

HONORS EXPERIENTIAL LEARNING PROJECT PROPOSAL FORM

Complete this proposal **prior** to your project's start date and upload it in the UHP Database (<https://webapps.uc.edu/uchonorsstudent>). Create a project ("Add a new record") in the "Tracking Project" tab and then upload your proposal document as an attachment. Your submission will be reviewed during the next [review cycle](#).

While the quality of the proposal is most important, strong proposals are typically 3-4 pages in length (single-spaced). Please maintain the proposal format.

Basic Information

Full Name: Ashley Taylor Lengel

UC Email: lengelat@mail.uc.edu

College: College of Engineering and Applied Science

Major: Biomedical Engineering

Title of Project: Working with the Wendell Lab

Thematic Area (choose only one): Research

Expected Project Start Date: January 6, 2014

Expected Project End Date: April 18, 2014, with possible extension on October 30-November 3, 2014

Project Information

1. Provide a detailed abstract of your proposed honors experiential learning project.

During the spring semester 2014, I will be volunteering in an environmental/biomedical engineering research laboratory. I have been assigned to work on a project involving genetically engineering E.coli to produce small, robust gas vacuoles. The hope of this project is to be able to apply this production of gas vacuoles to humans for use in ultrasound imaging. A modern medical issue is that ultrasound imaging relies on air vacuoles to produce an image from, but sometimes these vacuoles are not very stable and burst. If more robust vacuoles could be produced, and that production controlled, medical imaging can be heavily improved and enhanced from their use.

Not only is this an exciting and challenging project to be working on and studying, but a major component of this experience is the presentation of the research. The International Genetically Engineered Machine (iGEM) competition is a competition that promotes competition and education in biological research. We hope that we will be able to form a team from this project and will be able to present our research in the iGEM competition. This part of the experience, itself, is a significant challenge. I am the only undergraduate student so far in the laboratory, and I will be in charge of this project and leading the team in competition.

Having the ability to take part in this and have such a critical role in the project at this point in my college career is a fantastic opportunity. This experience is so meaningful because it provides a great head start into my career at such an early point in my life. My current career goal is to work in tissue engineering and dedicate my career to medical research, and it means so much to me to be able to start doing that now. Most can't say that they started gaining experience that applies to their career during their first year of college. I will also be improving my skills in working with other people and communications from the competition and the fundraising necessary for the project.

Although the project and team hasn't officially started, I've been volunteering in lab for the last month. My current time commitment averages around eight hours per week (four or five hours every Monday and three or four hours every Wednesday), but the quality of the time spent there is immeasurable. Working in the lab and on this project requires reading previously published research papers on the subject to become familiarized with the terminology, writing a protocol for the work being done on the project, keeping a research journal of the successes and failures, and countless trials to find a solution. At the semester change, I will be dedicating more time to work on the project and put

together a presentation, but also I will need to educate new members of the lab that will be joining the team about the material.

Clearly and thoroughly address how each of the following elements will be exhibited in your work:

2. Connection to Learning Outcomes within the Honors Thematic Area (identified above)

This experience will perfectly encompass the following three honors learning outcomes for the research thematic area: first, to possess a well-developed awareness of literature in the field; second, to gain the ability to frame and develop the research project question or problem; and third, to gain the ability to identify/apply appropriate methodologies.

The first learning outcome, possessing an awareness of literature in the field, will be accomplished through gaining the background knowledge necessary for the project. To be better aware of the terminology involved in the research and the biology behind the project, it will be necessary to read previously published research. For example, one paper necessary to read had to do with gas vacuole production, specifically about the relationship between width of the vacuole and its strength. It is also necessary to read literature on the subject to gain familiarity with protocols that were previously used with this research to find a successful method. A significant part of becoming aware of the literature in the field is developing a strategy for reading research papers. This is a useful skill that will be used for the rest of my career, which is why it was very important and advantageous to develop it early.

Having the ability to develop the research project problem, the second learning outcome, is a considerable portion of the experience. The basis of engineering is to see a problem and find a way to work with others and take a multi-disciplinary approach to work towards a solution. This couldn't be more evident in this experience. The problem, ultrasound imaging being compromised by susceptibility of gas vacuoles to burst, was looked at first through an environmental standpoint by using the E.coli to experiment and will eventually be applied to the biomedical field. The majority of this experience is focused on researching and trying various things to find a protocol that works and find a solution to this problem. The problem will be developed by finding various processes tried, adjusting that where needed, and finding a best fit.

Building off of the previous learning outcome is the final learning outcome, developing the ability to identify/apply appropriate methodologies, is the last significant component of this research experience. Being in charge of the project, one of my jobs in this project is to find a process of genetically engineering the cells to portray the desired qualities, which requires a very specific methodology. I will need to produce a final protocol for the project to be used in the research, which will also need to be presented in iGEM. By keeping a journal log, the successes and failures of what was tried will be kept track of, leading to the discovery of a fully successful protocol. This is a very important skill for my future in research, because the basis of research is learning what does and doesn't work to find solutions to medical problems.

3. Connection to Goals and Academic Theories (include reference list, as appropriate)

A.

In my time here at UC, I have been trying to carry out my goals of being a well-rounded student and thrive in my academics. This experience of volunteering in a graduate research lab and taking on a huge research responsibility greatly contributes to both of those goals. Dedicating so much time to the lab has forced me to be better at time management and prioritize my activities. Also, the knowledge of DNA replication, the differences between the human genome and bacterial DNA, and various laboratory procedures has helped me prepare academically for courses I will be taking later in my program and future work I may be doing.

Having a goal to focus my career on conducting medical research and be able to make significant contributions to medicine and science, this experience couldn't be more appropriate to take part in. Working on a project as a freshman is definitely challenging and demands a lot of mental and emotional energy, but the skills and experience I will gain from it is incredibly

valuable. When pursuing a co-op later next year, I will be a step-ahead of my peers because I have experience in the field and a more developed resume. Although I am majoring in biomedical engineering, being part of a lab that mainly focuses on environmental engineering will expose me to the other disciplines of engineering that I may need to collaborate with during my career. Lastly, developing leadership skills from the iGEM team will provide me with communication and leadership skills that are very important in the workforce.

B.

The thing I could do to gain some background knowledge for the project is to read scientific publications. I already have read papers specific to my project, but it would be beneficial also to read papers on genetic engineering in general to be more knowledgeable in the field and understand more about other iGEM presentations. Specifically, one reading I have already done is entitled “*Gas Vesicle Genes Identified in Bacillus megaterium and Functional Expression in Escherichia coli.*” This paper first provides background information about how gas vacuoles are produced in E. coli cells, while also describing the relationship between the width and strength of the gas vacuoles. I chose this paper as a resource because it helped me to gain a better understanding of the biology and functionality of the cells I would be working with and reasoned that it would increase my chances of success. In my own research, we are working to induce gas vacuole production in cells, then to work towards making those vesicles more robust for future use in medical echo-imaging. In modern echo-imaging (i.e. ultrasound), the image is produced via an echo being rebounded from a gas vacuole. Problems arise when the gas pockets burst, being too weak, and therefore a poor image is retrieved. The goal of our project is to work towards making stronger gas vacuoles for improved medical imaging.

The other article that I have read was “*Molecular Genetic Manipulation of the Diatom Thalassiosira Pseudonana (Bacillariophyceae).*” This publication was given to me by my advisor in order to familiarize myself with genetic engineering in general. From reading both of these research papers helped me gain knowledge of the material to better prepare myself for future presentation, but also to allow me to gain skills in analyzing scholarly publications. Lastly, an article I was suggested to read was “*The Benefits of Undergraduate Research: The Student’s Perspective*”. This article was written by two students from the University of Alberta, reflecting on the immense benefits of being involved in research as an undergraduate student. My mentor suggested I look into this topic to help me not only understand how my work would be benefitting others, but also how being part of the project will benefit me. The article describes how working in research allows students to improve their teamwork skills, collaborate with others to achieve a common goal, and grow in their passion for science and that field of work, which is absolutely true for me. Working in Dr. Wendell’s lab has confirmed my love for medical research and genetic engineering. That passion combined with the background knowledge gained from the other articles I was told to read will lead me to a successful experience, both academically and personally.

References:

- “Gas Vesicle Genes Identified in Bacillus megaterium and Functional Expression in Escherichia coli.” – Ning Li and Maura C. Cannon, Department of Microbiology, University of Massachusetts, Amherst, Massachusetts
- “Molecular Genetic Manipulation of the Diatom Thalassiosira Pseudonana (Bacillariophyceae)” - Nicole Poulsen, Patrick M. Chesley School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia; and Nils Kroger, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia

- “The Benefits of Undergraduate Research: The Student’s Perspective” – The Pennsylvania State University, Department of Undergraduate Studies

4. Initiative, Independence, and/or Creativity

Although there will be a few other undergraduate students working on the team, I have a specialized role in the project. First, I not only have the time I have put in during this semester as increased experience and knowledge for the project over the other members, but I have prior research experience to that. For the past two summers, I have been working in an ophthalmic research lab at the Cleveland Clinic’s Cole Eye Institute. I am able to bring all of this experience in a lab setting to the project and feel confident leading the other team members through the project and in competition.

The leadership position I will be taking in this project makes the experience unique to me. Being a leader in the project means that I have to take on a role of higher responsibility, putting in more time and research into the topic so that I can teach the others and lead the team. Putting in the time this semester before the others join the lab has been indicative of the initiative I have taken towards this project. The experience would be radically different if I was just a member of the project team, rather than being the head of it. Leading means that I have to constantly be focused, aware of what is happening, and confident in my communication/presentation skills.

5. Reflection

Because of the nature of this research experience, I will be able to reflect on my time spent through the lab journal I will need to keep. A lab journal is a critical component of a research project because it is very important to remember what did and didn’t work to not waste time and resources and to find a solution more effectively. Writing in the lab journal is almost an every-day task and in it are the steps of various procedures done that day and any notes needing to be made. After results are gained, we can look back and see what did or did not go well and build from there. This part of research embodies the reflection component of the experience because it will cause me to focus on my methodology and will help me learn about how certain biological processes happen. Things that I may need to ask myself are: “Why didn’t this work?”, “What can I change in this to where it might provide better results?”, and “Can I test a certain component of this to possibly save resources?” At the end of the experience and/or when a successful protocol is discovered, it will be important for my overall learning and understanding to reflect upon my time spent in the lab and all that I had done to reach that point.

6. Dissemination

Most significantly, I will be sharing what I learned in my project at the iGEM competition. The other students presenting research will hopefully be able to see my work, as well as presenting their own, making them my audience. It is great to have fellow college students who have a passion for scientific research as an audience because they can appreciate the work that went into it and also learn a little bit more about a subject they may not be familiar with. Also, if this project is successful, we will hopefully make a research poster for the material and hang it in a UC science building for students to see and read, maybe even presenting it publicly.

7. Project Advisor (list the person’s name, title, and contact information)

David Wendell, Ph.D.
Asst Professor
wendeldw@ucmail.uc.edu
(513)556-2482

8. Budget (if applicable)

Competition: 10/30-11/3/14

Flight

- Delta Airlines
- These particular dates were not available for booking yet, so a time period of the same days and length was used instead.
- Example:
 - Depart Time (Cincinnati) = 11:40 a.m. Wednesday
 - Arrival Time (Boston) = 1:45 p.m. Wednesday
 - Depart Time (Boston) = 10:40 a.m. Monday
 - Arrival Time (Cincinnati) = 1:00 p.m. Monday
 - Total cost for round trip ticket = \$461.00

Hotel (Chandler Inn Hotel):

- Check in 10/29/14 (Wednesday)
- Check out 11/4/14 (Monday)
- Price:
 - Wednesday: \$249
 - Thursday: \$249
 - Friday: \$249
 - Saturday: \$189
 - Sunday: \$189
 - Monday: \$189
 - Total = \$1,314

Money for Cab:

- \$8.00 from hotel to convention center (and back) = \$16.00 per day * 6 days = roughly \$100.00
- Extra money for travel to other places in Boston (food, sightseeing, etc.) = roughly \$100.00
- Total \$200.00

Money for Food/Extra Expenses

- Allot \$150.00

Total Budget = \$2,125