Office of National & International Fellowships (ONIF)

Example of a Goldwater Scholarship application

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Please email fellowships@lmu.edu with any questions.
Application Form

Profile Information

Registration ID

[Redacted]

Full Name

[Redacted]
Permanent Phone

For your state of legal residence, select your U.S. Congressional House District

Is your state of legal residence the same as your permanent address? (Usually the address of your parent/legal guardian)

Career Goals/Professional Aspirations

What is the highest degree you plan to obtain?

Ph.D.

In one or two sentences, describe your career goals and professional aspirations (see example below). This statement will be used in publications if you are selected as a scholar or honorable mention.

Ph.D. in Biochemistry. I will be a tenured professor at a university where I will teach students and perform research on the protein mechanisms of diseases.

What are your career goals and professional aspirations? Indicate which area(s) of mathematics, science or engineering you are considering pursuing in your research career and specify how your current academic program and your overall educational plans will assist you in achieving your career goals and professional aspirations.

I aspire to do a Biochemistry PhD program like the Biochemistry, Molecular and Structural Biology (BMSB) Graduate Program at UCLA after my undergraduate career at Loyola Marymount University. In this program, I would work under respected faculty such as Dr. David Eisenburg at UCLA, who conducts research on amyloid-forming proteins related to the development of diseases like Type 2 Diabetes or Alzheimer’s. After I receive my PhD, I will become a tenured professor at a research university where I will determine structures of unknown proteins and teach Chemistry to generations of college students.

At LMU, I have excelled in coursework like Organic Chemistry, Cell Function, and Biochemistry. In the future, I will broaden my scientific knowledge with courses like Inorganic and Physical Chemistry. I also tutor Organic Chemistry through my school’s Academic Resource Center, TA for a General Chemistry Lab, and volunteer as a science tutor at Verbum Dei High School through Magis, a Service Organization at LMU. Through these experiences, I have learned the importance of teachers in creating an effective learning process for students. When I see first-hand how my students finally comprehend concepts they previously struggled to understand, I feel a sense of accomplishment through helping students live up to their full potential.

To prepare for Graduate School, I have conducted research investigating the link between Type 2 Diabetes and IAPP protein aggregation under Professor David Moffet at LMU since spring 2018. Islet Amyloid Polypeptide (IAPP) is a protein secreted from pancreas β-cells that is believed to contribute to the development of Type 2 Diabetes when the protein misfolds and forms aggregates toxic to pancreas cells. Therefore, molecules that inhibit IAPP aggregation could potentially be used to develop experimental therapies and medicine. Over the past two years, I have worked in the Moffet lab learning about the amyloid hypothesis of Type 2 Diabetes and testing potential inhibitors of IAPP through in-vitro characterization. I have
conducted Western Blots, SDS-PAGE gels, and Atomic Force Microscopy to determine the inhibitory potential of different molecules. In November 2018, I attended the Southern California Conferences for Undergraduate Research (SCCUR) symposium where I presented my research in a poster session. In spring 2020, I will also present my research at the West Coast Biological Sciences Undergraduate Research Conference (WCBSUR) hosted at LMU. The efforts of my research group and myself culminated in a journal publication called Amyloidogenicity of naturally occurring full-length animal IAPP variants in the August 2019 edition of the Journal of Peptide Sciences.

Currently, I am applying to summer programs like REU’s and the Amgen Scholars program to diversify my research experiences. With my extensive research and teaching experience, I will be a competitive PhD candidate and effective university professor in the future.

Describe an activity or experience that has been important in helping shape or reinforce your desire to pursue a research career in science, mathematics or engineering.

Participating in LMU’s Summer Undergraduate Research Program (SURP) after my freshman year helped shape my desire to pursue a career in research. While I once thought research was scientists toiling away in the lab, my experiences in the SURP program changed my idea of research. I worked 20 hours every week for six weeks on a research project with Dr. Moffet working to validate the amyloid hypothesis of Type 2 Diabetes using in-vitro characterization of IAPP. At first, I felt confused during research because everyone else seemed to understand the science and methodology behind our lab group’s experiments. However, day by day I became more comfortable with the rhythm of pipetting, measuring, and cleaning cuvettes in the Thioflavin T assay and the often-cumbersome Atomic Force Microscopy imaging system. I also performed a Western Blot, which most biochemistry majors do not perform until their junior year. Of course, I was not alone in the Moffet lab. Over the summer, I felt a sense of community and camaraderie from working with my fellow lab members. As we all performed assays and worked through laboratory issues together, I realized that research was a collaborative experience. In research, everyone uses the best of their abilities to investigate and analyze a shared problem. Thanks to my experiences in SURP, I improved my scientific research abilities and grew as an individual. I knew I wanted to seek a research career in the sciences in the future.

Research Projects

Research Project #1
Amyloidogenicity of naturally occurring full-length animal IAPP variants

Starting Month
02

Starting Year
2018

Ongoing
No

Ending Month
03
Ending Year
2019

Average Hours/Week (Academic Year)
3

Average Hours/Week (Summer)
20

Name of Project Mentor
David Moffet

Title of Project Mentor
Professor of Chemistry and Biochemistry

Description of research, including your involvement in AND contribution to the project.
The protein Islet Amyloid Polypeptide (IAPP) can misfold to create aggregates that are toxic to pancreatic β-islet cells in Type 2 Diabetes. However, it is uncertain whether this toxicity is necessary for the progression of Type 2 Diabetes or is just a side effect of the disease. To link IAPP aggregation with the progression of type 2 Diabetes, our lab group tested numerous other nondiabetic and diabetic animal IAPP sequences to determine if they would aggregate. In this project, I conducted numerous Thioflavin-T Assays and used Atomic Force Microscopy to determine the aggregation of protein samples. I also performed immunoassay methods like ELISA to determine protein aggregation. My fellow lab members and I also created collaborated to make many of the figures in the final publication, such as the bar graph describing Thioflavin T Binding. Overall, the results show that IAPP sequences from diabetic animal aggregate, providing evidence for the amyloid hypothesis of Type 2 Diabetes.

Do you have Papers/Publications associated with this research project?
Yes

If yes, how many publications are associated with this work?
1

Citation

Status
Published

How are you listed in the publication?

Type of Publication
National Professional Society Journal

Do you have Presentations associated with this research project?
Yes
If yes, how many presentations are associated with this work? 
1

Citation

Campus, Regional, National or International
Regional

Presentation type
Poster

How are you listed on the presentation?
Co-presenter

Additional Research Projects

Research Project #2
Animal IAPP inhibitors of human IAPP

Starting Month
05

Starting Year
2019

Ongoing
Yes

Average Hours/Week (Academic Year)
3

Average Hours/Week (Summer)
20

Name of Project Mentor
David Moffet

Title of Project Mentor
Professor of Chemistry and Biochemistry

Description of research, including your involvement in AND contribution to the project.
Building off the results of the previous study, it appears that certain animal IAPP sequences actually inhibit human IAPP aggregation to a significant extent (Study is currently in progress, so specifics about inhibitory sequences cannot be disclosed). The next study aims to (1) find the best animal IAPP inhibitor of human IAPP, (2) the smallest possible inhibitory peptide sequence based off the best animal IAPP inhibitor and (3) the mechanism of the inhibitory
interaction. Similar to the previous study, I was responsible for testing three trials of over a dozen full and truncated animal IAPP sequences using Thioflavin-T and Atomic Force Microscopy Assays. In this case, selected animal IAPP inhibitors were tested for the inhibitory potential. During summer 2019, I worked to finalize the crosslinking procedure to further characterize the IAPP inhibitory mechanism. After animal and human IAPP were crosslinked, they were run down an SDS-Page Gel and visualized through silver stain.

Do you have Papers/Publications associated with this research project?
No

Do you have Presentations associated with this research project?
No

Mentor Recognition Information

Mentor Name
David Moffet

Mentor Title
Principle Investigator (PI)

Mentor Name
Cassidy Alvarado

Mentor Title
Director of National & Interna

Research Skills

Skill Description #1
I learned the Thioflavin T Assay doing research with Dr. Moffet. Since Thioflavin T forms a complex with amyloid fibrils that can be detected with spectroscopic methods, it is important for quick analysis of suspected amyloidogenic protein sequences.

Additional Research Skills

Skill Description #2
I also learned Atomic Force Microscopy in Dr. Moffet's research lab to detect protein amyloidogenicity. It is important to visualize the protein amyloid structures and to provide stronger evidence of amyloid aggregation than other indirect assays.

Additional Research Skills

Skill Description #3
I learned SDS-PAGE from Moffet's lab and a Biochemistry Lab course. For any protein chemist, SDS-PAGE is an essential tool. It allows for separation of proteins by their molecular weight, which is important for my research to identify protein inhibition complexes with increased molecular weight.
**Additional Research Skills**

*Skill Description #4*

I learned ELISA in research and Biochemistry lab. It is another vital tool for protein chemists, allowing for the highly specific detection of certain antigen. In my research, ELISA is an important assay used to detect amyloidogenic oligomers or fibrils.

**Additional Research Skills**

*Skill Description #5*

I learned PyMOL Software in Biochemistry Lab. For me, PyMOL was eye opening to visualize the dynamic 3D nature of proteins. Also, Using computer modeling like TANGO to predict protein aggregation is to help focus and expedite experimental testing.

**Other Activities and Accomplishments**

*Activity/Accomplishment*

Magis Service Organization

*Scope of Activity/Accomplishment*

College/University

*Role/Involvement*

In Magis, I do 30+ hours of service tutoring students at verbum dei high school and working at a food pantry at Blessed Sacrament Church in Hollywood. Additionally, being in Magis has helped me reflect on service, masculinity, and spirituality.

*Length of Involvement*

More than one academic year

**Additional Other Activities and Accomplishments**

*Activity/Accomplishment*

Pokemon Go Club

*Scope of Activity/Accomplishment*

College/University

*Role/Involvement*

In Pokemon Go Club, we provide a method for Pokemon Go players to coordinate game activities like trades, raids, and in-game events. We also hold meetings and social events in order to create a community of dedicated and helpful Pokemon Go players.

*Leadership Position*

Vice President

*Length of Involvement*

More than one academic year
Additional Other Activities and Accomplishments

Activity/Accomplishment
Attic Salt

Organization (if applicable)
LMU Honors Program

Scope of Activity/Accomplishment
College/University

Role/Involvement
In this interdisciplinary journal, I was responsible for advertising the journal and helping select STEM-related submissions for inclusion. I suggested edits and helped finalize a conservation biology paper about the merits of rewilding.

Leadership Position
Editor

Length of Involvement
Academic Year

Additional Other Activities and Accomplishments

Activity/Accomplishment
HanTao

Scope of Activity/Accomplishment
College/University

Role/Involvement
HanTao is LMU's premier student-run Chinese-American organization to promote a Chinese cultural community. During the club's annual Chinese Cultural Night, I delivered, sold, and helped cook food items like Dan Tat and Cha Siu Bao to fundraise.

Leadership Position
Cultural Committee Member

Length of Involvement
Semester

Additional Other Activities and Accomplishments

Activity/Accomplishment
Volunteers Around the World

Scope of Activity/Accomplishment
College/University
Role/Involvement
In freshmen year, my club learned basic medical training and participated in fundraising efforts to prepare for a one week Medical Volunteering trip in Guatemala. In the rural Lake Atitlan community, we shadowed local doctors and measured vitals.

Leadership Position
Treasurer

Length of Involvement
Academic Year

Recognitions
Recognition
Type
College/University
Award Description

Additional Recognitions
Recognition
Type
College/University
Award Description

Current College/University
Institution type:
4-year institution
Field of study
Life Sciences

Life Sciences areas of specialization
Biochemistry

Official cumulative unweighted GPA

How many credit hours does your school require for graduation?

How many credit hours will you achieve as of January 1, 2020?

How many credit hours do you plan to achieve for graduation?

Expected baccalaureate graduation month
05

Expected baccalaureate graduation year
2021

According to the definition provided above, indicate whether you are a sophomore or junior.
Junior

Matriculation status at the institution you will be attending during the 2020-2021 academic year
Currently Enrolled

Have you been involved in or do you plan to Study Abroad?
No

Coursework

Current Course 1
Advanced Biochemistry Lecture

Current Course 2
Advanced Biochemistry Lab

Current Course 3
Analytical Chemistry Lecture and Lab

Current Course 4
Advanced Topics in Biochemistry and Biotechnology

Current Course 5
Chemistry Seminar
Future Course (In Major) 1
Physical Chemistry

Future Course (In Major) 2
Physical Chemistry Lab

Future Course (In Major) 3
Inorganic Chemistry

Future Course (In Major) 4
Inorganic Chemistry Lab

Future Course (In Major) 5
Toxicology

Future Course (In Major) 6
Physics 2

Future Course (Outside Major) 1
Contemporary Chinese Cinema

Future Course (Outside Major) 2
Asian and Pacific Studies Thesis

Future Course (Outside Major) 3
Honors Thesis

Previous Schools Attended

Future Academic Plans
Is the institution you will be attending for the 2020-2021 academic year the same as your current academic institution?
Yes

Certification and Release
App nature
Introduction
Type 2 Diabetes has become a global health epidemic, with 27 million people diabetic and 86 million people prediabetic in the United States alone [1]. This chronic condition can be characterized by a detrimental change in glucose processing; either through insulin resistance or insulin deficiency. One proposed explanation for the progression of Type 2 Diabetes is the amyloid hypothesis, which posits that misfolded Islet Amyloid Polypeptide (IAPP) in the form of small oligomers or insoluble extracellular plaques known as amyloids directly contribute to the death of pancreatic β-cells in Type 2 Diabetes. While IAPP is co-secreted with insulin from pancreas β-cells, the misfolded version of the protein has a high propensity to misfold into toxic conformations. One study demonstrated that in 95% cases of patients afflicted with Type 2 Diabetes, IAPP was present in both amyloid aggregate and fibrous forms [2]. Though the exact mechanism of IAPP misfolding is unknown, amyloid structures appear to be dominated by antiparallel β-sheet strands, which may induce conformational misfolding in native form IAPP [3].

While many other organisms have pancreas β-cells which secrete their own form of IAPP, not all of them develop Type 2 Diabetes. For example, Mice and rats, which share identical IAPP protein sequences, neither develop Type 2 Diabetes nor have amyloidogenic IAPP. However, when mice in one study were genetically engineered to express human IAPP, the mice developed symptoms characteristic of Type 2 Diabetes[4]. Therefore, determining if the IAPP from animals that develop Type 2 Diabetes is amyloidogenic may demonstrate that the progression of Type 2 Diabetes is linked to IAPP aggregation. In this research project, I will be testing if IAPP aggregation propensity is linked to the progression of Type 2 Diabetes. A list of diabetic and nondiabetic animals whose IAPP aggregation susceptibility has not been determined will be assembled, and then the IAPP protein sequences from these animals will be tested for aggregation. First, Thioflavin T-Assay will be a spectroscopic method used to measure proclivity for IAPP aggregation. Then, Atomic Force Microscopy and Immunodetection Dot Blot Assay will be utilized to further verify IAPP aggregation.

Methods and Results

Thioflavin T-Assay
Animal variants of the 37-residue IAPP were ordered from Watson Bio and suspended in 7.4 pH Tris buffer. These samples were incubated for 5 days, after which they were mixed with Thioflavin-T. Thioflavin-T binds to aggregated, misfolded IAPP to create a chemical complex, which can then be detected using a spectrometer. In this procedure, I created the Thioflavin chemical solution, thawed frozen IAPP samples, mixed IAPP samples and Thioflavin solution together, and measured aggregation using a spectrophotometer. However, only human, cat, chicken, dog, horse, and racoon IAPP showed aggregation in this assay (Table 1) while some other animals known to develop Type 2 Diabetes did not. While this result was unexpected, my mentor and I speculate that Thioflavin might have less affinity for binding to other animal IAPPs since ThT was designed to bind to the large human IAPP fibers.

Atomic Force Microscopy (AFM)
Atomic Force Microscopy was used to visualize the aggregation of IAPP, including amyloid fibers and small oligomers. I created the slides used for AFM imaging, and also operated the AFM to scan different animal proteins. Operating the AFM included proper scanning alignment, replacement of cantilever probes, and determination of the presence of fibers. The AFM images are almost all consistent with previous literature, with nondiabetic animals like Chicken clearly displaying fibers (Figure 1) and diabetic animals like Rat not displaying fibers (see Figure 2). However, two rodent animals, the degu and guinea pig, did not display amyloid fibers even though they develop Diabetes (Table 1). It is possible that the amyloid fibers from these IAPP proteins did not fully bind to the mica on the AFM slides or an incorrect portion of an AFM slide was visualized.

**Immunodetection Dot Blot**

A11 is an antibody produced by rabbits which can bind to amyloidogenic oligomers. Utilizing Dot Blot procedures, animal IAPP samples were tested for the presence of misfolded oligomer structures. The darker the spot, the greater oligomer concentration present and degree of binding to the antibody (see Figure 3). In this procedure, I was responsible for spotting IAPP samples onto the nitrocellulose membrane used for the Dot Blot, performing washes between additions of antibody, and creating different buffers used in the dot blot washes. Like the AFM procedure, results are generally consistent with literature knowledge (Table 1), yet pig and polar bear IAPP consistently showed A11 oligomer binding contrary to expected results. Due to material limitations, the horse IAPP sample could not fully verified through this Immunoassay.

**Table 1**: Summary of the Thioflavin T, AFM, and Dot Blot results for each animal. The star (*) represents the degree of ThT binding. The Diabetic status of each animal is also included.
The research results demonstrate a correlation between the development of Type 2 Diabetes and IAPP aggregation propensity. Except for degu, guinea pig, and pig, this correlation was present amongst all the different IAPP proteins tested. Therefore, further evidence has been added in support of the amyloid theory of disease - that IAPP aggregation plays a role in the progression of Type 2 Diabetes.

**Future Studies**

This research has been presented at multiple research symposiums by the Moffet lab; I personally presented a poster about this project at the 2018 Southern California Conference for Undergraduate Research poster session. Findings from this research were published in August 2019 edition of the Journal of Peptide Science under the title *Amyloidogenicity of naturally occurring full-length animal IAPP variants*. Further research projects involving animal IAPP will be conducted. Literature suggests that IAPP from animals like rats and mice could inhibit human IAPP amyloid formation [5]. In the future, I could test if IAPP from other animals could inhibit IAPP amyloid formation. Additionally, in human IAPP, the 20-29 residue region region is widely considered to be the amyloidogenic sequence of IAPP [6]. I could also attempt to investigate how residue differences in human and non-amyloidogenic animal sequences result in amyloidogenicity (or the lack thereof). IAPP mutants, based off suspected inhibitory sequences in animal IAPP could be created and studied using the Thioflavin-T, AFM, and Dot Blot skills that I have developed throughout this research project. I also plan to learn TANGO software to predict propensity of protein aggregation based on residue sequences and circular dichroism techniques to determine protein secondary structure. With these skills, I will continue to contribute to the Moffet lab’s research projects and research about the nature of IAPP aggregation.

**References**


