

# **Faculty Development Project Report**

## **Funding for Summer 2022 Research**

**Title of project:** Positioning of the chromosome passenger complex for proper chromosome segregation

**Name of the Applicant:** Viridiana E. Herrera, PhD

**Rank of the Applicant:** Assistant Professor

**Expertise Area:** Biochemistry, Structural Biology, Synthetic (Protein) Chemistry

**Proposal Submission Term:** Summer 2022

**Date of Report:** January 31<sup>st</sup>, 2023

## **A Concise Overview of the Project:**

My research explores the principles governing faithful chromosome inheritance. Diverse lines of investigation show that the tetrameric Chromosomal Passenger Complex (CPC) is responsible for the timely and accurate orchestration of mitotic events needed for proper cell division. My **long-term research goal** is to determine the mechanism by which the CPC is recruited into the inner centromere and the mode of CPC-chromatin interaction. This ambitious goal is being worked on continuously and in collaboration with investigators at UPenn. However, the results of the Summer 2022 proposal efforts are summarized below.

**The specific goals for Summer 2022 and related outcomes were as follows:**

### **Goal 1: Implement a research collaboration with the Department of Biochemistry and Biophysics at the University of Pennsylvania.**

Outcome: To strengthen research efforts at LU and introduce our students to research-intensive opportunities led by LU faculty, I applied for and obtained an appointment as an Adjunct Assistant Professor in the Department of Biochemistry and Biophysics at the University of Pennsylvania. This offer gives me the opportunity to officially serve as a research mentor to LU students at UPenn. Thus far, I mentored one dedicated LU student, as he contributed directly to this project. In addition, to carry out the scientific goals outlined in my proposal, I also established a research collaboration with other Principal Investigators at UPenn. With this ongoing collaboration, I was granted access to the specialized equipment needed to carry out the proposed experiments.

### **Goal 2: Experimental objectives: create mono- and di-nucleosomes for biophysical studies.**

Outcome: Under my supervision, my LU summer research student developed the biochemical and biophysical techniques necessary to make a meaningful contribution to the research project. During their summer internship, said student successfully built mono- and di-nucleosomes that mimic the mitotic centromere chromatin on a large-scale. And I successfully developed methods to purify the CPC tetrameric complex in sufficient quantities for biochemical assays. *These results were presented by me at the 2022 Faculty Development Grant Series on November 18<sup>th</sup> 2022, and at several local and national conferences by my summer research student.*

### **Goal 3: Mentor Lincoln Students During the Summer of 2022 (ongoing).**

Outcome: During the Spring of 2022, I began working with several dedicated LU students who showed great interest in research and eagerness to pursue a postgraduate degree. To help these students gain research experience and decide if this trajectory is for them, I encouraged and helped them apply for internship programs. Of direct interest to this project, Kevin Carver applied for the Summer Undergraduate Internship Program at UPenn, which he was awarded. Thanks to my position as an Adjunct Assistant Professor in the Department of Biochemistry and Biophysics at UPenn, I was able to serve as a research co-mentor for him in an official capacity. Moreover, to date, Kevin continues to

be involved in new aspects of this project here at LU. We received the FUTURES Act Grant and have been pursuing other research aims pertinent to this work.

**Goal 4: Goal: Research results will inspire new areas of collaboration and future projects that enhance research at Lincoln University.**

Outcome: The results of my Summer 2022 research provided the scientific foundations for an internal FUTURES ACT Grant Application. The FUTURES ACT proposal aims to design an improved cloning and purification strategy for recombinant Sgo1, a protein that works with the CPC and is crucial for chromosome biorientation. With this project, Kevin and I reviewed scientific literature and identified the most stable portions of Sgo1 that maintains the protein regions necessary for CPC and chromatin interaction. Together we design a synthetic gBlock that encodes the cDNA for the expression of our double-tagged StrepII-SgoI-CBD protein. In the upcoming months, Kevin and I will work on the expression and purification of this recombinant protein. This added experience in plasmid design and cloning directly results from the Summer 2022 research funding. Additional preliminary data is needed for an external grant application, which will be the focus of a follow-up FDRC grant application.

**Goal 5: Enhance teaching at Lincoln University by incorporating more hands-on research examples and discussions into chemistry courses.**

Outcome: The protein constructs used in this research have been used as classroom tools to teach recombinant protein design, cloning, and purification in Biochemistry I & II (CHE303 and CHE304). Students learn to use UniProt to find the cDNA sequence for target proteins, as well as the sequence for the distinct affinity chromatography tags. They learn to design DNA primers to amplify these sequences using Polymerase Chain Reactions and introduce restriction enzyme sequences for directional cloning into *pET* plasmid vectors. These classroom experiences allow the students to learn hands-on how to design and clone recombinant proteins for expression in *E. Coli*. Furthermore, students take these classroom designs and purify (easier to handle) recombinant proteins in the laboratory. These activities provide comprehensive experiences in protein design, expression, and purification.

**Goal 6: Disseminate research results locally and at national conferences.**

Outcome: The results from this proposal were presented by me at the 2022 Faculty Development Grant Series on November 18<sup>th</sup>, 2022. This work also served as the basis for a research-based poster which was presented at several local and national venues:

- **K.B. Carver**, V.E. Herrera, N. John, N. Sapp. B.E. Black. Reconstituted Chromatin to Test Binding Models of the Chromosome Passenger Complex. Leadership Alliance National (LANS) Symposium. Hartford, CT. July 29-31, 2022.
- **K.B. Carver**, V.E. Herrera, N. John, N. Sapp. B.E. Black. Reconstituted Chromatin to Test Binding Models of the Chromosome Passenger Complex. Summer Undergraduate Internship Program (SUIP) Symposium. Philadelphia, PA. August 3, 2022.

- **K.B. Carver**, V.E. Herrera, N. John, N. Sapp. B.E. Black. Reconstituted Chromatin to Test Binding Models of the Chromosome Passenger Complex. National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Annual Meeting. Orlando, FL. September 26-29, 2022.
- **K.B. Carver**, V.E. Herrera, N. John, N. Sapp. B.E. Black. Reconstituted Chromatin to Test Binding Models of the Chromosome Passenger Complex. The 26<sup>th</sup> Annual Science Fair, Lincoln University, Pennsylvania, November 4, 2022.