Research Experience for High School Students Project Description

Project Title: Molecular mechanisms of diseases: cancer, autism, Alzheimer's disease

Project Overview

Autistic Spectrum Disorders (ASD)

ASD is a neurodevelopmental disorder that includes social impairments, restrictive and repetitive behavioral patterns, and communication difficulties. Scientists have not found the cause for autism, however ASD is associated with both genetic and environmental factors. Autism is predicted to be caused by genetic mutations in critical neurological areas of the genome due to its etiological heterogeneity and likelihood in siblings. Specific genes and genomic loci have been located and implicated in ASD development. We study these genes interactions with the transcription factors that activate them and to find the spots of possible drug administration, molecular modeling and molecular dynamics simulations.

Alzheimer's

Alzheimer's Disease is a neurodegenerative disorder that affects a variety of the brain's functions, starting with short term memory loss, and eventually progressing to mood swings, disorientation, depression, and even loss of bodily functions. It is responsible for 60-70% of all dementia cases, and is the sixth leading cause of death in America. It is characterized by a buildup of β-amyloid plaques in the brain. There is no known cure for the disorder today, but recently, the amyloid hypothesis has been heavily researched as the mechanism of the disease. The amyloid precursor protein (APP) is cut by two enzymes, β-secretase and γ-secretase, and β-amyloid, the toxic form of the protein, is one of the segments that remains. Since the marker of Alzheimer's is the buildup of this plaque in the brain, there is potential for slowing the progression of the disease if production of this protein is inhibited. We study existing drugs inactions with the target proteins and try to find methods to improve their action.

Cancer

Cancer is the second leading cause of death in the United States, and responsible for 580,350 deaths in 2013, it has become ever more imperative that researchers focus their attention in this field. Ingenuity Integrated Pathway Analysis (IPA) program is used to build and explore transcriptional networks, microRNA-mRNA target networks, phosphorylation cascades, and Protein-Protein or Protein-DNA interactions. We try to identify regulatory effects that lead from signaling events to transcriptional events for causal network analysis and to construct a comprehensive chart of diseases and functions associated with target genes so as to elucidate gene functionality and possible points of drug administration.

2. Number of Students to be supported: 1

3. Name of Lead person: Dr. Igor Tsigelny, Dept. of Neurosciences, SDSC

4. Plan to Integrate Student into Group Activity
The student will be a part of the research team working on the larger scale project that includes the project described here. He or she will attend the group meetings and communicate with the team members using other methods of communication. The student will work closely with the lead person and the other personnel involved.

5. Student Prerequisite

We are looking for a student who is interested in both biology and computation.

6. Number of hours per week: 15-20 hours

7. Relevant link:

San Diego Supercomputer Center: http://www.sdsc.edu