Honors Self- Designed Proposal

**Basic Information**  
Full Name: Emily Kim

Title of Project: Genetics of Brain Development and Hydrocephalus

Thematic Area(s): Research

Expected Start Date: January 11, 2016

Expected End Date: April 28, 2016

1. **Abstract**

In the spring semester of 2016, I will participate in the Biomedical Research and Mentoring Program through the University Honors Program. Specifically, I will be working in a lab in the pediatric neurosurgery division of Cincinnati Children’s Hospital Medical Center to study the development of communicating hydrocephalus, a type of congenital hydrocephalus, one of the most common birth defects of the central nervous system. In general, hydrocephalus is a condition in which excessive accumulation of cerebrospinal fluid widens the ventricles (spaces) in the brain, causing detrimental pressure on the brain tissue. Because cerebrospinal fluid is constantly produced by the choroid plexus, a structure within the brain, and absorbed by the cisterns at the base of the brain, the balance between these two processes is crucial to maintain normal pressure on the brain tissue. There should be enough pressure to adequately cushion and nurture the brain, but in excess, this pressure could result in harmful effects on the brain. One type of hydrocephalus is called communicating hydrocephalus, in which the flow of cerebrospinal fluid is blocked after it exits the ventricles. In the lab, with the help of my mentor and principal investigator (PI) June Goto, PhD, I will be studying a possible recessive mutation causing communicating hydrocephalus. I will be doing this by studying a mouse mutant line called “progressive hydrocephaly, prh” through whole genome sequencing. I will learn basic brain anatomy, lab molecular biology techniques, and the functions of cerebrospinal fluid in brain development. In the lab, I will gain experience in mouse DNA genotyping, mouse brain tissue sectioning, and fluorescent immunohistochemistry.

This experience will be particularly meaningful because of three things. First of all, my goal for my career path is to become a pediatric neurologist, and with this research experience being located in the pediatric neurosurgery division of Children’s and focusing on an issue in pediatric neurology, I am very dedicated and interested in this research. Second, I have no prior research experience, so I am looking forward to learning about basic lab techniques, the lab environment, and how to read scientific literature. Perhaps I will find that research is my passion and that I want to pursue an MD/PhD degree to become a researcher. Even if I find that research is not the career path I want to take, I will gain much experience learning about the research environment, the people doing research, and how it might connect to a clinical setting in which I will work. Finally, I am specifically interested in learning more about the role of genetics in brain development and hydrocephalus. By working with mice and genetic engineering, I hope to learn much more about brain structure and possibly embryology in the neurological aspect.

I hope to work in the lab eight to ten hours a week for fifteen weeks in the semester, adding up to around 135 hours total for this semester. With my time, I will be working in the laboratory to try to learn about the lab environment, how research is conducted, learn how to read and write scientific literature, and to gain general research experience. I will most likely be working on Tuesdays in the lab for an extended period of time because I have scheduled only one night class for that day of the week. This will allow me to gain a full, enriched, integrated experience in the lab instead of spending two hours in the lab at a time.

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| **Advisor Feedback** | | |
| Must Include:  Brief description of the experience  Personal connection to the experience  Identified goals for the experience  Timeline from start to finish  \*Itinerary (international experiences only)  \*\*Explanation of differentiated experience from what is required of other students | Required Revisions: | Effective: |

1. **Experience Advisor**

Dr. June Goto, PhD

Division of Pediatric Neurosurgery

Cincinnati Children’s Hospital Medical Center

[june.goto@cchmc.org](mailto:june.goto@cchmc.org)

Dr. Goto will be my mentor and principal investigator for this research experience. She will be the one to guide and train me in the lab as well as help me find other medical opportunities to enrich my undergraduate experience. I chose her because she is an expert in a field of research in which I am extremely interested, and I plan to ask her for advice and direction in and outside of the lab. An example of how I will engage with Dr. Goto is when I learn how to perform mouse genotyping.

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| **Advisor Feedback** | | |
| Must Include:  Experience advisor name and contact information  Description of why advisor was selected  Specific plans to engage with advisor | Required Revisions: | Effective: |

1. **Connection to Learning Outcomes**
2. Demonstrate the ability to locate, interpret, and critically evaluate primary sources appropriate to field.
   1. In preparation for seeing what the final product of the research on communicating hydrocephalus in Dr. Goto’s lab will be, I will read scientific papers on similar research to enrich my knowledge on the method by which scientific papers are published. This will also help me see how abstracts, procedures, results, analyses of data, and conclusions are translated into published journals. Perhaps I will be able to see how the results I will find in the lab will contribute to Dr. Goto’s paper. I will find papers on my own and also read anything that Dr. Goto gives me. Additionally, I will also learn about basic brain anatomy and the functions of the cerebrospinal fluid while working in the lab. This knowledge will help me greatly in examining mouse brain tissue samples. I will spend approximately 20 hours engrossed in the topic of learning from primary sources in the field of neurosurgery and hydrocephalus.
3. Identify and apply appropriate methods to collect and organize data for analysis.
   1. In the lab, some of my main duties will include learning lab techniques like mouse genotyping, Western blotting, ELISA, PCR, gel electrophoresis, and tissue culturing. These techniques will definitely prepare me to apply appropriate methods to college and organize data for analysis because doing these techniques will help Dr. Goto and her team obtain results for their experiments which may lead to more knowledge on how the *prh* gene may affect communicating hydrocephalus. Learning and performing these techniques in the lab will definitely add up to the majority of my time in lab; I estimate this learning outcome will expend 100 hours of my time during this honors experience.
4. Articulate the broader significance of the research project and its relationship to other fields, research and ideas.
   1. Towards the end of my time in spring semester at Dr. Goto’s lab, I will have gained much knowledge on how a lab works, molecular biology techniques used in the lab, how to work with a mouse model, the phenotypic impact a single mutation can have on an organism, and general information on basic brain anatomy and cerebrospinal fluid in connection to communicating hydrocephalus. In my research journal, I will have recorded much of this information. I will then reflect on what the findings of this research project could do for people afflicted with communicating hydrocephalus. In the spring, I hope to shadow a pediatric neurologist. If I observe a patient with hydrocephalus, I will definitely be able to see the application of the research I contributed to and how it affects people in the real world outside of a laboratory.

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| **Advisor Feedback** | | |
| Must Include:  3 learning outcomes explicitly identified from any thematic area(s)  Examples of activities and explanation of how each will assist the progress towards the chosen learning outcome  Estimated time commitment for each activity | Required Revisions: | Effective: |

1. **Academic Resources Connected to the Learning Outcomes**

To enrich my experience in the lab, I must first have a bit of background knowledge on the research topic at hand. In this case, I will learn about hydrocephalus, specifically, communicating hydrocephalus in infants and children. Before I read the description of Dr. Goto’s lab’s research, I barely knew what hydrocephalus was. Now, with these resources, I will be able to gain some base knowledge of hydrocephalus to give myself a head start to comprehend the greater meaning of the research in the lab. Although I will probably be performing tasks like Western blotting, mouse genotyping, ELISA, and immunohistochemistry, I will be able to more easily connect these seemingly rudimentary tasks to the impact that the research has on the scientific community and people. First, I will use the video entitled, “Pediatric Playbook- Hydrocephalus” narrated by Dr. Benjamin Warf, a pediatric neurosurgeon at Boston Children’s Hospital (one of the top ranked in the nation). The video (which may be found at <https://www.youtube.com/watch?v=bHD8zYImKqA>) gives an overview of the causes of hydrocephalus, especially in children. It provides a basic understanding of hydrocephalus for somebody with little medical knowledge, and it helped me understand more of what I was researching. Secondly, I found the article on hydrocephalus on the National Institute of Neurological Disorders and Stroke website. This article, titled “Hydrocephalus: Fact Sheet,” answers several questions, including “What is hydrocephalus,” “What are the different types of hydrocephalus,” and “What is the current treatment.” No specific author is listed, but more information can be found at <http://www.ninds.nih.gov> and other websites listed on the page (<http://www.ninds.nih.gov/disorders/hydrocephalus/detail_hydrocephalus.htm>).

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| **Advisor Feedback** | | |
| Must Include:  1-2 academic resources connected to the learning outcomes  Title and author of each resource  Description of how resources will help make progress towards learning outcomes and execution of experience | Required Revisions: | Effective: |

1. **On-going Reflection**

Throughout my experience, I will keep a lab journal. Although it is typical to write down specific lab protocol, procedures, and possible results for each day in the lab in this journal, I will record additional thoughts in this journal to promote deeper on-going reflection. Traditionally, the lab journal is used to record academic progress in the research project. First, I will record my lab protocols daily, writing down everything I performed in the lab each day to be able to go over each point with my mentor/PI to possibly improve on techniques that I performed incorrectly or inadequately. Additionally, I will record academic questions in this journal that I think of during the day to ask my PI/mentor later. This is typical of a lab journal. To create an environment and method to further reflect on my experiences in the lab, each day, I will also write about the lab environment itself and what non-academic topics I learned. For example, if I talk to a researcher or physician I had never encountered before, I will write down what I talked about, his/her contact information, and how I may network with them in the future. Another example may be if I learned something about how to operate in the lab environment socially: how do I ask my PI how to perform an experiment, how do I act around other researchers, etc. These topics in my lab journal will help me reflect both academically and non-academically to create a deeper reflection for myself.

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| **Advisor Feedback** | | |
| Must Include:  Method for ongoing reflection  Reflection questions/topics clearly specified | Required Revisions: | Effective: |

1. **Sharing Your Learning**

In order to effectively share my experience, I will talk about my experience in the lab through Biomedical RaMP at Beavercreek High School’s (my alma mater) pre-med club. This club is composed of about fifty students ranging from freshmen to seniors in high school considering pursuing a career in the healthcare field, from physicians to researchers to nurses to occupational therapists. Many of them do not have research experience, do not know how to get involved with research, or are even intimidated by the research environment. Because of my experience through Dr. Goto’s lab at Children’s Hospital, I will be able to share my experiences in a research environment for the first time, what to expect, and possibly how to pursue research in the future. I will investigate research opportunities for high schoolers in my area and present to them how to get involved and tips on how to obtain a position in a lab. This will have a direct impact on students that specifically want to learn how to be involved in research to better their chances of attending the universities of their choices. Additionally, it will help me to reflect on what the important parts of my research experience were, what I learned, and how I can use that information to help others and prepare myself for more research in the future.

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| **Advisor Feedback** | | |
| Must Include:  At least one method to actively share take-aways/learning from the experience  A specific audience and why the audience was selected | Required Revisions: | Effective: |

1. **Budget (if applicable)**

See abstract for hours to be worked (approximately 135 hours, 9 hours per week for fifteen weeks).

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| **Advisor Feedback** | | |
| Notes:  Detailed budget of expenditures with sources to justify budget estimates  \*Indicates the number of hours per week and number of weeks of participation | Required Revisions: | Effective: |