New Jersey Center for Science, Technology & Mathematics

GROUP SUMMER SCHOLARS RESEARCH PROGRAM

2020 Research Streams

Analytical Chemistry & Chromatography:
Isolation, Identification and Characterization of Drug-Like Chemical Compounds in Medicinal Plants Using Biological Assays, Chromatography, and Mass Spectrometry Techniques

Faculty Leader: Dr. Dil Ramanathan

Students in this research stream learn bioanalytical methods, including chromatography, mass spectrometry, and solid phase extraction, while studying plants that show anticancer, antibacterial, and antimicrobial activity. Students will isolate, identify, and quantitate drug-like chemical compounds in medicinal plants using biological assays and analytical instruments such as liquid and gas chromatography coupled to mass spectrometry.

Medicinal Chemistry & Modern Drug Discovery:
Synthesis of Chemokine Receptor Antagonists

Faculty Leader: Dr. James Merritt

Students in this research stream learn basic principles of medicinal chemistry and pharmaceutical research by synthesizing and testing novel receptor antagonists. Students work as part of a multidisciplinary drug discovery team to optimize compounds that can block chemokine receptor signaling. Using real drug discovery screening assays, students test the newly created compounds in collaboration with the Cancer Biology Team to determine effects on the growth and activation of cultured glioblastoma cells.

World of Data:
Virtual Reality & Scientific Visualization

Faculty Leader: Dr. David Joiner

Immersive environments, such as 3D games and virtual reality headsets allow for the rich exploration and modeling of multi-dimensional scientific data. There has been a growing variety of options for developing and viewing virtual reality, and students in this stream will be part of a team building a virtual reality application for scientific visualization, developed across multiple platforms including the Oculus Rift, Kean's 7'x10'x10' 3D CAVE, and the Gear VR. The tool will enable students, teachers, scientists, and enthusiasts to view, build, and share a variety of scientific data and simulations in virtual reality. Prior programming experience is helpful but not required, and instruction in programming in the Unity3D environment will be part of the stream. In addition to being part of the World of Data design team, students will also search for, curate, and visualize data across a variety of disciplines including biology, mathematics, chemistry, physics, bioinformatics and computer science.

Molecular & Cellular Biology:
Exploring Cancer Malignancy

Faculty Leader: Dr. Salvatore Coniglio

This research stream provides opportunities for inquiry-based learning of cell and molecular biology, with a focus on cancer. Students search for novel interactions between cancer cells and macrophages, specialized cells of the immune system found in the cancer microenvironment. Changes in gene expression are measured in these cells, giving students the opportunity to learn methods to quantitate mRNAs and proteins of interest using real-time PCR, SDS PAGE based immunoblotting (western blotting), and immunofluorescence microscopy and cell culture. Ultimately, students test their findings in a cell invasion assays to determine their functional significance.

Computational Mathematics:
Applied Machine Learning

Faculty Leader: Dr. George Avirappattu

Machine learning is at the heart of artificial intelligence today. In this stream, students will be introduced to python programming, algorithmic thinking, and mathematics/statistics necessary for machine learning. Through hands-on experiments, we will explore the basics of machine learning such as modeling frameworks, data collection/generation, preprocessing, data engineering, training, testing, and validation. Introduction to deep learning. Students will have the opportunity to complete a machine learning project.

Developmental Biology:
Gene Expression and Regulation

Faculty Leader: Dr. Matthew G. Niepielko

During animal development, a handful of highly conserved cell signaling pathways regulate when and where genes are expressed within a developing tissue. This process, called tissue patterning, is an essential step to ensure that animals' organs develop in the correct location and at the right time. A growing body of evidence suggests that changes gene regulation during tissue patterning drives the evolution of new animal structures and morphologies. In our lab, we use Drosophila, the common fruit fly, as a model system to investigate the underlying mechanisms that tightly regulate gene expression during development. Additionally, we explore how these mechanisms evolve and give rise to new morphologies using a combination of computational and molecular techniques.

Microbiology:
The Skin and Gut Microbiomes

Faculty Leader: Dr. Mohamed El-Sherbeini

The human microbiome is "the community of microbes that naturally inhabit the human body or certain organs within it. The human body contains more bacterial cells than human cells. While some microbes may make us sick, other microbes are important for human health, leading to the conclusion that "you are what you host". We are studying the gut microbiome as it may correlate with colorectal cancer and the skin microbiome as it associates with common skin infections and inflammation. Skin microbiota vary based on many factors including age, gender, antibiotics use and different skin locations. The dynamic interplay among microbial residents of the skin are investigated using culturing of microorganisms, as well as biochemical and molecular techniques.