Colorado Science and Engineering Fair

2024 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Toxin-like Microproteins: A Novel Approach to Unveil the Intricacies of Acetylcholine Receptors

Finalist's Name: Angelina Wang

School and City: Fairview High School, Boulder

Sponsor's Name: Michael Stowell

Category: Micro & Molecular Biology (MCRO)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

Over 50 million people have been diagnosed with neurodegenerative diseases worldwide, however the fundamental molecular mechanisms for the development of these diseases are not well understood. Identifying and deconstructing these mechanisms is vital to discover disease pathways and support drug discovery. Published research shows that conotoxins are able to interact with nicotinic acetylcholine receptors (nAChRs), which helps mediate chemo-electric signals in the nervous system. My work is to investigate toxin-like microproteins, which are non-coding RNAs in the human genome similar to conotoxins, and examine if these microproteins are able to bind and interact with the nAChR subunit α4β2. I first selected a toxin-like microprotein (TXM-3092) by blasting a human genome database against a natural conotoxin database. I then analyzed protein models and ligand-binding sites, synthesized TXM-3092, labeled TXM-3092 with Cyanine-5 NHS Ester fluorescence, and utilized murine brain tissue slices to verify the localization and specificity on α4β2 nAChRs. I performed similar database testing on conotoxin mr5.1a which showed similarity to TXM-3092. Results of t-Test analysis comparing the protein model energy scores revealed that TXM-3092 had a significantly higher binding affinity to the α4β2 nAChR ($p < 0.001$) and an exceedingly large effect size (Cohen's $d = 243.4$), showing agreement with fluorescence imaging results. Additionally, with comparison to the Allen Brain Atlas, TXM-3092 showed the expected localization of binding. Future work includes performing a dose response of TXM-3092 and testing an additional toxin-like microprotein for further confirmation of toxin-like microprotein specificity on the α4β2 nAChR.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature: Angelina Wang Date: 2/28/24

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES o all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.