



Colorado Science and Engineering Fair

2025 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: "ProteinFlow" v2 - Biocomputational Analysis of Metabolic Pathways to Discover New Carbon Capturing Bacteria

Finalist's Name: Ayush Vispute

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Sponsor's Name: Pankaj Vispute

Category: Mathematics & Computer Sciences

Division: Senior (grades 9 - 12)

Abstract (250 words or less):

Climate change poses a significant threat to global ecosystems. Current mitigation strategies are inefficient and costly. Biological solutions offer a promising alternative. *Synechococcus elongatus* (SE), has demonstrated remarkable carbon-capturing capabilities relative to its size and the potential to convert CO₂ into valuable products. Despite this potential, little research has been conducted to identify other bacteria with similar or superior carbon-capturing abilities.

ProteinFlow is a coded workflow that addresses this gap by leveraging bioinformatics tools, with the primary goal of uncovering new carbon-capturing bacteria. The key to this lies in the proteins of SE.

There are a certain number of proteins that perform any given function in a bacteria. There are 7 proteins in SE that are key to its unique efficiency in capturing carbon. ProteinFlow analyzes this metabolic pathway to find new carbon-capturing organisms. The workflow integrates three key analyses: sequential, phylogenetic, and structural. The proteins in SE are compared to millions of other organisms. With a 3 dimensional approach ProteinFlow is capable of identifying new organisms with SE's capability, supported statistically.

Utilizing ProteinFlow identified *Synechocystis* PCC 6803 and *Nostoc Punctiforme* as bacteria that are capable of capturing carbon. These bacteria offer partial solutions to the climate change crisis and must be tested in a laboratory setting to quantify their carbon capturing capability.

ProteinFlow is a pipeline applicable to other bacterial studies. It can be used as a method to identify plastic-degrading bacteria and other environmental use cases.

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:

Date:

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 of 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.**