HOWARD HUGHES MEDICAL INSTITUTE
WEEKEND RESEARCH EXPERIENCE
for High School Students
at California State University, Fullerton
November 8, 9, and 15, 2014

PROGRAM GOAL AND DESCRIPTION

The HHMI Weekend Research program targets the engagement of high school students in research experiences that will excite their interest in chemistry, biology and mathematics. It is particularly interested in supporting those who have little or no experience with, or knowledge of, research. Students will immerse themselves in three days of in-depth work on an actual research question under the supervision of faculty mentors over two contiguous weekends.

Entry into the HHMI Weekend Research Experience is by application (next pages). Applicants need to be juniors or seniors, and must have completed a high school course in chemistry and/or biology, plus advanced algebra. **Applications must be submitted to Mary Flores (mflores@fullerton.edu) at Cal State Fullerton.** Application forms are available online from the CSUF-HHMI website (http://hhmi.fullerton.edu).

FALL 2014 WEEKEND RESEARCH PROJECT

Dr. Christopher R Meyer is Chair and Professor of Biochemistry in the Department of Chemistry and Biochemistry at CSUF and has been studying carbon metabolism and the synthesis of biodegradable and renewable carbon sources, such as starch. A major focus is to elucidate structure-function relationships among the ADPGlucose pyrophosphorylases (ADPG PPase), which are the rate limiting enzymes for glycogen and starch biosynthesis in bacteria and plants, respectively. These enzymes are activated or inhibited by diverse metabolites depending upon the organism. As a key step in the starch biosynthesis pathway, ADPG PPase is an attractive target for bioengineering to increase the yield of starch in plants. Three dimensional structure data have revealed considerable information about the active site of the enzyme, but there is still a large gap of knowledge about how enzyme activity is regulated. In addition, little is known about the amino acids responsible for heat stability in forms of the enzyme produced by bacteria that survive high temperature (a trait particularly attractive to industry), and whether aggregation of individual units (subunits) of the enzyme enhances activity. A better understanding of how these enzymes work will allow us to engineer these proteins to increase the yield of starch in commercially important crops, providing not just starch for food but an inexpensive starting material for making bio-ethanol and biodegradable plastics. Increased starch production may also enhance photosynthesis and biomass, removing more CO_2 from the atmosphere.

Students will work in small groups focused on different recombinant forms of the bacterial ADPG PPases—from the heat stable enzyme from *Thermus thermophilus* (T.th.), to the salt insensitive form with a novel activation profile from *Thermodesulfovibrio yellowstonii* (Td.y.), and the two-subunit form which lacks an inhibitor from *Thermotoga maritima (T.ma.)*. We are interested in probing the roles of a number of amino acid positions or regions in these target proteins in catalysis, regulation, and aggregation of the enzyme. Work on the first weekend will include purification of the different forms of the enzyme, characterization of their activity in the presence and absence of effector molecules as well as their state of aggregation. Crystallization trials will be set up as a first step to obtain additional structural data. We will also be generating additional altered enzymes via site-directed mutagenesis. The following Saturday would be used to confirm the DNA sequences of the new altered forms of the enzyme, examine crystal trays for "hits", analyze and interpret the data collected and then present the results to the group as a whole. Participants will thus gain experience in basic biochemistry and molecular biology in the context of a larger protein engineering project.

Supported by a Grant from the Howard Hughes Medical Institute to Cal State Fullerton

HOWARD HUGHES MEDICAL INSTITUTE — CSUF
WEEKEND RESEARCH EXPERIENCE
APPLICATION FORM for HIGH SCHOOL STUDENTS
November 8, 9, and 15, 2014

Application Deadline: October 3, 2014

Applications may be downloaded at http:// hhmi.fullerton.edu

APPLICANT INFORMATION

Name: _____
Last First Middle

Date of Birth (MM/DD/YY): _____

Gender: ☐ Female ☐ Male

U.S. Citizenship: ☐ Yes ☐ No (Permanent Resident No.: _____)

Current Address:

_____

_____

Permanent Address: ☐ Same as Current Address

_____

_____

Telephone Home: _____ Mobile: _____

Email address: _____

Ethnicity:

☐ American Indian/Alaskan/Native American ☐ African-American/Black. ☐ Asian-American
☐ European-American ☐ Filipino/Filipino-American ☐ Latin/Other Spanish American
☐ Mexican/Mexican American ☐ Mid Eastern-American ☐ Pacific Islander
☐ PuertoRican ☐ Other: _____

Primary language spoken at home: _____

Parent's Education (Highest level completed)

Father ☐ Some H.S. ☐ H.S. Diploma/GED ☐ Some College ☐ Bachelor's
☐ Some graduate school ☐ Masters ☐ Doctorate

Mother ☐ Some H.S. ☐ H.S. Diploma/GED ☐ Some College ☐ Bachelor's
☐ Some graduate school ☐ Masters ☐ Doctorate

ACADEMIC INFORMATION

High School: _____

Year (Check One): ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Overall GPA: _____ Science GPA: _____

Expected graduation date: (Check One): ☐ June 2015 ☐ June 2016 ☐ June 2017

Select ALL science and mathematics courses completed:

☐ Biology ☐ Chemistry ☐ Physics ☐ Integrated/Physical Science ☐ Other _____

☐ Algebra ☐ Geometry ☐ Algebra II ☐ Precalculus ☐ AP Calculus ☐ Other _____

SPECIAL CONSIDERATIONS

Please indicate whether you:

☐ Are an under-represented minority (NIH defines this category as African American, Pacific Islander, Hispanic American, or Native American.)

☐ Are applying as a financially-disadvantaged student (include a copy of your last federal income tax reporting form).

☐ Are the first person or generation in your family to have attended a four-year university.

☐ Enrolled in a high school that does not send a high percentage of students to four-year colleges.

LETTERS OF REFERENCE

List the name of at least one teacher who can provide a Letter of Reference on your behalf (http://hhmi.fullerton.edu/docs/HHMIRefLetter.pdf). *One letter must be received by Mary Flores (mflores@fullerton.edu) no later than Oct. 3.*

Name: _____ E-mail (required): _____

Title/Affiliation: _____ Telephone: _____

Name: _____ E-mail (required): _____

Title/Affiliation: _____ Telephone: _____

HHMI PROGRAM INFORMATION

How did you learn about the CSUF-HHMI Program? (Check all that apply)

☐ Teacher or advisor at your school (name) _____

☐ Past HHMI Scholar (name) _____

☐ Other (specify) _____

APPLICANT'S SIGNATURE

Student Signature _____ Date _____

Parent Signature _____ Date _____

Parent Name _____ Parent Contact Info _____

ESSAY

Explain briefly why are you interested in participating in this HHMI Weekend Experience and in doing biomedical research.