2021
Undergraduate
Research Symposium

ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

Research is to see what everybody else has seen, and to think what nobody else has thought.

Albert Szent-Gyorgyi

Hungarian biochemist who
won the Nobel Prize in
Physiology or Medicine in 1937

SYMPOSIUM WEEK

April 12 – Opening Program
April 12, 13 and 14 – Student Presentations
April 15 – Closing Session

proudly presented by

Independent Colleges and Universities for New Jersey
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INDEPENDENT COLLEGE FUND OF NEW JERSEY

Undergraduate

Research Symposium

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we graciously acknowledge the support of our
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THE COUNCIL OF INDEPENDENT COLLEGES

Roche

On behalf of the students who benefit from participation in the Undergraduate Research Symposium, thank you. Your support has provided access to research opportunities emphasizing new explorations in Science, Technology, Engineering, and Math (STEM) fields. The research experience bridges the gap between students' interests, classroom knowledge, and current lab opportunities. The intersection of these key elements promotes retention in STEM majors.

thank you

Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

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Innovation is like looking for pieces in a jigsaw puzzle. You have to find a lot of pieces that don't match to find the one or two pieces that match.

Edward Conard
American businessman, author and scholar

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Welcome Message

On behalf of the Independent Colleges and Universities for New Jersey, I want to welcome you to this year's Undergraduate Research Symposium. This past year, we have suffered losses and been repeatedly challenged to overcome the unforeseen. Our college students became an integral part of our work and learn from home socially distanced society. They showed tremendous fortitude in staying the course toward a college degree. Research and development of a vaccine became pivotal to establishing how we can engage at work, school and in our communities.

Recognition of the significance of maintaining student interest in research and a determination to foster the STEM pipeline compelled the Independent Colleges to move forward with the Symposium. With the support of an outstanding group of faculty sponsors, independent student research prevailed. Over the next few days, talented and dedicated undergraduate students from our member institutions will share the struggles of conducting research during a pandemic and report on their findings in virtual meetings. Their commitment parallels the unflappable efforts of the scientists and researchers around the world who have contributed to the vaccines that will save lives.

Introduced as a resource to increase retention in science, technology, engineering and math (STEM) fields, the Undergraduate Research Symposium has developed into something greater because of the generosity of our industry and academic judges who share their time, knowledge and experience with our students. By incorporating the presentation component, the Independent Colleges provide an opportunity for students to build the communication, demonstration and interview skills they will need to earn a career position or opportunity for advanced study. Students are challenged to convey the elements of their research while being evaluated on the clarity and comprehensibility of their timed presentations. We thank each of the judges for their generosity and assistance in offering meaningful feedback that bridges the knowledge and skills gaps between academia and the workplace.

To help a student's first research undertaking to be exciting and transformational requires the support and guidance of dedicated faculty. Faculty sponsors help students build on existing research and create new areas of exploration. Working with faculty members, students have an opportunity to connect the knowledge gained in the classroom to real life issues. We are grateful for their day-to-day efforts in the classroom and for the enthusiasm brought to the research process. By participating in the Symposium, these advisors and mentors play an integral role in encouraging more students to "stay the course" in STEM fields.

The Symposium would not be possible without the sponsors who share in the commitment to strengthening the STEM pipeline and who recognize the important role of our member colleges in preparing students for a career and/or graduate study in STEM fields. Through the generosity of our funders new undergraduate research projects across our member campuses were realized despite the challenges of the pandemic. The impact of that investment will be realized over the course of careers that extend from research labs and conference rooms to environmental sites and health care facilities.

Please join me in wishing all our students the very best as they continue on their path of lifelong learning.

JOHN DRZYMKOWSKI
Chair, Independent College Fund of New Jersey

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Events of the Week

April 12 Monday	9:00 a.m.	**Opening Program** **Welcome** **Charting Your Path to Career Success** a virtual panel discussion with BD professionals
	11:00 – 11:30 a.m. 11:30 a.m. - Noon Noon - 12:30 p.m.	**Virtual Presentations** Each student will have an opportunity to present their research findings to a panel of judges in a virtual meeting room.
April 13 Tuesday	9:00 – 9:30 a.m. 9:30 - 10:00 a.m. 10:00 - 10:30 a.m.	**Virtual Presentations** Each student will have an opportunity to present their research findings to a panel of judges in a virtual meeting room.
April 14 Wednesday	2:00 – 2:30 p.m. 2:30 – 3:00 p.m. 3:00 – 3:30 p.m.	**Virtual Presentations** Each student will have an opportunity to present their research findings to a panel of judges in a virtual meeting room.
April 15 Thursday	10:00 a.m.	**Closing Session** Donor Recognition Acknowledging Top Performers Closing Remarks

Communication – the human connection – is the key to personal and career success.

Paul J. Meyer

trailblazer and leader of the self-improvement industry

Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

Independent Colleges & Universities

Enabling Student Success

- Our member institutions enrolled 65,147 students in Fall 2019 providing opportunities for students to find the right academic, cultural, and social blend to enhance individual learning.
- We enroll 24% of all students attending four-year institutions in New Jersey.
- The overall minority enrollment at our member institutions is 35%, with the undergraduate minority enrollment even greater at 40%.
- Our colleges and universities provide over $1 billion in institutional grant aid to undergraduate students which resulted in over 15% of independent college students in NJ paying NOTHING and another 27% will pay less than $10,000 in tuition and mandatory fees in 2018-19 due to federal, state and the institutional aid we provide to them.

Meeting the Workforce Demand

- While enrolling 16% of all higher-education students, New Jersey's independent colleges awarded 20% of all degrees conferred in FY2019.
- Our students earned 23% of the baccalaureate degrees and 36% of all advanced degrees conferred in FY2019.
- Our students earned 31% of all the education degrees and 30% of all advanced education degrees conferred by four-year institutions in FY2019.
- New Jersey's independent colleges excel in degrees awarded by four-year institutions in the fields of Science and Technology:

37% of all math degrees	*67% of all physical science advanced degrees*
30% of all nursing degrees	*43% of all chemistry degrees*
39% of all engineering degrees	*41% of all computer science advanced degrees*

Federal Investment in Independent Higher Education

- More than 15,000 students receive PELL grants totaling $73.4 million in aid.
- More than 5,700 students receive $5.3 million in FSEOG grants.
- More than 19,000 students have subsidized Federal Loans totaling $81.8 million.
- 5,300 receive Federal Work Study jobs worth $7.2M.

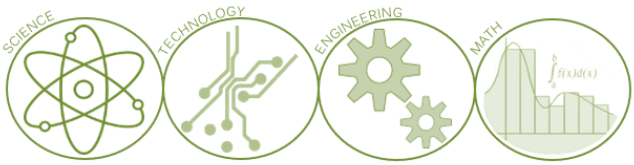
Contributions to the State of New Jersey

- The economic impact of the sector on the State of New Jersey is over $4 billion.
- New Jersey's independent colleges and universities directly employ more than 20,000 people plus more through contractors for food service, bookstores, etc.
- The fourteen institutions collectively have more than 611,340 living alumni. About 52% of all graduates of these institutions still live in New Jersey.
- Our 14 member institutions will spend over $796 million in 2020 and 2021 on new construction and renovation of campus facilities. These projects will generate many jobs in construction and related industries over the next several years.

Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

About the Symposium

By offering the Undergraduate Research Symposium, the Independent College Fund of New Jersey (ICFNJ) seeks to engage and retain students in STEM majors; prepare students for career and graduate study by enhancing knowledge and skills; introduce students to the variety of careers available to STEM graduates; and define career opportunities and success in multiple ways.



Both research grant awardees and ICFNJ administered scholarship recipients conducting research participate in the Symposium. The research – typically taking place during the Fall semester - is augmented by the opportunity to interact with professionals from New Jersey's industry leaders during the one-day symposium during the Spring semester. Each presentation is judged by multiple professionals who provide feedback on student abstracts, visual tools, presentation and communication skills.

Beyond the research experiences, which encourage collaboration, foster problem solving and perseverance, the Symposium provides students with feedback to assist them in developing the soft skills that will be assets for future research presentations, graduate school and career interviews as they support collaborative and team projects.

maintaining the STEM pipeline	The most cost-effective strategy for increasing the supply of STEM workers for the U.S. economy is to reduce college student attrition in STEM fields. Small and mid-sized independent institutions have higher student persistence and degree completion rates in STEM fields and shorter time to the bachelor's degree. *(Strengthening the STEM Pipeline: The Contributions of Small and Mid-Sized Independent Colleges, CIC, May 2014)*
fostering deep learning	The 21st-century classroom has emerged and the standard themes seen in the past are evolving. Students are becoming free to create their own research questions; work with collaborative groups; conduct their own experiments, make mistakes, and learn from them; and even draw connections between multiple subjects. *(The Immediate Value of STEM Education, Carmody, January 2016)*
creating problem solvers	Empirical research by Meyrick has shown that STEM education provides students with a "systemic approach" to solving the unknown. Providing students with a clear path to investigate problems gives students the freedom and confidence to form a conclusion on their own. *(The Immediate Value of STEM Education, Carmody, January 2016)*
building confidence	According to DRPF Consults, STEM education teaches students how to learn and provides students with a valuable skill that will never leave them – confidence. Instead of telling a student that they are right or wrong, STEM education enables a student to become a lifelong learner in which they have the confidence to find an answer for his or herself. *(The Immediate Value of STEM Education, Carmody, January 2016)*
exploring career options	Affording students the opportunity to interact with industry professionals during the Symposium exposes students to the myriad of career opportunities available to them in STEM fields and demonstrates that career success is defined in multiple ways. The experience provides students access to professionals who can provide positive, real-life contact to STEM careers making them more accessible. *(Siemens Foundation, 2013)*
developing soft skills	A common complaint among employers is that young people do not know how to effectively carry on a conversation and are unable to do things like ask questions, listen actively and maintain eye contact. At the Symposium, students engage in a series of judged presentations and receive performance feedback to promote these skills.

Undergraduate Research Symposium
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Meet the Panelists

Nichola Charles

Senior Program Manager, New Product Development and Product Engineering

Nichola was born and raised in the Caribbean on the island of Dominica. She holds a BSc. in Chemical Engineering from the University of the West Indies in Trinidad and Tobago, MASc in Chemical and Bioprocess Engineering from the University of British Columbia in Vancouver, Canada, and a PhD in Biomedical Engineering from the University of Rochester in New York. She is a Commonwealth Fund for Technical Corporation and Commonwealth Scholarship and Fellowship Plan scholar and currently holds 5 patents. Nichola started her career in Quality Assurance at Colgate-Palmolive and Coca-Cola before joining BD as a Senior Engineer and rising through the ranks to Staff Engineer, then Senior Program Manager. She has been the technical and project lead for multiple product engineering and new product development initiatives, most recently launching the BD PureHub disinfecting cap.

Sebastian Luna

Senior Research & Development Engineer (Diabetes Care)

Sebastian is a first-generation Columbian who graduated college in 2013 and joined BD a few month later, as a part of the Pharmaceutical Systems R&D team, supporting product development and holding lab management responsibilities. Since joining he has held positions of increasing responsibility within the R&D function and participated in multiple product improvements and launches. He contributed to launching two insulin pen injector products and facilitating over 15 insulin pen customizations. He also led multiple material replacement projects as an R&D Core Team Member.

Since January 2020, Sebastian joined the Diabetes Care team as a Senior R&D Engineer working on new product development in injectable devices.

Sebastian holds a Bachelor of Engineering in Biomedical Engineering and a Master of Engineering in Engineering Management from Stevens Institute of Technology, as well as a Graduate Certificate in Data Exploration and Visualization.

Choose a job you love,
and you will never have to
work a day in your life.
Confucius

Allan Spina

Vice President, Research & Development Portfolio Management & Innovation Training

Mr. Spina drives effective decision-making and new to world innovation.

As part of the R&D leadership team, Mr. Spina has developed the global vision and strategy for portfolio management including methods, processes, techniques, and tools, as well as implementation of a companywide Portfolio Management program. Responsibilities include defining overall goals and objectives for Portfolio Management, creating a corporate Portfolio Management Office (PfMO), enabling and supporting a global user base, developing and supporting guidelines for weekly, monthly semi-annual and annual processes, and facilitating change management related to Portfolio Management processes and solution, all used to drive key decisions and strategies.

Mr. Spina also lead's the Innovation Training efforts globally and is responsible for supporting the relationship with Stanford University's Beyer's Center for Biodesign, a medical device innovation methodology that is taught and used both domestically in the United States and abroad. Intensive in-house delivered workshops enable participants to understand and use the innovation methods and techniques on real-world business challenges, driving high-value unmet clinical needs and equipping associates with the skills needed to collaborate effectively on early product development activities.

Allan joined Becton, Dickinson, and Company in December 2017 as part of the acquisition of C. R. Bard, Inc., where he was Vice President, Portfolio Management & Process Improvement since 2013. Prior to Bard, Allan served as Founder and Managing Principal of Information Asset Associates, LLC (IAA), an innovation and process improvement consulting firm, from 1999 until 2013. Before joining IAA, he was the Senior Director of Workflow Services at Fujitsu Consulting from 1995 through 1999. Mr. Spina has been involved with AIIM International, a non-profit industry association related to information and process excellence, holding positions of New Jersey Chapter President, Vice President & Programs Chair as well as Treasurer from 1988 through 2017. Allan has been actively involved in many charitable endeavors including the New Jersey Health Foundation, performing Grant reviews and prioritization, the Independent College Fund of NJ (ICFNJ), as a Grant recipient poster judge at the annual Undergraduate Symposium, and a member of the Executive Board of Directors of the Junior Essex Troop's Garden State Horse Show, which had been the premier junior horse show in New Jersey for over 3 decades.

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Judges Roster

Darryl Aucoin, Ph.D.
Assistant Professor
Department of Natural and Physical Sciences
Caldwell University

Joseph Badillo, Ph.D.
Assistant Professor
Department of Chemistry and Biochemistry
Seton Hall University

Lauren Bergey, Ph.D.
Associate Professor,
Director of the Honors Program
Science Department
Centenary University

Agnes Berki, Ph.D.
Assistant Professor
Department of Natural and Physical Sciences
Caldwell University

Dustin Branting
Sales Manager – Automation Solutions
Siemens Industry, Inc.

Alfredo Castro, Ph.D.
Associate Professor
Chemistry and Physical Sciences
Felician University

Nichola Charles
Senior Program Manager
Innovation & New Product Development
BD

A leader is one who knows the way, goes the way, and shows the way.
John C. Maxwell

Lillian Chu Zawislak
Modeling Lead
Power Finance – Quantitative Analysis
PSEG

Jessica Cottrell, Ph.D.
Assistant Professor
Department of Biological Sciences
Seton Hall University

JoAnn Cummings, Ph.D.
Assistant Professor of Nursing
Georgian Court University

John Cusmano
Student Mentor, RISE
Drew University

Amanda Del Bene
Managing Director
Public Finance Investment Banking
Raymond James & Associates, Inc.

Monica Dema
Founder and President
M Dema, Inc.

Dustin DeVries
Global Talent Acquisition Lead
Zoetis Inc.

Kimberly Griswold, Ph.D.
Subject Matter Expert, Lead Technical Engineer
Project Office
ARDEC Picatinny Arsenal

Erik Hill, Ph.D.
Faculty Instructor
Department of Biological Sciences
Seton Hall University

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Judges Roster

We must find time to stop
and thank the people who
make a difference
in our lives.
John F. Kennedy

Edwin Howard
Senior Software Engineer (Retired)
Honeywell Corp.

Nuran Kumbaraci, Ph.D.
Associate Professor
Department of Chemistry and Chemical Biology
Stevens Institute of Technology

Dimitri Lavlinski
AP Chemistry, Science Faculty
High Tech High School

Krassi Lazarova, Ph.D.
Associate Professor of Physics
Science Department
Centenary University

Jessica Letizia
Global Talent Program Analyst
Zoetis Global Talent, DE&I COE
Zoetis

Sebastian Luna
Associate Director
Innovation & New Product Development
BD

Gina Moran
Director of Development
Morris Arts

John Nietzel
Senior Vice President
Investors Bank

Eileen L. Poiani
Special Assistant to the President
Saint Peter's University

Samantha Schlachter, Ph.D.
Assistant Professor
Department of Biology
Saint Elizabeth University

Allan Spina
Vice President R&D
Portfolio Management & Innovation
BD

Marjorie Squires, Ph.D.
Associate Professor
Department of Natural and Physical Sciences
Caldwell University

Benedict Torcivia, III
Finance & Administration Manager
Torcon, Inc.

Sarah West
Clinical Trial Associate
Novartis Institute for Biomedical Research

J.B. Wilson
President (Retired)
Independent Colleges and Universities
For New Jersey

Kelly Winder
Human Resources Director
Zoetis

thank you

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Symposium Participants

Project

1 **Seethalakshmi Anantharamakrishnan, '23** – Monmouth University
Investigating Ammonium Dependence of a Selected Hammerhead Ribozyme by Kinetics

2 **Anuj Aryal, '21,** - Caldwell University
Synthesis of 1-(Benzotriazolyl)ethyl Ferrocone

3 **Lois Ayim, '23; Ana Gonzalez Martin, '22** – Caldwell University
The Antibacterial Effects of *Zingiber officinale* and *Hibiscus rosa-sinensis* against *Staphylococcus aureus* and *Escherichia coli* to Treat/Prevent Cellulitis

4 **Lauren Baines, '22** – Monmouth University
Exercise Intensity Compared to Carbohydrate Intake and Insulin Sensitivity in Type 1 Diabetic Athletes

5 **Fernanda Correia Garcia Ordas, '22** – Caldwell University
The Effects of Trimethoprim and Caffeine on Staphylococcus aureus

6 **Hazel Cruz Henriquez,** '23 - Fairleigh Dickinson University
Developing iPhone Apps with Swift Programming Language

7 **Michael DelSignore, '21** - Fairleigh Dickinson University
Data Science and Machine Learning for Real-World Applications

8 **Caitlin Gartley, '21; Ruby Pasupuleti, '21; Selam Woldegerima, '21 -** Seton Hall University
Characterization of Insulin Mimetic Effects on Gene Expression during the ATDC5 Cell Line

9 **Flobater Gawargi, '21** – Monmouth University
Anti-Covid MicroRNA Therapy To Block The Expression Of The Spike, Envelop, Membrane And Nucleocapsid Genes of SARS-Cov-2

10 **Lana Hannineh, '23** – Seton Hall University
Zinc Perfluorophthalocyanine: The Production of Reactive Oxygen Species to Induce Regulation of Microbial Growth

11 **Samantha Johnson, '22** – Centenary University
Determination of Microplastics Concentrations in the Sediment of the Musconetcong River

12 **Sudeep Khadka, '21** – Caldwell University
Role of IP3R protein in Fertilization: Mediating Calcium Oscillation in Fertilized Oocyte

13 **Maha Khan, '21** – Seton Hall University
Finding Genomic Connections Between Bone Homeostasis and Inflammation

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Symposium Participants

Project

14 **Shivani Mody, '21** – Drew University
The Search for a Reliable Behavioral Assay to Model Parkinson's Disease in the Nematode *Caenorhabditis elegans*

15 **Alissa Mor, '22** – Centenary University
Spotted Lanternfly Microbiomes: An Initial Investigation into an Invasive Insect

16 **Nikolina Perrelli,'21** – Centenary University
Developing Our Understanding of the Influence of Environmental Factors and Microplastics on Seal Microbiomes

17 **Abigail Pierre, '22** – Seton Hall University
Photoacid Catalysis: Acetalization of Carbonyls

18 **Vanessa Raab, '21** - Drew University
Antibiotic resistance in *Kibdelosporangium sp.* -improving production of the medically important antibiotic, kibdelomycin

19 **Laura Sine, '22** – Monmouth University
Gene Therapy for Brain Tumors: Identification of New Therapeutic Targets Based on RNA structure

20 **Ahmad Smith,** '21 – Felician University
Supramolecular Complexes as Catalysts

21 **Benjamin Strickland, '21** – Drew University
In Silico Discovery of Potent Lead Compounds Inhibiting FtsZ for the Treatment of Multidrug-Resistant *Staphylococcus aureus*

22 **Sarah Sturges, '21** - Centenary University
The effects of longer exhalation breathing techniques on Heart Rate Variability

23 **Subah Soni, '21** - Monmouth University
The Effects of Kumquat Oil on the Proliferation and Viability of Cancer Cell Lines and Normal Human Fibroblast Cells

24 **Angelica Villatoro, '20** - Saint Elizabeth University
Harmful Algal Blooms and Cytotoxin effects on Microbial Diversity in Northern NJ Lakes and Ponds

25 **Stephanie Wang, '22** - Drew University
Modeling Autism Spectrum Disorder in *Caenorhabditis elegans*

26 **Kristi Wenger, '22** - Centenary University
Canine Cognition of Human Social Interactions

PROJECT 1

Seethalakshmi Anantharamakrishnan

Monmouth University, Class of 2023
Major: Biology with a Concentration in Molecular Cell Physiology

Faculty Advisor: Jonathan Ouellet, Ph.D., Associate Professor
Department of Chemistry & Physics

Investigating Ammonium Dependence of a Selected Hammerhead Ribozyme by Kinetics

Ribozymes are RNA enzymes capable of catalyzing biochemical reactions. They can serve different functions, one of which being as a biosensor. This project focuses on a selected hammerhead ribozyme, the 2 Hydroxyglutarate aptazyme which is derived from SELEX. The secondary structure of the hammerhead ribozyme consists of three stems and a conserved catalytic core. This enzyme-substrate complex can exist as both a cis and trans structure. Under the presence of sub millimolar concentration of divalent ions such as Magnesium or high concentrations of monovalent cations such as Ammonium the hammerhead ribozyme is known to undergo catalysis. Preliminary results with the 2-HG aptazyme seems to indicate that a lower concentration of Ammonium is capable of causing cleavage. The objective of this project is to investigate if cleavage occurs at a low concentration of Ammonium with the 2-HG aptazyme, and to make comparisons with other control hammerhead ribozymes. As of now, the project is still in its intermediate stage, and RNA quantification as well as Kinetics using Ammonia would have to be performed to validate this theory.

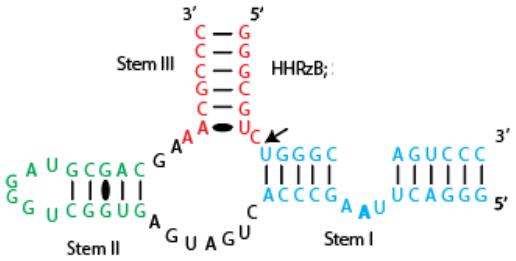

Figure 1: Secondary Structure of RzB with Sb adapted from Saksmerprome V et al. RNA. 2004 Dec; 10(12):1916-24.

Independent Colleges Undergraduate Research Award Recipient 2020
Additional Funding: Department of Chemistry & Physics

Anuj Aryal
Caldwell University Class of 2021
Major: Chemistry

Faculty Advisor: Marjorie Squires, Ph.D., Assistant Professor
School of Natural Science

SYNTHESIS OF 1(BENZOTRIAZOLYL)ETHYL FERROCENE: A POTENTIAL CANCER CELL GROWTH INHIBITOR

Ferrocene (Fe(C 5 H 5) 2) is an interesting organometallic compound because it chemically can be easily modified. This versatility allows Ferrocene complexes to serve as catalysts, fuel additives, and as beneficial pharmaceuticals. Ferrocene salt and mine/Amide derivatives are suggested to inhibit cancer cell growth. In this project, 1(benzotriazolyl)ethyl ferrocene was synthesized using a three steps synthesis, purified via chromatography and recrystallization, and analyzed spectroscopically. The toxicity of this compound was tested using E. coli as a model organism in the Kirby-Bauer assay. The results showed a mild and dose dependent toxicity which was evident from the diameters of the kill zones. 60.3 g/L of 1(benzotriazolyl)ethyl ferrocene in ethanol resulted in kill zones of 6mm, 12mm, and 15mm when 1μL, 5μL, and 10μL of the samples were used respectively. The toxic activity of 1(benzotriazolyl)ethyl ferrocene against our model organism suggests its potential efficacy against cancer cells. Its mutagenic properties were also tested using the AMES test and the results will be discussed. Further research will focus on evaluating the effect of 1(benzotriazolyl)ethyl ferrocene on cancer cells.

Acknowledgments: ICFNJ, Caldwell University, Dr. Marjorie Squires

Lois Ayim
Caldwell University, Class of 2023
Major: Biology
Faculty Advisor: Marjorie Squires, Ph.D., Associate Prof.
School of Natural Sciences

Ana Gonzalez Martin
Caldwell University, Class of 2022
Major: Biology
Darryl Aucoin, Ph.D., Assistant Prof.
School of Natural Sciences

The Antibacterial Effects of *Zingiber officinale* and *Hibiscus rosa-sinensis* against *Staphylococcus aureus* and *Escherichia coli* to Treat/Prevent Cellulitis

Cellulitis, a condition caused by a bacterial infection of the deep layers of skin and its underlying tissues, affects over 14.5 million individuals per year in the United States. The most frequent cause of cellulitis is *Staphylococcus aureus* infection, and, in some cases, it is *Escherichia coli*, and therefore treated with prescription antibiotics. One of every three people who had cellulitis will have it again once they stop taking the antibiotics. Moreover, in many countries antibiotics are too expensive for the majority of the population. Several flowering plants have been indicated to possess antibacterial properties. *Hibiscus rosa-sinensis* and ginger, *Zingiber officinale*, are common plants that can possibly be used as alternatives to antibiotics. The aim of this study was to investigate the antibacterial activity of ginger and hibiscus flower water and ethanol extracts. To determine the antimicrobial effects of hibiscus and ginger against *S. aureus* and *E. coli* the Kirby Bauer test was employed. The experiment was repeated 8 times. We obtained dose dependent inhibition zones with the ethanol extracts against both organisms. Against *S. aureus*, the following ginger concentrations: 50% and 100%, produced kill zones with 10 mm and 11.3 mm, respectively. In the case of hibiscus, the concentrations 50% and 100% produced zones of 15.6 mm and 11.6 mm, respectively. Against *E. coli*, 50% and 100% ginger concentrations resulted in zones of 10 mm and 18 mm, respectively. 50% and 100% hibiscus extracts produced 13 mm and 14.3 mm zones, respectively. The only water extract that showed inhibition was the hibiscus with 13 mm against *E. coli*. Our findings demonstrate that both ginger and hibiscus possess antibacterial effects against *E. coli* and *S. aureus*. These herbs can present an alternative treatment for cellulitis, recurring cellulitis and can act as preventive treatments against cellulitis caused by *E. coli* or *S. aureus.*

Lauren Baines

Monmouth University, Class of 2022
Major: Nursing BSN

Faculty Advisor: Patricia Sciscione, Ph.D., RN, CSN, Specialist Professor
Department of Nursing

Exercise Intensity Compared to Carbohydrate Intake and Insulin Sensitivity in Type 1 Diabetic Athletes

In the nursing profession, the management of diabetes mellitus has become an integral part of patient care. The disease process of type 1 diabetes is an autoimmune destruction of pancreatic beta cells, which results in a complete lack of insulin production in the body. Synthetic insulin is used to regulate blood glucose levels back to homeostasis, but over time the prolonged use of synthetic insulin can become less effective in type 1 diabetics causing insulin resistance. In this scenario the body then requires higher doses of insulin when covering carbohydrates or correcting high blood glucose concentrations. Prior research has been done to determine factors that increase insulin sensitivity in type 1 diabetics, but there are very few studies that investigate how to increase insulin sensitivity in type 1 diabetic athletes. An athlete with type 1 diabetes that is already physically active and eats a healthy diet can still present with insulin resistance and needs advanced methods to increase insulin sensitivity. This research proposal is experimental and aims to investigate the effects strict diet and exercise regiments could have on insulin sensitivity in four different experimental groups of type 1 diabetic athletes.

Independent Colleges Scholarship Award: *Novo Nordisk Scholarship Award, 2020-21*

PROJECT 5

Fernanda Correia Garcia Ordas
Caldwell University, Class of 2022
Major: Biology

Faculty Advisor: Darryl Aucoin, Ph.D., Assistant Professor
School of Physical and Natural Sciences

The Effects of Trimethoprim and Caffeine on Staphylococcus aureus

Advances brought about by the antibiotic revolution of the mid- twentieth century are now threatened by bacteria that are becoming increasingly resistant to these drugs. This resistance has the potential to affect people at any stage of life, as well as the healthcare, veterinary, and agriculture industries, making it one of the world's most urgent public health problems. If antibiotics lose their effectiveness, then we lose the ability to treat infections and control public health threats. Many medical procedures now considered routine, are dependent on antibiotics and their ability to fight infections. These include joint replacements, organ transplants, cancer therapy, and treatment of chronic diseases like diabetes, asthma, and rheumatoid arthritis. Each year in the U.S., at least 2.8 million people are infected with antibiotic-resistant bacteria or fungi, and more than 35,000 people die as a result of these infections (CDC, 2020). Further understanding of the causes of bacterial resistance is needed. Antibiotics must be tested on bacteria to see if and how the mutations occur. This research project investigated the effect of simultaneous use of caffeine and trimethoprim at the usually consumed concentrations at different amounts on Staphylococcus aureus. Disk diffusion tests were done to test the bacteria's susceptibility to the antibiotic and caffeine separately as well as the combination of both. Computer analysis using Discovery Biovia computational was also used to determine potential mutations. Results will be discussed in presentation.

PROJECT 6

Hazel Cruz Henriquez

Fairleigh Dickinson University, Class of 2023
Major: Computer Science
Minor: Mathematics

Faculty Advisor: Neelu Sinha, Ph.D. Professor
Mathematics and Computer Science

Developing iPhone Apps with Swift Programming Language

My research focused on developing an iOS application using the Swift programming language on Xcode. I discovered more about the Xcode development environment and extensions that can be applied to it. I explored the usage of Cocoa Pods, a dependency manager for Swift Cocoa projects, and Firebase, a Google platform that allows you to implement rapid prototyping of mobile applications. These tools allowed me to explore and utilize various features to implement in an application and configure them for my own program. I created a messaging app that allows users to message one another. I focused on the security of each user's data being distinctly their connection. I plan to develop later more features that include visual machine learning capabilities that are informative and keep improving the app. Due to the difficulties in obtaining the funds to procure the necessary device to test my ML application idea, I changed my initial machine learning app to the messaging app. I concentrated more on the user interface and databases that hold the information of the user. I handled the user interface programmatically because it allowed me to control my design components and structure. Control of one's app appearance provides an easier way of adding elements to your app to facilitate things later on. Focusing on the front and the back of an application has given me an insight into all the little nuances that go into the production of an app. The knowledge about both frontend and backend developments has enabled me to make the app through my vision. I learn a lot about using my development skills from class and my ability to adapt into this project.

Michael DelSignore

Fairleigh Dickinson University, Class of 2021
Major: Computer Science (Data Mining Concentration)
Minor: Mathematics

Faculty Advisor: Neelu Sinha, Ph.D., Professor
Mathematics and Computer Science

Data Science and Machine Learning for Real-World Applications

Data Science uses a unified approach to extract knowledge and insights from data with scientific methods, processes, and algorithms. Machine Learning, a data-driven systems development paradigm, refers to a collection of techniques used by data scientists that allow computers to learn from data. These techniques help us make informed decisions and predictions in an efficient and reliable way. Machine Learning is especially suited for solving extremely labor-intensive problems, and one such problem is addressed in this project. Following the 2020 presidential election, tensions are high throughout the US sociopolitical climate. In times of such social unrest and political divide, it seems that the Republican vs Democrat dichotomy is more rigid than ever. This project aims to take an objective approach to understanding the factors that determine which political party people will align themselves with. The research, conducted in September, right before the 2020 presidential election, involved a survey that inquired about demographic information (age, gender, ethnicity, etc.), personality-oriented information (music taste, movie preference, favorite food, etc.), and who they planned on voting for in the election. The data was analyzed, taking note of significant trends and correlations, and the logistic progression prediction model was applied to draw further insights into how the data correlated with the chosen candidate. The findings of this model showed Biden to be a clear favorite amongst my survey dataset. Also, the genre of Sci-Fi/Fantasy, those who said yes to reading books, and those who favored Chinese food were all found to be strong predictors.

Caitlin Gartley[1]
Seton Hall University, Class of 2021
Major: Biology

Ruby Pasupuleti[2]
Seton Hall University, Class of 2021
Major: Biology

Selam Woldegerima
Seton Hall University, Class of 2021
Major: Physics

Faculty Advisor: Jessica A. Cottrell, Ph.D., Assistant Professor
Department of Biological Sciences

Characterization of Insulin Mimetic Effects on Gene Expression during Chondrogenesis in the ATDC5 Cell Line

Previous data has shown that insulin mimetic such as vanadium compounds can enhance bone healing like insulin without the risk of glycemic changes. Our study used ATDC5 chondrocytes derived from mouse cells to analyze the potential regenerative effects of vanadium compound treatment during chondrogenesis differentiation, a key process in long bone healing. ATDC5 cells were treated with the DMEM/F12 media only (untreated, negative control), 10uM insulin (positive control), and vanadium compounds: vanadyl acetylacetonate (VAC) and vanadium (II) sulfate (VSO4) at concentrations of both 10uM and 100uM. Chondrocyte lysates were harvested at days 1, 2, 4, 7, 10, 14, 17, 21, and 28 for all treatment groups. After RNA isolation, quantification of RNA was completed using a Biodrop, followed by reverse transcription for each sample. Successful conversion of RNA to cDNA was verified using polymerase chain reaction (PCR) and DNA gel electrophoresis for the housekeeping gene, glyceraldehyde 3-phosphate dehydrogenase (GAPDH). Finally, gene expression of key markers of chondrogenesis (i.e. Collagen 2a1, *col2a1*) was completed using quantitative real time polymerase chain reaction (qPCR) for each treatment group overtime. qPCR analysis demonstrated that *col2a1* gene expression was more abundant on Days 4, 7, and 10 when compared to insulin or untreated samples. Our data also demonstrated that *col2a1* expression increased over time. Together our data supports the hypothesis that vanadium compounds enhance chondrogenic differentiation which in turn can improve bone healing. Our study also demonstrates that vanadium compounds can serve as an alternative to insulin in modulating chondrogenesis and may be more impactful during the early stages of differentiation. In future experiments, we will continue to characterize the gene expression response to these vanadium compounds in our model and hope to determine if this enhancement occurs through the same molecular pathway as insulin.

Independent Colleges Undergraduate Research Award Recipient 2020
Independent Colleges Scholarship Award: *Novo Nordisk 2019-20*[1]*; Novo Nordisk 2019-20*[2]

Flobater I. Gawargi

Monmouth University, Class of 2021
Major: Biology with a concentration in molecular cell physiology
Minor: Chemistry

Faculty Advisor: Martin Hicks, Ph.D., Assistant Professor
Department of Biology

TOP PERFORMER 2021

Anti-Covid MicroRNA Therapy To Block The Expression Of The Spike, Envelop, Membrane And Nucleocapsid Genes of SARS-Cov-2

Emerging viral diseases have increased in recent decades. In December 2019, an epidemic with low respiratory infections emerged in Wuhan, China. The disease, Covid-19 was found to be caused by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of March 24, 2021, WHO has confirmed 124,477,094 global cases and 2,738,905 deaths worldwide, 544,724 in the USA. Fortunately, a vaccine has recently been accepted to be given to people, but there are no therapeutics for infected individuals yet. From advances in biotechnology, the genome and structure of SARS-CoV-2 is known. Three proteins are anchored in the viral envelope, Spike (S), Envelope (E), and Membrane (M), which is linked to the Nucleocapsid (N) protein connecting to the viral RNA genome. Our lab is developing an innovative therapy that delivers multiple therapeutic microRNAs to simultaneously block the expression of these distinct viral proteins. In the current work, we propose an anti-Covid microRNA therapy designed to degrade each of the mRNA transcripts of these critical genes, stopping viral assembly, and reducing the severity of infection. The design of the anti-Covid microRNAs 1) mimics microRNA cluster 17-92 structural stability, 2) forms guide-RNA substrates for the RNA induced silencing complex, and 3) are complementary to specific regions of the SARS-CoV-2 RNA genome without off-targets effects in the human genome. Twenty-one microRNA sequences were designed to target the S gene, six for N, two for M, and one for E. In the first phase, six microRNA sequences are being cloned into microRNA-17-92 therapy vector, while the S gene is being cloned into our mammalian expression vector PBI-CMV3. The S gene will be expressed in our tissue culture model to measure the efficacy of the anti-Covid microRNA therapy to down-regulate S-protein expression. Subsequently, we will be testing the efficacy of each anti-Covid microRNA to knockdown the expression of the viral proteins, E, M and N. The Anti-Covid MicroRNA construct secondary structure will be analyzed by applying SHAPE-MAP to compare it to the original Mir-17-92a.

Independent Colleges Undergraduate Research Award Recipient 2020
Independent Colleges Scholarship Award: *Novartis Science Scholarship 2020-21*
Additional Funding: School of Science, Bristol Myers Squibb and the MU Department of Biology

Independent Colleges and Universities for New Jersey
PROJECT 10
Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

Lana Hannineh
Seton Hall University, Class of 2023
Major: Biology BS
Minor: Chemistry

Faculty Advisor: Sergiu Gorun, Ph.D., Professor
Department of Chemistry and Biochemistry

Zinc Perfluorophthalocyanine: The Production of Reactive Oxygen Species to Induce Regulation of Microbial Growth.

The purpose of this project is to reduce the growth of, or even eliminate families of micro- and microorganisms, such as bacteria and algae that are produced due to fouling, common in marine environments modeled by a fish-tank. A -nonplanar perhalogenated metallophthalocyanine- zinc perfluorophthalocyanine ($F_{64}PcZn$) was used as the main component of a photocatalytic coating. To synthesize the fluorinated phthalocyanine a microwave reactor was used. Zinc acetate and perfluoro-(4,5-di-isopropyl)phthalonitrile in a 4:1 ratio were reacted, resulting in $F_{64}PcZn$. This fluorinated phthalocyanine is photoactive and has the capacity to produce singlet oxygen, a family of reactive oxygen species (ROS), when irradiated with visible light. The production of singlet oxygen has been tested on organic dyes and great results were produced, the current phase of the project is to investigate this coated surface on living organism. These reactive oxygen species are able to penetrate the cell structure of microorganisms, causing enough cellular damage to ultimately lead to a regulated microbial growth. Thus, to evaluate the effects of continuous exposure of free radicals on microbial growth, $F_{64}PcZn$ will be placed in a biologically active aquarium tank. Two tanks will be used, each containing five neon tetra fishes. The photoactive coating, namely the $F_{64}PcZn$ embedded in a polymer will be applied to glass slides that will be immersed in the tank. There will be three types of slides used: control slides with nothing coated on them, slides coated with a siloxane- epoxy resin and amino silane and slides coated with a photoactive, modified polymer. All three types of slides will be placed on a wire and hung inside both tanks. One tank will be placed in a cardboard box completely covered and blocked from outside light and illuminated for only three hours a day using red LED lights wrapped around the tank. While the control tank will be placed next to a window and exposed to natural light. Both tanks will be kept at approximately the same temperature and the fish will be fed the same amount of food at the same time. The growth of algae will be monitored function of time, while the fish will be examined to document the anticipated lack of toxicity of the photoactive polymers. Over time the interior of both fish tanks started showing signs of algae growth. There was less algae growth on the slides with the $F_{64}PcZn$ then there was on the control and the slides coated with a siloxane-epoxy resin and amino silane. Also there was less algae on the slides that were in the fish tank by the window. Since there is constant sunlight the $F_{64}PcZn$ gets excited with releases the reactive oxygen species causing oxidative stress on the algae which limits its growth. In the fish tank that is constantly covered except and only small amounts of light there is no ROS released; therefore the algae growth was not limited.

Independent Colleges Undergraduate Research Award Recipient 2020
Independent Colleges Scholarship Award: *PSEG Advancing STEM Scholarship 2020-21*
Acknowledgments: Department of Chemistry and Biochemistry, Dr. Gorun and Dr. Gorun's Research Group. Prabh Jassal

Independent Colleges and Universities for New Jersey
PROJECT 11
Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

Samantha Johnson
Centenary University, Class of 2021
Major: Environmental Science

Faculty Advisor: **Julie A. LaBar, Ph.D.,** Assistant Professor of Environmental Science
Director Center for Sustainability
Science Department

FIRST RUNNER UP 2021

Determination of Microplastics Concentrations in the Sediment of the Musconetcong River

Microplastic pollution in waterways is an emerging environmental issue. Microplastics pose a threat to the food chain of marine and aquatic ecosystems because of plastic's indigestible nature and potential to release toxic compounds. The Musconetcong River located in northwestern New Jersey undergoes many tests such as macroinvertebrate and water quality sampling and analysis, but lacks research and data in microplastics prevalence. This river is located in a rural section of New Jersey and is a designated Wild and Scenic River. However, this river is not free from human impacts, as it flows through many towns and is utilized for fishing and recreation. In order to identify and track the prevalence of microplastics in the Musconetcong River over time, a preliminary study and establishment of a standard operating procedure is necessary. Samples of sediment were collected along transects at two sites on the Musconetcong River. Sediment samples were processed using a series of density separations and wet peroxide oxidation as outlined by NOAA. Through microscopic analysis, it was determined that the dominant plastic type was fibers. Microplastics are everywhere, but the discovery of microplastics in a seemingly healthy river is cause for concern. With the establishment of preliminary data on microplastics in the sediment of the Musconetcong River, more studies can be conducted across more locations to gain a better scope of the issue. Future studies can expand on sediment concentrations, while also investigating the presence of microplastics in the riverbank, water column, and macroinvertebrates.

Independent Colleges Undergraduate Research Award Recipient 2020

Acknowledgments: I would like to thank Dr. Julie LaBar for advising my research and supporting me through the entirety of my project. Thank you so much for being so motivated to help me succeed by spending many hours assisting me in planning, sampling, and analysis. I am so grateful for all of the expertise and guidance you provided me with that made participating in this research both educational and enjoyable.

I would like to extend my thanks to Dr. Lauren Bergey for recommending me to participate in this research project. Thank you so much for writing a recommendation and continuing to support my academic journey.

I also would like to thank Nancy Lawler and the Musconetcong Watershed Association for providing me with sampling locations to complete this research. Thank you so much for allowing me to sample in the Musconetcong River and providing me with suitable locations for sample collection.

Independent Colleges and Universities for New Jersey
PROJECT 12
Undergraduate Research Symposium
ADVANCING RESEARCH AND STEM FIELD ENGAGEMENT

Sudeep Khadka
Caldwell University, Class of 2021
Major: Biology
Minor: Chemistry

Faculty: Darryl Aucoin, Ph.D., Assistant Professor
Advisor: School of Natural Sciences

Role of IP_3R protein in Fertilization: Mediating Calcium Oscillation in Fertilized Oocyte

Fertilization involves fusion of male and female gamete to form a zygote that initiates the development of a new organism during sexual reproduction. While the fusion of a single male gamete with a female gamete is expected in a fertilization, many cases of polyspermy, where two or more male gametes fuse with a female gamete, have also been observed. Polyspermy disrupts formation of the cleavage groove in zygote which leads to its death and eventual miscarriage. Fertilized female gamete prevents polyspermy by two known pathways: fast block and slow block. Fast block pathway, facilitated by Na^+ ions, is initiated immediately after the contact of male and female gamete and is short-lived. Meanwhile, slow block pathway, facilitated by Ca^{++} ions, is initiated after fast block pathway and sustains for a longer period. We proposed a computational study of the binding affinity of a calcium ion membrane protein, IP_3R, isolated form *Rattus norvegicus*, and inositol-1,4,5-triphosphate (IP_3), an agonist to IP_3R protein using in-silico methods to lengthen short block pathway which will reduce the chances of polyspermy. The binding affinity of I_3P with IP_3R was studied based on structural docking scores and relative energy of the ligand-protein binding system. Upon molecular docking of IP_3R crystal structure with IP_3, amino acid residues: SER490, LEU 495, PHE499, VAL498, SER500, LYS501, PRO502, and ARG504 were observed to be involved in the active binding site. Every amino acid residue except ARG504 showed favorable interactions defined by H-bonds or Van der Walls interaction. ARG504 showed an unfavorable donor-donor bond with the phosphate group of I_3P. Upon mutation of ARG504 to LYS, a favorable H-bond was observed and upon molecular docking, docking score increased along with the increment of relative energy. Upon addition of methyl alcohol to position 3C of IP_3, more favorable H-bonds were observed with increased docking scores. The results suggest that mutation of ARG504 with LYS and addition of methyl alcohol on 3C of IP_3 increases the binding affinity of IP_3 and IP_3R for longer period and facilitates slow block pathway, reducing the chances of polyspermy. Given the role of calcium oscillation during fertilization, the study of IP3R, calcium ion channel protein, will help us in better understanding of fertilization in mammals and potential fertility treatments of polyspermy.

Independent Colleges Undergraduate Research Award Recipient 2020
Independent Colleges Scholarship Award: *PSEG advancing STEM 2020-21*
Additional Funding: ICFNJ Pfizer PURE Grant
Acknowledgments: Dr. Darryl Aucoin, Dr. Marjorie Squires, Dr. Agnes Berki

Maha Khan
Seton Hall University, Class of 2021
Major: Biology
Minor: Asian Studies

Faculty Advisor: Jessica Cottrell, Ph.D., Assistant Professor
Department of Biological Sciences

Finding Genomic Connections Between Bone Homeostasis and Inflammation

The purpose of this study is to identify novel molecular connections that link bone homeostasis and inflammation. In this study, we identified genes and proteins of interest that are involved in inflammation and bone homeostasis by using Qiagen's Ingenuity Pathway Analysis (IPA) genomic software. The IPA software is a cutting-edge genomics tool that can identify important targets (genes or proteins), interconnect their importance to both bone homeostasis and inflammation, and predict their likely effects in organisms. IPA analysis was completed by inputting terms such as bone homeostasis, osteitis, and potential gene names into IPA's search tool. These were then inputted into IPA's Pathway Designer tool and connected using the Build and Connect tools. The Grow tool was used to find more genes relevant to both conditions. The list of genes was reduced by filtering out items that did not yield connections, which provided five genes to focus on, including genes of the JAK family, BMP2, and TNSF11. Our IPA results demonstrated that these genes could significantly affect bone homeostasis under chronically inflamed conditions, such as diabetes. In upcoming experiments, we plan to measure how high insulin conditions may change bone homeostasis at the molecular and physiological level.

Independent Colleges Scholarship Award: *Johnson & Johnson Pre-Professional Healthcare Scholarship 2020-21*

Acknowledgments: Thank you to Dr. Marvin Bayne, RISE, Drew University, and E. Elegans Stock Center at the University of Minnesota

Shivani Mody
Drew University, Class of 2021
Major: Neuroscience
Minor: Chemistry

Faculty Advisor: Marvin L. Bayne, Ph.D., RISE Faculty Mentor
Research Institute for Scientists Emeriti (RISE)

HONORABLE MENTION 2021

The Search for a Reliable Behavioral Assay to Model Parkinson's Disease in the Nematode *Caenorhabditis elegans*

Parkinson's Disease is a nervous system disease associated with abnormal damage to dopamine neurons that play a role in reward and movement, mediating the substantia nigra region of the basal ganglia and the ventral tegmental area, with projections to the striatum (caudate and putamen). This disorder is the second most common neurodegenerative disorder known to affect individuals, after Alzheimer's disease, with an increased predisposition combining both environment and genetics. Apart from long-term pesticide and toxin exposure, mutations in LRRK2 and α-synuclein proteins are shown to greatly influence the onset of Parkinson's. Animal models have been vastly used for the study of Parkinson's disease including rodents, non-primates and the nematode worms, *Caenorhabditis elegans.* My research involves studying Parkinson's behaviors in *Caenorhabditis elegans* mutants because they are good models with a small dopamine system, which is relevant to the mechanism of Parkinson's. In my study, I experimented and modified multiple behavioral assays, including the swim-to-crawl assay, the movement-over-alternate-terrain (MOAT) assay, the ethanol avoidance assay, and the swimming-induced-paralysis (SWIP) assay to track and model behaviors of *C. elegans* mutants. I hypothesized that the *C. elegans* LRRK2 worms display a loss of dopamine neurons over time, compared to the wild-type worms and this hypothesis was applied to the ethanol assay, as previously established in literature. The MOAT and SWIP assays gave inconclusive results and were not well-suited as an assay to model Parkinson's disease. In the future, we plan to focus on testing older age LRRK2 worms in the ethanol avoidance assay and reproducing the literature results for the basal-slowing response assay, as these are good models for studying Parkinson's. Potential treatments for Parkinson's have been focused on developing LRRK2 kinase inhibitors, that directly inhibit LRRK2 kinase and lead to a decreased loss of dopamine neurons, increasing neuroprotection. We plan to use our *C. elegans* model of Parkinson's to identify new LRRK2 inhibitor compounds.

Independent Colleges Scholarship Award: *Novartis Science Scholarship 2020-21; BD Healthcare Scholarship 2019-20*

Alissa Mor

Centenary University, Class of 2022
Major: Biology

Faculty: Amanda Tokash-Peters, Ph.D., Assistant Professor of Biology
Advisor: Science Department

Spotted Lanternfly Microbiomes: An Initial Investigation into an Invasive Insect

Spotted lanternflies (Lycorma delicatula) are invasive insects currently spreading in the mid-Atlantic region of the United States. Spotted lanternflies can feed on crops and cause severe downstream damage to agricultural systems. There is currently not an efficient method for controlling them. However, there is hope for microbial methods of controlling the spread and impact of the spotted lanternfly. The first step in searching for potential microbial methods of control is to categorize the spotted lanternfly microbiome. This study sought to understand what bacteria were present in the microbiome using 16S V4 region of rRNA gene markers. The Earth Microbiome Protocol was followed and the gMAX DNA mini kit from IBI Scientific was used for extractions. The samples were sequenced on an Illumina sequencer using a 300 cycle kit and analyzed using QIIME2. The microbiome was successfully characterized in this study, and future studies will expand on these results by investigating the seasonality of the microbiome.

Nikolina Perrelli
Centenary University, Class of 2021
Major: Biology
Minor: Chemistry

Faculty: Amanda Tokash-Peters, Ph.D., Assistant Professor of Biology
Advisor: Department of Science

HONORABLE MENTION 2021

Developing Our Understanding of the Influence of Environmental Factors and Microplastics on Seal Microbiomes

Marine mammals play critical roles in oceanic ecosystems and serve as indicators of the health of the environment. Microbiome compositions of marine mammals are understudied but can provide insights into the relationship between mammalian and environmental health. In this study, the microbiome composition of gray seals (*Halichoerus grypus*) was characterized as part of a larger study investigating the relationship between microbiomes and microplastics present in the environment. Gray seals are an ideal marine mammal species to examine because of their haul-out and foraging behaviors. DNA was extracted from 70 fecal, environmental, and direct swab samples from gray seals located on Great Point Beach in Nantucket, Massachusetts, an area protected by U.S. Fish and Wildlife. Samples were processed using the Earth Microbiome protocol and a Zymo Research Quick-DNA/RNA MagBead kit for extraction. The V4 region of the 16S rRNA gene was amplified using Polymerase Chain Reaction (PCR) and sequenced using a 300-cycle kit on an Illumina sequencer. The sample sequences were analyzed using the QIIME2 microbiome bioinformatics platform. The microbiome was successfully characterized, and future studies will seek to analyze the levels of microplastics present in seal fecal samples and their surrounding environment to relate it to microbiome composition.

Abigail Pierre

Seton Hall University, Class of 2022
Major: Biochemistry

Faculty Advisor: Joseph Badillo, Ph.D., Assistant Professor
Department of Chemistry and Biochemistry

Photoacid-Catalyzed Acetalization of Carbonyls

Photoacid-catalyzed processes have recently emerged as a useful strategy for organic synthesis using visible light as a mild way to modulate chemical reactivity. Photoacids are bench stable weak acids in the absence of light irradiation and only upon irradiation become strongly acidic and thus catalytically active. This presentation will discuss the development of photoacid catalyzed acetalization reaction using either Schreiner's thiourea or 6-bromo-2-maphthol. The reaction scope, various light sources, and preliminary mechanistic studies will also be discussed.

Independent Colleges Scholarship Award: *Novartis Science Scholarship 2020-21*
Additional Funding: New Jersey Space Grant Consortium and NASA Fellowship
Acknowledgments: Dr. Joseph Badillo, Jason Saway

Vanessa Raab
Drew University, Class of 2021
Major: Biology
Minor: Public Health, Biochemistry & Molecular Biology

Faculty Advisor: John Perkins, Ph.D., RISE Fellow
Biology Department

Antibiotic resistance in *Kibdelosporangium sp.* -improving production of the medically important antibiotic, kibdelomycin.

Kibdelomycin is a natural product antibiotic produced by *Kibdelosporangium sp.* discovered at Merck Research Laboratories. The mechanism of action of kibdelomycin is inhibition of DNA gyrase and topoisomerase IV similar to marketed quinolone antibiotics. Kibdelomycin is of interest because it inhibits the growth of microorganisms resistant to quinolone antibiotics. Unfortunately, kibdelomycin has demonstrated poor activity in animal models due to poor pharmacokinetics. Our goals are to produce sufficient quantities of fermentative kibdelomycin and then modify the chemical structure to improve the pharmacokinetics. In order to increase the production of kibdelomycin, eighteen new strains of *Kibdelosporangium sp.* were obtained by selecting strains resistant to streptomycin and rifampin following chemical mutagenesis. These strains produced up to 3-fold more kibdelomycin. Increased natural product production via this method has been correlated to mutant ribosomal genes: *rpsL* and *rpoB* (Hu & Ochi 2001). The *rpoB and rpsL* genes of these mutants will be sequenced to determine if mutations within them are responsible for increased kibdelomycin production.

Laura Sine
Monmouth University, Class of 2022
Major: Chemistry with a concentration in Biochemistry
Minor: Biology and Physics

Faculty Advisor: Martin J. Hicks, Ph.D., Assistant Professor
Biology Department

SECOND RUNNER UP 2021

Gene Therapy for Brain Tumors: Identification of New Therapeutic Targets Based on RNA structure

Individuals diagnosed with glioblastoma multiforme (GBM) have a short life expectancy of 12-15 months. This project is to develop therapies for effective and continuous drug delivery to the brain, targeting cancer-driving genes. Tumor cell proliferation in GBM is often stimulated by epidermal growth factor receptor (EGFR) and is important for tumor cell survival. In our lab, we are developing RNA therapies to alter the splicing mechanism of EGFR to block its activation, thus stop tumor cell growth. Our approach uses an adeno-associated virus gene transfer vector encoding RNA therapeutics targeting critical elements of the EGFR pre-mRNA transcript. We have examined the 'pre-mRNA structurome' of EGFR to evaluate the accessibility of targetable regions. To advance our therapeutic strategy, we have analyzed the secondary structure of the EGFR transcript using selective 2' hydroxyl acylation and primer extension followed by mutational profiling (SHAPE-MaP). SHAPE-MaP reactivity profiles were generated revealing the structure of splicing and cryptic polyadenylation signal (PAS)elements within the targeted region. We identified enhancer binding motifs surrounding the 5' splice site and hidden elements of a cryptic polyadenylation signal. Based on these structural profiles, we generated RNA therapies interact with structural elements to unravel the hidden polyadenylation signal with the potential to activate expression of the short therapeutic isoform. My project is to clone these therapies into our therapeutic deliver platform and test their efficacy to downregulate EGFR gene expression in tissue culture cell. In the future, I will be generating a DNA template to transcribe the novel RNA therapeutics and working with collaborators I would like to evaluate their *in vitro* interaction with the target sequence of the EGFR pre-mRNA transcript.

Independent Colleges Undergraduate Research Participant
Additional Funding: *American Society for Biochemistry and Molecular Biology*

Ahmad Smith

Felician University, Class of 2021
Major: Biology

Faculty Advisor: Alfredo Castro, Ph.D., Associate Professor of Chemistry
Natural Sciences Department

Supramolecular Complexes as Catalysts

Although all three cyclodextrins showed a temporary and small increase in pressure, with beta and gamma showing more of an increase, it can be concluded that they did not act as catalysts when compared to catalase when mixed with hydrogen peroxide, see Figures 1 & 2 below.

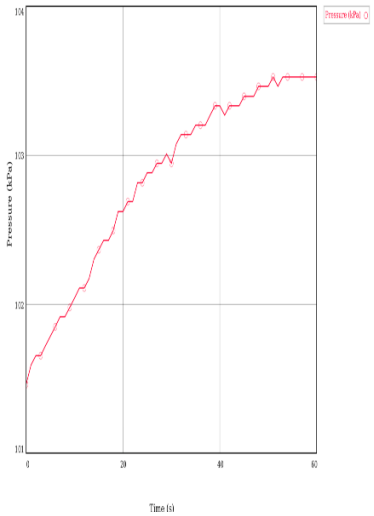

Figure 1-Catalase

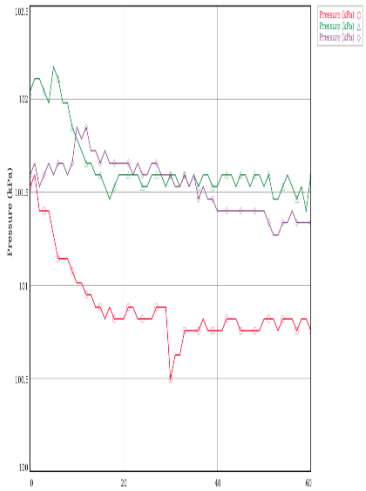

Figure 2-

Alpha Cyclodextrin-red

Beta Cyclodextrin-green

Gamma Cyclodextrin-purple

Independent Colleges Undergraduate Research Award Recipient 2020
Acknowledgments: ICFNJ and Felician University

Benjamin Strickland
Drew University, Class of 2021
Major: Biochemistry and Molecular Biology
Minor: Business

Faculty Advisor: Vincent Gullo, Ph.D., Director of RISE
Research Institute for Scientists Emeriti (RISE)

In Silico Discovery of Potent Lead Compounds Inhibiting FtsZ for the Treatment of Multidrug-Resistant *Staphylococcus aureus*

Pathogenic bacteria resistant to current first-line antibiotic treatments in the United States are responsible for two million infections a year, costing the United States healthcare system an extra $20 billion USD per year in associated medical costs. Of particular concern is methicillin-resistant *Staphylococcus aureus* (MRSA), which exhibits resistance towards almost all clinical β-lactams (*e.g.* penicillins, cephalosporins, and carbapenems) and commonly acquires additional resistance determinants, giving rise to multidrug-resistant MRSA subtypes (MDRSA) which can be especially challenging to treat. The bacterial cellular division protein Filamenting temperature-sensitive mutant Z (FtsZ) represents a novel and attractive target for combating such multidrug resistant infections, with efficacious preclinical allosteric FtsZ inhibitors of the benzamide family reported in literature. However, benzamide-resistant MRSA FtsZ isolates (G193. G196, N263) have hindered advancement of the compound class, with N263K-mutant FtsZ inducing steric occlusion to the benzamide pharmacophore and conferring resistance to all presently known members of the benzamide family. Accordingly, there is a need for continued development of novel FtsZ inhibitors which are unaffected by known FtsZ mutants. Lead-like candidate compounds targeting FtsZ were rapidly identified though an evolutionary virtual high throughput screening methodology, with *in silico* predictions revealing 10 promising candidate compounds. All proposed compounds exhibit favorable predicted absorption, distribution, metabolism, excretion, and toxicity properties suitable for a lead-like candidate and potencies surpassing that of the preclinical compound TXA707 against the clinically relevant *S. aureus* MRSA252 strain and that of the preclinical compound TXA6101 against the G196S FtsZ mutant; the most common mutant conferring resistance to TXA707. In addition, a subset of the proposed compounds exhibit strong predicted affinity for N263K mutant FtsZ.

Independent Colleges Scholarship Award: *Novartis Science Scholarship 2020-2021*
Acknowledgments: Dr. Vincent Gullo, Dr. John Perkins, BioSolveIT GmbH, Novartis

Sarah Sturges

Centenary University, Class of 2021
Major: Biology

Faculty Advisor: James J. Monks, Ph.D., Assistant Professor of Biology
Science Department

The effects of longer exhalation breathing techniques on Heart Rate Variability

Poor heart rate variability (HRV) has been correlated to heart disease, Post-Traumatic Stress Disorder, premature death from various health conditions, and other comorbidities. Decreased HRV is a symptom of dysautonomia, a functional imbalance of the autonomic nervous system, where the sympathetic nervous system is overstimulated and parasympathetic control is decreased. This dysregulation leads to the brain's inability to readily switch between sympathetic and parasympathetic dominance. This switching between the sympathetic and parasympathetic states is essential for a well-functioning body and nervous system. Bhastrika pranayama is a type of breathing exercise that emphasizes longer exhalation periods which has been observed to stimulate the parasympathetic nervous system through the Vagus nerve. A common hypothesis is that a longer exhalation phase of breathing and its subsequent removal of carbonic acid from the blood, alters blood pH and slows the sympathetic response. Sympathetic dominance is often denoted by acidic blood. There are currently preliminary studies which suggest that an alkaline blood pH has a positive impact on HRV. Thus, favorable heart rate variability is indicative of a well-adapted nervous system. As in most dynamic systems, the more complexity, the healthier the system. Specifically, the brain regulates the autonomic nervous system by either stimulating the sympathetic or parasympathetic systems. While there are no proven methods of increasing HRV, there are studies that show that longer exhalation periods decrease blood acidity, as well as decrease the likelihood of panic attacks, which is an exaggerated stress response triggered by the sympathetic nervous system. If Bhastrika pranayama proves to be effective at increasing HRV, this could be a safe and effective technique to improve overall health and increase the effectiveness of the nervous system.

Independent Colleges Scholarship Award: *Novartis Science Scholarship 2020-21; Celgene Sol. J. Barer Scholarship for Life Sciences 2019-20*

Subah Soni

Monmouth University, Class of 2021
Major: Biology conc. In Molecular Cell Physiology
Minor: **N/A**

Faculty Advisor: Dorothy Lobo, Ph.D., Chair of Biology and Associate Professor
Biology Department

The Effects of Kumquat Oil on the Proliferation and Viability of Cancer Cell Lines and Normal Human Fibroblast Cells

Kumquats are small citrus fruits produced by the *Fortunella japonica* tree. In addition to its aroma, kumquat essential oil may have anti-proliferative effects, however research on the effects of kumquat essential oil on human cell lines is limited. A variety of human cell lines (HT-1080 fibrosarcoma cells, HeLa cervical adenocarcinoma cells, and CUA-4 normal human fibroblasts) were treated with kumquat essential oil at different concentrations and the effects on cell proliferation were ascertained. Proliferation was quantified by direct cell counting utilizing trypan blue dye exclusion, and viability was also measured using an MTT assay. As the concentration of essential oil increased, proliferation decreased, with a concentration of 500 μg/ml kumquat essential oil significantly decreasing the proliferation of all three cell lines tested. High concentrations of kumquat oil (500 μg/ml) also significantly decreased MTT activity in all three cell lines. To determine if the decreased cell number was the result of apoptosis, PARP cleavage was detected through western blot analysis of fibrosarcoma cells treated with kumquat essential oil (500 μg/ml). Treated cells demonstrated significant PARP cleavage in comparison to untreated cells. The JNK mitogen-activated protein (MAP) kinase signaling pathway has been implicated in the response to a variety of cellular stresses. Compared to untreated cells, HT-1080 fibrosarcoma cells exposed to a concentration of 500 μg/ml of kumquat essential oil exhibited an increased presence of phosphorylated JNK, indicating activation of the MAP kinase signaling pathway in response to cellular stress.

Angelica Villatoro

Saint Elizabeth University, Class of 2020
Major: Biology
Minor: Chemistry

Faculty Advisor: Samantha Schlachter, Ph.D., Assistant Professor of Biology
Tara Cominski, Ph.D., Director of the Biology Program

Harmful Algal Blooms and Cytotoxin effects on Microbial Diversity in Northern NJ Lakes and Ponds

Harmful algal blooms occur when colonies of algae grow out of control and produce toxic or harmful effects on the ecosystem. While we know of environmental and physical factors that contribute to HABs, how these factors come together to create a bloom of algae is not well understood. HABs occur naturally but human activities that disturb ecosystems seem to play a role in their more frequent occurrence and intensity. Increased pollution, nutrient loading, food web alterations, water flow modifications and climate change all play a role. The aim of this research was to screen for the presence of HABs in local, smaller bodies of water; and to use comparative analyses to identify if the presence of toxin-producing algae, impacts the biodiversity of phytoplankton in these ecosystems. Since 2019, toxin producing strains have been routinely identified in larger lakes of New Jersey. Given this, we suspect that many of the smaller lakes/ ponds that share the same geographical area, and are subjected to similar environmental and physical conditions, may also contain these HABs. To identify the presence or absence of HABs in lakes and ponds that are local to our campus community, four bodies of water were selected for testing; Lake Hopatcong (Sussex-Morris Counties, NJ), White Meadow Lake (Morris County, NJ), The Great Divide Pond (Sussex County, NJ) and the pond on the campus of Saint Elizabeth University (Morris County, NJ). Visual observations and physical characteristics, including temperature and pH measurements, were conducted at each of the geographical sites. Amongst the four lakes surveyed there were no significant differences in temperature. However, there was considerable variation of pH measurements. Lake Hopatcong was recorded to have the lowest pH reading compared to the other lakes/ponds. In further support of the physical indicators of HABs, the presence of common cyanotoxin genes were only detected by PCR screening of samples from Lake Hopatcong; suggesting that the smaller bodies of water in the local area were unaffected by HABs. Coliform bacteria are frequently used as indicators of water quality; finding an increased presence of coliform bacteria within water samples is an indicator of pollution and of a decrease of other necessary nutrients for other organisms. Filtrating collected water samples and using a selective agar plate, we were able to screen and measure the concentration of total coliform bacteria colonies. The highest number of distinct bacterial colonies were again found in Lake Hopatcong, suggesting that HABs may disrupt the biodiversity in the ecosystem. However, the pond at Saint Elizabeth University also displayed a high degree of coliforms, suggesting that other environmental factors, such as pollution, also negatively impact biodiversity. The data collected in this project highlights the negative environmental impacts of HABs. Additionally, the data collected supports that HABs lead to less favorable conditions for the growth and diversity of other phytoplankton,and supports the overgrowth of certain bacteria.

Stephanie Wang
Drew University, Class of 2022
Major: Neuroscience

Faculty Advisor: Marvin Bayne, Ph.D., Rise Fellow
Biology Department

Modeling Autism Spectrum Disorder in *Caenorhabditis elegans*

Autism Spectrum Disorder (ASD) is disorder in which individuals experience difficulties relating to social skills, communication, and repetitive behaviors. Prior research has shown that in a small subset of patients, mutations in pre (Neurexin, NRXN) and post (Neuroligin NLGN) transmembrane synaptic adhesion molecules have been linked to ASD. In humans, there are five forms of NLGN proteins and three forms of NRXN. Depending on the specific type of synapse, different combinations of the NLGNs and NRXNs can be found. Individuals whose ASD is linked to genetics may have mutations found in their NLGN-3 or NLGN-4 genes. *Caenorhabditis elegans* (*C. elegans*) are nematodes that are widely used as model organisms. This is due to their relatively short life span of approximately three days. *C. elegans* have a total of 302 neurons thus working with the nervous system becomes much easier. *C. elegans* have homologues of the human NLGN and NRXN genes. In *C. elegans* there is however only one copy of NLGN and NRXN, greatly simplifying creating a model system.

In past years, attempts were made to create a complete knockout of the NLG gene in *C. elegans*; the work is ongoing. This occurred through creating a complete knock out of the NLG-1 gene, inserting it into a plasmid and utilizing CRISPR/Cas9 technology. Due to the current COVID-19 pandemic, Drew University and subsequently the lab has been shut down, therefore more focus has been devoted to bioinformatic analysis of the nlg-1 gene products. In *C. elegans*, there are nine different isoforms of neuroligin, of which none had 3D structures previously predicted. Utilizing online resources such as Swiss Model, the Zhanglab I-TASSER program and Pymol, the structures of all nine nlg-1 isoforms have been predicted. The differences between all isoforms have also been determined. Isoform E is the largest of all and contains all sixteen exons thus no alternative splicing. Observing the different isoforms one of the striking differences is that seven of nine isoforms are missing exon 14. Also, there is a second start codon located in exon 8 which is responsible for creating two of the isoforms. There is a strain of *C. elegans,* VC228, which has a disruption in the nlg-1 gene, however, the structure of this mutated protein is unknown. The structure of this protein was also predicted. The structure of the VC282 neuroligin suggests that *C. elegans* with this mutation may still have partial function of their nlg-1 gene.

Independent Colleges Scholarship Award: *Johnson & Johnson Pre-Professional Healthcare Scholarship 2020-21*

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Kristi Wenger

Centenary University, Class of 2022
Major: Animal Health Pre-Veterinary

Faculty Advisor: Lauren Bergey, Ph.D., Associate Professor of Biology, Director of Honors Program
Science Department

Canine Cognition of Human Social Interactions

Canine intelligence or cognition is complex in the fact that there is still a lot about how canines think that is still unknown. Humans have a great impact on how domesticated dogs act. A study was conducted to determine how canines interpret three different social interactions between two individuals. In this experiment, a dog watches its owner walk away and out of sight. In order to reach its owner, the canine must pass through several interactions between strangers in order to get to its owner. Results showed that the range of time to complete the path was highly variable (2-34 sec). Survey data collected from the owner was used to compare these time differences relative to baseline.

The survey responses were used to perform two cluster analyses. The first cluster analysis separated the subject into two clusters based on similarities in their level of formal training and how reserved they were perceived by their owners. A second cluster analysis separated the subjects into two groups based on similarities in the number of moths they had owned and how calm they were perceived by their owners. Cluster analysis is an exploratory analysis that tries to identify structures within the data. More specifically, it tries to identify homogeneous groups of cases if the grouping is not previously known ("Conduct and Interpret a Cluster Analysis", 2020). In the cluster analysis for formal training and level of reserve, cluster one (n=7) had 0% formal training and a mean survey response, on a Likert scale of 1 to 7, of 2.3 respectively. Cluster two (n=6) had 83.3% formal training and a mean survey response, of 4.7 respectively. In the analysis comparing months owned and level of calmness, the subjects in cluster one (n=8) were owned for an average of 23.9 months and had a mean survey response, on a Likert scale of 1 to 7 of 4.6, while the subjects in cluster two were owned 72.0 months on average and had a mean survey response of 6.6. For each cluster analysis, the time difference measurements from the experiment were compared by cluster. This data can be further investigated to hypothesize about other behaviors or can be used to make a correlation among the existing evidence.

Independent Colleges Scholarship Award: *Schering-Plough Undergraduate Research Scholarship 2020-21*

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- Benjamin Franklin

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