Pre-College Research Academy

2024

Proposed projects

For more information or for questions please contact:

Dr. Balazs Hargittai
(bhargittai@francis.edu)
Professor of Chemistry
Director, Office of Student Research

Therapeutic Gardening

Dr. Timothy Bintrim
Professor of English
Coordinator of Sustainability Program

Tentative dates: The time commitment is flexible, but two hours, two mornings or afternoons per week from mid-June through July is ideal. We can work around family vacations, camps, and other prior time commitments.

In 2019, SFU's Sustainability program established the Pavilion Garden at Cambria Care Center (today Maple Heights). Named for the Pavilion at its center, this walled sensory garden features herbs, edible flowers, and vegetables started in our high-tunnel greenhouse on campus and transplanted into beds and planters at an ideal height for wheelchair users.

Research proves that when elderly people have access to gardens, the activity elevates their mood, reduces the need for medication, and encourages wellness, flexibility, and fine motor skills. This pre-college academy will be ideal for students who may want to major in occupational or physical therapy, gerontology, psychology, nursing, physician assistant science, horticulture, botany, or ecology.

We will soft-start our Therapeutic Gardening Pre-College Research Experience on Tuesday, June 11, 2024, from 9-11 at the SFU Hoophouse (a plastic covered high-hoop greenhouse near Torvian Dining Hall). On Thursday, June 13, we will meet from 9-11 at the Maple Heights Pavilion Garden. If you have a prior family or school event and must miss, don't worry—I don't take attendance and we have other gardeners to keep things moving forward.

If there is a better time or day of the week for the group to meet, let me know and we may be able to adjust. From June 20-23, I must be at a free dental clinic in Reading, so I must cancel our meetings that week, but perhaps some of you can keep the Hoophouse and Pavilion Garden watered.

Pavilion Garden in full bloom around July 4, 2022.

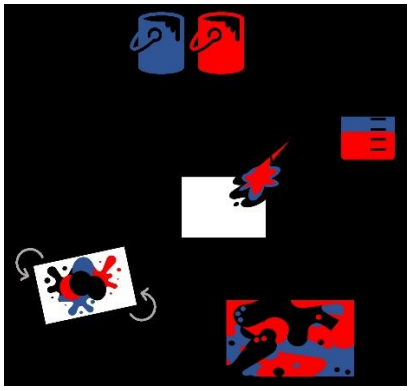
Pavilion Garden at Maple Heights, 429 Manor Road, Ebensburg

The Science behind the Art of Paint Pouring: Measuring Viscosity and Contact Angles

Dr. Edward P. Zovinka
Professor of Chemistry

Tentative dates: Monday, June 10, 2024 – Friday, June 14, 2024

Many people think of paint pouring as an artistic only endeavor where paint are mixed and then poured onto a surface for an aesthetic work of art. However, a great deal of chemistry is going on "behind the scenes" requiring the study of paint density, liquid viscosity, and contact angle (due to intermolecular forces). I invite you to spend a week in our Saint Francis University laboratory learning and applying chemical knowledge – and even having fun completing a number of paint pours. You will work in the lab, learning to use a viscometer, use your phone to make scientific measurements, apply statistical analysis to the data, and some wet lab work (making paint solutions).



Saint Francis Students have already published their results in phase one of the project, and I am looking forward to publishing our results from phase two too![1]

1. Ochs, Alexandra*; Dee, Julianne*, Barber, Katelyn; Arnold, Anne, Zovinka, Edward P. "Connecting Active Artwork to Chemistry: Leading Students in Inquiry-Based Learning of Density and Viscosity" *J. Chem. Educ.* **2023**, 100, 9, 3703–3708.[#]
* SFU chemistry student
[#] selected for cover art; https://doi.org/10.1021/acs.jchemed.3c00277

Nanoscience Exploration

Dr. Ashley Smith-Diemler
Assistant Professor of Chemistry

Tentative dates: Monday, June 10, 2024 – Friday, June 14, 2024

Have you ever wondered: What is a nanoparticle? How do you make one? Can I see something so small? We will address these questions and more in the Nanoscience Exploration Pre-College Research Academy. In this project, you will gain hands on experience working in a Chemistry lab, creating and analyzing gold nanoparticles. We will synthesize these nanoparticles using Green Chemistry methods and characterize the resulting nanoparticles in terms of size, shape, and surface chemistry. Additionally, you will gain experience reading articles about cutting-edge nanotechnology applications, including nanomedicine and water filtration.

We will start off with developing the skills we need to work in a scientific laboratory using Green Chemistry methods. You will have an opportunity to make chemical reagent solutions and combine them to create nanoparticles of different sizes and shapes. You will then get the opportunity to use various instruments throughout the laboratory to analyze the nanoparticles, including examining their size/shape through spectroscopic methods. Finally, we will give students the opportunity to explore scientific literature, working to build the important skills associated with understanding scientific journal articles. Students selected for this project must have the ability to work independently.

Examination of Yeast During Fermentation

Dr. Benjamin Smith
Assistant Professor of Chemistry

Tentative dates: Monday, June 10, 2024 – Friday, June 21, 2024

Yeast have been essential microbes for people for more than the last ten thousand years—since before history has been written down. Without them, we would not be able to ferment bread, brew beer, produce wine, and make biofuels. *Saccharomyces cerevisiae* is a model organism in biological research, and yeast have been a part of many important scientific discoveries. We will be growing baker's yeast in a variety of conditions to examine their health and reaction rates. Variables include pH, temperature, chemical additives, competitive bacteria, and more. We'll learn about biochemistry, analytical chemistry, and food science. Data gathered will be used to create lab experiences and volunteering outreach events for undergraduate and high school students.

Cytochrome *c* Structure and Function: How does changing the microenvironment around the protein affect the electron transfer process?

Dr. Rose Clark
Professor of Chemistry

Tentative dates: Monday, June 10, 2024 – Friday, June 14, 2024

Cytochrome *c* is a vital protein in the electron transport chain needed for the production of ATP. Cytochrome *c* shuttles electrons between two membrane proteins and has to dock at their surface to pick up or drop off electrons. To help understand how cytochrome c functions in biological systems models are created to probe the protein chemistry. The models used to study the protein docking incorporate gold electrodes, gold nanoparticles, and self-assembled monolayers (SAMs). A SAM is one of the most widely used ways to study surface attached proteins. SAM's can be created by adsorbing alkanethiols (hydrocarbon chain with a sulfur) on gold electrodes. The SAMs being studied in this experiment mainly contain carboxylic acid and alcohol terminal groups ($HS(CH_2)_6COOH$); however, new SAMs containing peptide chains are being developed in our group. A carboxylic acid group is used to hold cytochrome *c* on the surface through the means of electrostatic attraction. To better understand the protein interaction with the SAM and the changes in the microenvironment around the protein electrochemistry is used to collect data. Electrochemical measurements are made on many different types of electrodes to determine whether cytochrome *c* interacts functionally with the surface of the modified electrode. If the protein is functional, the protein electron transfer rate and the formal potential can be determined. By changing conditions of the microenvironments, we can probe what affects the proteins' structure and changes its electron transfer properties (functional properties).

Design and Testing of Hydroturbines for Oceanic and River Power Production

Dr. Timothy Miller
Associate Professor of General Engineering

Tentative dates: Monday, June 3, 2024 – Friday, June 14, 2024

Earth's ocean, river, and wind currents contain massive amounts of energy. The sources of this energy are inherently renewable because they derive from temperature gradients in the water and air columns (caused by solar irradiation), by alternative wave action (caused by planetary tidal effects), and by the movement of water from lower elevations to higher by evaporation and precipitation. The challenge of harvesting useful energy, whether electrical or kinetic, comes down to concentrating this energy and developing devices to extract or convert the energy to useful forms. Students that participate in this topical area of the Saint Francis University Pre-College Research Academy will work with designing and testing innovative energy-harvesting technologies, low speed water, and wind turbines.

As part of the Pre-College Research Academy, students will work with reduced-scale models of turbines that they will design and 3d-print, and generators in the MECS hydraulic water flume. Students will predict harvesting power production, trouble-shoot aspects of the device, measure device power production, extrapolate to full scale devices, and determine design modifications to improve performance. Students will gain experience with solid-modeling (CAD) software, three-D printing, data-acquisition apparatus and software, and foundational theory of aero- and hydro-turbine design. Students will be able to explore novel power-producing designs from their own imaginations.

Engineering environmentally friendly fishing lures using 3D printers and biodegradable materials

Dr. Travis Tasker
Assistant Professor of Environmental Engineering

Tentative dates: Tuesday, June 25, 2024 – Friday, June 28, 2024
or Tuesday, July 9, 2024 – Friday, July 12, 2024

Fishing lures are often made from non-biodegradable plastic materials that can persist in the environment for many years. When these plastic materials are ingested by fish, they can clog their digestive systems, thereby increasing fish mortality. For this project, student researchers will use engineering principles, including fluid dynamics, statics, physics, and chemistry, to design and develop biodegradable fishing lures. Students will use various engineering equipment and tools to test their lure's strength, buoyancy, shape, stability in water, and ability to biodegrade. If time permits, lures may also be tested for their effectiveness in catching fish.

Can metformin and dexamethasone effectively induce apoptosis of cervical cancer cells?

Dr. Irene Wolf
Associate Professor of Biology

Tentative dates: Within the time frame of Monday, June 3, 2024 – Friday, June 28, 2024

Utilizing dexamethasone and metformin, a known treatment for pancreatic cancer cells, we aim to quantify cellular apoptosis in various cervical cancer cell lines. Cervical cancer claims the lives of approximately 527,624 globally each year. With annexin V as a marker for apoptosis and staurosporine as a positive control, we will use fluorescent imaging of cells undergoing apoptosis when treated with dexamethasone and/or metformin to quantify induction of apoptosis.

The effects of training, enrichment, and socialization on the wellbeing of shelter cats

Dr. Shlomit Flaisher-Grinberg
Associate Professor of Psychology

Tentative dates: Exact dates to be determined, but ideally early June

Cats living in shelters are posed with distinct welfare concerns. Shelter cat welfare can be improved using training methodologies, environmental enrichment, and human interaction. The project aims to assess different stressors at the shelter environment, compare the effects of different intervention methods on shelter cats' stress, behavior and related physiological measurements, and design procedures that will lead to the reduction of cats' stress and facilitation of their adoption outcomes. At this time, the project will take place at the shelter (either Central PA, Cambria County, or Huntingdon County), but we are exploring the option of having the cats reside on campus for the duration of the study.