoughts, we are each unique. But I suspect that there is one driving force that affects many people around the world – the desire for something to be “better” – the desire to achieve a goal. For many this goal may be simply shelter, food, or health; others might want to be better at a skill. For me, entrepreneurship is helping a set of people achieve a specific goal. This is most exemplified by the work I did in conjunction with the User Oriented Collaborative Design (UOCD) course I took during my sophomore year.



*A “looks-like” prototype tracking and guide system for indoor rock climbers.*

UOCD is not about polishing a business plan or marketing strategy – it’s about doing the work up front to make those jobs easier. My team in UOCD was tasked with designing for indoor rock climbers. My teammates and I were all active people and we could speculate about potential products for hours – but sitting in a room ideating didn’t do much. When developing something people will use, befriend your audience. We took multiple trips to local rock gyms not just to poke around for ourselves, but mainly to chat with other climbers about their values, both for climbing and their general life styles. We learned that a climber’s goal isn’t always to improve to be able to climb harder routes. A climber’s goal might be stress relief, or social opportunities.

As entrepreneurs, my team and I had to be flexible about what it was we were creating because we needed to help climbers achieve their goals, not just create a product we felt had a place in a rock gym. After rounds of more informed ideation, we settled on a couple ideas, made simple mock-ups, and returned to the climbing gyms. This wasn’t engineering testing – it was validating our design: verifying that we had understood the needs and values of the rock climbers we wished to help. Some things the team had right, other places we had missed the mark. It was all a learning experience for both my team and all the climbers with whom we were able to interact.

For me, I learned that entrepreneurs have to be risky. When is an idea a revolutionary new paradigm that will actually help people achieve a goal, and when is it a good idea but misaligned with a person’s needs and can’t make as much of an impact towards achieving the goal? My UOCD experience helped me develop the knowledge of when to be open to change and when to promote my own ideas – a skill that is invaluable when changing the paradigms of the world.

## Global Awareness: Habitat for Humanity

All animals, including humans, have a basic need for shelter. Habitat for Humanity is an organization with global reach helping people out of slum housing and homelessness. I was drawn to volunteer with Habitat because the need for shelter is such a global hardship, but something I have never truly experienced firsthand. I have worked with Habitat multiple times during my experience at Olin, both in major week-long build projects and more focused individual build days.

Every time I have worked with Habitat has been an eye-opening experience, as each community I have had the opportunity to help seems to be living in such a different world than the world I experience. The opportunity to come into a community stricken with poverty and lend a helping hand towards one of life's basic necessities is both saddening and empowering. During longer builds, I have often had the chance to meet the future owner and work alongside that person or family on their new home. In my discussions with people receiving and owning Habitat homes, while they are overwhelmed by the fact that shelter will become much less of a burden for their family, it is truly the opportunities – such as education and better health – that are the most awesome benefits. (As a college student helping Habitat I have been primarily involved as a laborer, but Habitat volunteers also provide families with money management aid and referrals to other social services to help restart their lives.) My personal experience may be lending an extra set of hands to holding up a wall or laying shingles or painting, but for me I am truly putting in physical work to bring the possibilities of education and higher quality of life to people with need. At the core, even though everyone has their own stories and situations, we are all humans trying to have a good life, and it is amazing how affording basic shelter is such a burden for many people worldwide, but also so empowering.

Besides working first-hand on builds in various locations in the United States, I had the opportunity to visit the Habitat for Humanity Global Village. At the Global Village, Habitat exhibits the various types of materials and home styles that the organization works to erect across the globe. The differences between the Habitat houses I had worked on in the US and the examples of structures built internationally was striking, but I know that each is just as important in each community. A three room mud-brick house is nothing like the small single-family homes I have worked on, but I know it still serves just as large a role in empowering one more family by taking shelter off the list of daily worries. With shelter, we can start thinking about water, food, and health. I intend to continue to spend time working towards projects with global impact such as shelter for the homeless around the globe. My two hands can make much more impact than simply the walls I help to build. With Habitat International, families are moving out of poverty one house at a time.



*Olin students build a home with Habitat for Humanity in Statesville, North Carolina, USA.*

## **Service Learning: Council of Olin Representatives (CORe)**

Over the past four years at Olin I have participated in various service events, from the Habitat Builds described above to soup kitchen visits and charity fundraising events. Each has been an exciting way to step out into the larger community, put myself in the shoes of someone in need, and try to make a difference. But sometimes we forget that simply helping those people close to home who might need a hand to get through their day is also be a huge help. One major way that I have done this is serving as part of Olin's Student Government over the past three years, including this year as President.

In my eyes CORe isn't at all about advocating for students – it's about making connections in a community and making sure that any hardships are communicated effectively to those who might be able to lend a hand. As CORe President, I have been able to help various groups continually improve Olin by making the right connections. One of the most important and service oriented aspects of this has been in helping community members working towards curricular innovation and the grand challenge of advancing personalized learning.

Curricular innovation does not happen on its own and it can't be forced by professors or students – that is what personalized learning is about – finding out what works for individuals. During my time on CORe, I have helped connect faculty with a wide range of students to rethink curriculum and learning techniques. I have also helped students to realize some of the missions of Olin that go beyond coursework, and coordinated with students, faculty, and staff to be sure that work towards this mission, is done effectively. This has included simple things to keep the wheels turning smoothly such as registration surveys, all the way to coordinating student participation and open minds in campus-wide curricular review initiatives.

CORe has given me a great opportunity to work with a group of passionate educators, mentors, and students, and placed me in a position to synthesize and communicate the needs of various groups. I was able to shape ideas about both education and student experience into noticeable impact. Along with these real changes, reflecting on the methods of the past and implementing new strategies is all part of the Olin experiment that will impact education for the next century.

Service learning comes in many different forms – every individual has different talents to contribute. For me, I have learned that one of my talents is to serve by connecting people across boundaries, be they social, economic, or hierarchical. Working directly with those less fortunate is a huge task that I respect greatly, and I also believe that working one level higher in order to coordinate and lead initiatives to solve problems at the head is as relevant. Through participating in service I have learned that no matter what the situation is, I should always be asking "How can I help?" I look forward to the future and being able to use the skills from my positions on CORe to help more communities come together and work towards their goals.