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# 2025 O.U.R. Fall Conference

**November 14th, 2025**

***Location:*** **Setzer Student Center**

**Book of Abstracts**

**Part II - Poster Presentations**

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**Glossary:**

GR means Graduate student.

UG means Undergraduate student

**H** – Humanities, Arts, Social and Behavioral Sciences, Education, and Business

**S** – Science, Technology, Engineering, and Mathematics

UG-H means Undergraduate student in HASBSEB area.

UG-S means Undergraduate student in STEM area.

SURF means Summer Undergraduate Research Fellowship.

URG means Undergraduate Research Fellowship (at Lamar University)

McNair, SURF, Beck, Welch, and other sponsorship programs are indicated.

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GR-S / In-progress
Welch Foundation Research
College of Arts & Sciences
Spring Research Award Project

## Development of Dual-Fluorescence Probes for Selective Targeting of G-Quadruplex DNA.

G-quadruplexes (GQs) are guanine-rich DNA secondary structures located in telomeric and oncogenic regions that regulate telomerase activity. Stabilization of GQs can inhibit telomerase, providing a promising anticancer mechanism. However, most existing fluorescent probes suffer from poor selectivity and single-color emission, limiting their potential in diagnostic and imaging applications.

This study focuses on the synthesis of novel dual-fluorescence probes (MUA1–4) designed to selectively bind and visualize GQ DNA. Photophysical and biological evaluations were conducted to assess optical efficiency and biocompatibility. Molecular docking using AutoDock 4.2 was performed with four telomeric GQ structures (PDB IDs: 1NMZ, 1KF1, 2JPZ, 1XAV) and duplex DNA (1Z3F) as a control.

Docking studies revealed strong and consistent binding of the ligands to all GQ receptors, with the lowest binding energy (ΔG = –9.37 kcal/mol) observed for receptor 1NMZ, indicating a stable complex formation. Key interactions included hydrogen bonding and π–π stacking with guanine tetrads. The coumarin–imide derivative MUA-I-4 exhibited dual fluorescence emission at 360 nm and 460 nm and demonstrated low cytotoxicity (2–50 µM) in MTT assays, confirming its biocompatibility.

MUA-I-4 displays selective and stable binding toward telomeric G-quadruplex ($G_4$) DNA with minimal cytotoxicity, making it a promising candidate for fluorescence-based GQ visualization and cancer diagnostics.

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**Poster 10**
GR-S / In-progress
Departmental Research

## Does Farnesol Inhibit the Formation of Ergosterol in Candida Tropicalis?

Farnesol has been studied as a growth inhibitor of the Candida family of yeasts. The mechanism of this drug is unclear, however, based on previous studies of the sterol metabolic pathway of eukaryotic cells it is possible that farnesol disrupts the ergosterol biosynthetic pathway. To test this hypothesis, Candida tropicalis cells were exposed to different amounts of farnesol. Following extraction, the relative amounts of lipids were evaluated using gas chromatography. Results suggest that while farnesol affects the sterol pathway, it is likely because of a more complex mechanism of activity.

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**Poster 12**
UR-S / In-progress
Faculty Research Grant

## Controls of Methane Emissions in the Coastal Marshes of the Texas Chenier Plain experiencing subsidence and restored by dredge material placement.

Coastal marshes are important sinks for atmospheric $CO_2$, but they can also emit methane, a more potent greenhouse gas. Methane emissions tend to increase when salinity falls below ~18 ppt because limited sulfate availability reduces competition between sulfate-reducing bacteria (SRB) and methanogens. In the Texas Chenier Plain, marsh subsidence and sea-level rise have caused more frequent and prolonged flooding, leading to elevated sulfide, vegetation dieback, and formation of open-water ponds. Current restoration efforts in the Salt Bayou Watershed involve placing dredged sediment to raise marsh elevation and modifying hydrology to lower salinity stress.

This study examined sediment methane and atmospheric methane flux from six coastal marsh sites representing natural, degraded, and restored conditions. Sampling occurred in October 2023 after a severe drought and in July 2024 during a wetter period. Marsh elevation, sediment chemistry, and microbial community composition influenced methane patterns. The greatest sediment methane and emissions were found at the lowest-elevation marsh dieback areas, characterized by toxic sulfide concentrations, reduced dissolved iron, and sparse vegetation. These sites also showed increased abundance of methyl-reducing Methanomassiliicoccales, indicating a methanogenesis pathway less constrained by sulfate reducing bacterial competition. Restoring elevation appears to enhance plant production and reduce methane emissions in degraded marshes.

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**Poster 21**
UG-S / In-progress
CNAS Research

## Heat Shock Protein 70 (HSP70) in the rotifer Adineta Vaga: Genome-Wide Screening, Phylogenetic Annotation, and Expression in Response to Heat Stress.

HSP70, also known as the "Guardians against Stress," is a molecular chaperone responsible for protecting cells against stress-induced damage. By establishing quick interactions with short, hydrophobic peptide regions, they have a significant role in a variety of biological processes. Rotifers, microscopic aquatic animals, are highly adaptive to various stressors in their environment, making them the model organism for researching more on HSP70. In this experiment, we study how the HSP70 gene in Adinetav aga, a class of Rotifers, responds to heat as a stressor. Three A. vaga samples were assigned to different treatments: a control group, a heat-treated group, and a recovery group. The Rotifer samples were incubated at different temperatures. RT-PCR was used to quantify HSP70 expression with specific primers to each variant of the chaperone gene, allowing precise measurement of mRNA changes in response to heat. Our results show that among the A. vaga samples that were tested, those that received heat treatment had significantly higher levels of HSP70 compared to the control and recovery samples, despite varying primers. While heat treatment significantly increased HSP70 levels in all samples, decreases in the recovery of HSP70 levels varied among primers. Overall, these findings demonstrate that HSP70 is strongly induced by heat stress in A. vaga, emphasizing its importance in protecting cells against varied stressors and advancing future research on diligent stress mechanisms. The variation in recovery of HSP70 levels among different primers indicates a possibility of regulation mechanisms during the recovery phase, indicates the need for future investigation.

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**Poster 7**
GR-S / Advanced
Faculty Research Grant

## Highly Selective Schiff Base-Thiourea Fluorescent Probe for Hg2+ and Cu2+ Ions: Quenching Mechanism and Environmental-Biological Applicability.

This study presents the development of a thiourea derivative-based chemo-sensor and its precise fluorometric response to $Hg^{2+}$ and $Cu^{2+}$ ions. The chemo sensor ligand underwent a precise two-step synthesis process and was thoroughly characterized using NMR, IR, and MS techniques. Optimization

experiments established that the sensor achieves maximum fluorescence in a 75% DMSO-water mixture at pH 7.4 and displays remarkable stability across varying pH levels. Selectivity tests revealed significant fluorescence quenching upon interaction with $Hg^{2+}$ and $Cu^{2+}$ ions, though further titration confirmed binding ratio to $Hg^{2+}$ and $Cu^{2+}$ to be 1:1, verified with Job's plot analysis. Competition assays demonstrated the ligand's superior selectivity for $Hg^{2+}$ and $Cu^{2+}$ even in complex matrices. These findings present the ligand as an exacting and reliable chemo-sensor, optimized for detecting $Hg^{2+}$ and $Cu^{2+}$ with unparalleled precision. The study underscores its potential as a critical tool for environmental and industrial and biological applications demanding robust and selective ion detection.

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**Poster 4**
GR-S / In-progress
Departmental Research

## Differentiating Between Synthetic Fibers: A Forensic Evidence Investigation.

In the forensic field, fibers are commonly used as trace evidence since they are easily transferred between a person and the places they have been or the people they have interacted with. The challenge is to find physical or chemical characteristics that can lead to determining the origin of fiber evidence. Synthetic fibers such as nylon are difficult to differentiate. To develop a systematic approach in characterizing synthetic fiber, four test samples and a nylon standard sample were analyzed using Fourier transform spectroscopy (FTIR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and gas chromatography (GC). The combination of TGA and GC looks promising as a differentiation technique.

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**Poster 11**
GR-S / In-progress
Departmental Research

## Effect of TiO2 Nanoparticles on the Sterol Biosynthetic Pathway of Candida parapsilosis.

Candida parapsilosis cells were cultured in YPD broth at 30 °C for 24 h until mid-log phase and exposed to titanium dioxide ($TiO_2$) nanoparticles at concentrations of 5–200 µg/mL for 24 h. Following centrifugation, the pellets were hydrolyzed in 10 % KOH/methanol, and cellular lipids were extracted using hexane. The dried extracts were re-dissolved in methanol and analyzed by gas chromatography (Agilent 8860 GC, HP-5 column, TCD detector).

Microscopic imaging was used to observe morphological changes and cell density, while gas-chromatographic data were collected to quantify sterol composition, including cholesterol, ergosterol, and lanosterol peaks.

Microscopy revealed reduced cell density and the appearance of hyphal forms at ≥ 50 µg/mL $TiO_2$. GC analysis showed decreased total lipid content and significant alteration of sterol peak ratios compared with controls, suggesting nanoparticle-induced disruption of the ergosterol biosynthetic pathway.

The antifungal activity of $TiO_2$ nanoparticles against C. *parapsilosis* appears to stem from oxidative stress and interference with membrane sterol synthesis. These findings indicate that $TiO_2$ nanoparticles may serve as effective non-traditional antifungal agents, offering potential for applications in combating biofilm-associated and drug-resistant Candida infections.

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**Poster 25**
GR-S / Advanced
Faculty Research Grant

## Rapid Electroanalysis of Amphetamines in Biofluids: Sensor Development, Characterization and Modification using Nitrogen-Doped Carbon Nanotube/Chitosan Screen-Printed Electrodes.

Here we report simple, cheap and rapid electroanalytical method for the detection of two amphetamines, 3,4- methylenedioxyamphetamine (MDA) and 3,4- methylenedioxymethamphetamine (MDMA). The method used screen-printed electrodes (SPE) modified with N-doped carbon nanotube (N-CNT)/chitosan matrix and square wave voltammetry (SWV) to achieve a rapid method for screening and analysis of the psychoactive stimulants in the biofluids.

Commercial SPEs were drop-coated with aqueous N-CNT/Ch and dried. CV (0.5 mM K3[Fe(CN)6]) and EIS (Nyquist fits) quantified electron-transfer and charge-transfer resistance. SWV was optimized (step 10 mV, amplitude 25 mV, ~30 Hz) in phosphate buffer. Accuracy and matrix effects were assessed by spike-and-recovery of MDA/MDMA in human urine and saliva with minimal pretreatment.

Versus bare SPEs, cathodic peak current increased from ~4.3 to ~14.3 µA; charge-transfer resistance fell from ~383 to ~20 Ω. SWV gave linear ranges to ~50 µM (MDA, $R^2$≈0.998) and ~150 µM (MDMA, $R^2$≈0.992); LODs were ~0.22 µM (MDA) and ~1.2 µM (MDMA). Per-sample time was <1 min. Spike-recovery was 93–99% (MDA) and 82–94% (MDMA) in urine and saliva.

N-CNT/Ch-modified SPEs provide fast electron transfer, low interfacial resistance, and strong analytical performance. With SWV, they enable rapid, sensitive, accurate MDA/MDMA screening in biofluids, supporting portable forensic and clinical workflows at low cost.

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**Poster 19**
UG-S / Advanced
TEAM-UP Research Grant

## Impact of Multiple-Intelligences on Student Performance and Confidence in Preparatory Physics Course.

This study explores how multiple intelligence (MI) impact academic performance and confidence in the Preparatory Physics Foundation (PPF) Course. Using Howard Gardner's MI framework, 268 students were classified as analytical, introspective, or interactive. Findings show that over 51% of students identified as having introspective intelligence, 23% analytical and 26% interactive. By the end of the course, nearly half 47% experienced a decrease in confidence, 31% remained unchanged, and 22% reported increased confidence. Performance data revealed that analytical students excelled on early exams, whereas introspective and interactive learners scored lower initially. All groups experienced declines on the final exam. Statistical analysis, including Chi-square and Ordinal Regression, indicated no significant correlation between MI type and confidence change or overall performance. These findings suggest that while MI influences initial academic patterns, it does not serve as a reliable predictor of confidence or success, highlighting the complex nature of learning styles in PPF.

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**Poster 6**
UG-S / In-progress
Faculty Research Grant

## In Silico Analysis of a Novel Dual-Emission Fluorescent Ligand Targeting Telomeric G-Quadruplex DNA.

Telomeric DNA consists of guanine-rich sequences capable of forming G-quadruplex ($G_4$) structures, which regulate genomic stability and inhibit telomerase—an enzyme often overexpressed in cancer cells. Stabilizing these $G_4$ structures represents a promising anticancer strategy. This study reports the design, synthesis, and in silico characterization of a novel dual-emission ligand, MUA-I-4, for probing telomeric $G_4$ DNA. The ligand was synthesized via a Knoevenagel condensation between 3-formylchromone and 1,3-indandione, yielding a chromone–indandione scaffold exhibiting dual fluorescence emission at 360 nm and 430 nm. Molecular docking was conducted using AutoDock 4.2 against four telomeric $G_4$ DNA receptors (PDB IDs: 1NMZ, 1KF1, 2JPZ, 1XAV). Binding interactions were visualized with UCSF Chimera, and binding energies (ΔG) were used to evaluate stability and selectivity. MUA-I-4 demonstrated favorable and consistent binding affinities across all $G_4$ receptors, with the strongest interaction observed for 1NMZ (ΔG = −9.37 kcal/mol), supported by hydrogen bonding and π–π stacking with guanine tetrads. These findings indicate that MUA-I-4 selectively binds and stabilizes telomeric G-quadruplexes, supporting its potential use as a dual-emission fluorescent probe for telomeric imaging and structural studies. Future work will

involve molecular dynamics simulations and live-cell imaging to assess probe stability and biological applicability.

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**Poster 28**
UG-S / In-progress
Faculty Research Grant

## Assessing Domain Interactions in Fusion Proteins Through Structural Modeling.

Chromosomal rearrangements can generate oncogenic gene fusions that alter protein structure and function. We investigated the FGFR3-KHSRP fusion, found to be present in pancreatic tumors, to understand the physical consequences of the fusion on domain interactions and antibody accessibility. Using AlphaFold, we predicted three-dimensional structures of FGFR3, KHSRP, and the fusion protein, validating their reliability through alignment with Protein Data Bank structures with the structures in good agreement. To understand the interactions between domains we used ZDock, a rigid-body docking algorithm that samples rotational and translational configurations in phase space and scores their binding likelihood using statistical potentials. Docking analysis suggested strong interactions between FGFR3 domain 4 and KHSRP domains 1 and 2, with higher scores than our control interactions. This analysis suggests the domain binding may introduce excluded-volume effects that reshape the free-energy landscape of protein–antibody interactions. These results provide an explanation for experiments that show KHSRP antibodies do not bind to the FGFR3-KHSRP fusion. This work emphasizes the value of physics-based modeling in uncovering how fusion proteins may bypass therapeutic recognition.

*Key words: Genetics, Gene fusions, Pancreatic Cancer, Protein-Protein Docking, AlphaFold, ZDock*

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**Poster 35**
GR-S / In-progress
Departmental Research

## Development of Chroman–Rhodamine-Based Fluorescent Probes for Selective Targeting of G-Quadruplex DNA.

G-quadruplexes (G4s) are unique four-stranded DNA structures formed in guanine-rich genomic regions. They play critical roles in gene regulation and are closely associated with cancer development. Identifying small molecules that selectively bind to G4s can provide valuable tools for studying their biological functions and developing new strategies for cancer detection.

In this study, four chroman–rhodamine–based compounds were designed and synthesized to evaluate their binding affinity toward G-quadruplex DNA compared to conventional double-stranded DNA. Molecular docking studies with various G4 topologies revealed that these compounds exhibited strong and selective binding interactions with G-quadruplex structures.

Fluorescence microscopy demonstrated efficient cellular uptake and predominant nuclear localization, consistent with the intracellular distribution of G4s. Notably, the probes produced a pronounced fluorescence "turn-on" response upon binding to nuclear G-quadruplexes. Cytotoxicity assays using HeLa cells confirmed that the compounds are non-toxic within the concentration range of 2–12 µM.

Overall, these findings suggest that the newly developed chroman–rhodamine probes are promising, biocompatible tools for live-cell imaging of G-quadruplex DNA. Future work will focus on enhancing their selectivity and photophysical properties for advanced imaging and potential applications in cancer diagnostics.

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**Poster 5**
UG-S / In-progress
Departmental Research

## Does Hydrocortinone Affect Lipid Biosynthesis Pathways in Eukaryotic Cells?

Lipids, particularly steroids and sterols, are an important component in the metabolic pathway of opioids. Understanding changes in the lipid biosynthetic pathways can lead to the potential development of novel drug targets to minimize unwanted side effects of opioid consumption. Hydrocortisone, a glucocorticoid hormone, and *Pinus palustris* plant cells were used as proxies for opioids and eukaryotic cells due to accessibility. This study investigates the effects of hydrocortisone metabolism in *Pinus palustris* cells. Following cell exposure to 1% hydrocortisone, the cell lipids were extracted and analyzed using gas chromatography (GC) to determine appropriate metabolites. Preliminary results suggests complex metabolite formation.

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**Poster 13**
UG-S / In-progress
Faculty Research Grant

## Beneficial Fungus Trichoderma afroharzianum T22 Promotes Salinity Tolerance in Sorghum (Sorghum bicolor).

Salinity is a major environmental stress that limits sorghum (*Sorghum* bicolor) productivity by impairing growth, physiology, and yield. Beneficial soil microbes such as *Trichoderma afroharzianum* T22 have been recognized for their ability to promote plant growth and enhance stress tolerance through multiple mechanisms. However, its role in sorghum salinity response remains unexplored. In this study, sorghum

plants were grown in soil under control and saline conditions, with or without inoculation of *T. afroharzianum* T22, to evaluate its role in mitigating salt-induced stress. Results showed that salinity significantly reduced shoot height, fresh biomass, and root length compared with control plants. However, *T. afroharzianum* T22 inoculation markedly improved plant growth parameters under saline conditions, as evidenced by increased shoot and root biomass and improved overall vigor. Visual observations further indicated that T22-treated plants maintained better leaf greenness and shoot development compared to non-inoculated plants under salinity stress. These findings suggest that *T. afroharzianum* T22 holds strong potential as a bioinoculant to alleviate salt stress in sorghum, thereby contributing to agricultural sustainability in saline-prone environments.

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**Poster 2**
UG-S / In-progress
Center of Research

## Controlling Polylactic Acid Degradation Using MgO Nanoparticles for Biomedical Applications.

Magnesium-based biomaterials and biodegradable polymers, like polylactic acid (PLA), are increasingly appealing for temporary biomedical purposes due to their biocompatibility and ability to degrade. The challenge is to control degradation while managing the physical properties and conserving the biodegradability. This study focuses on evaluating the potential of PLA-MgO nanocomposite as a material for medical applications. Films of PLA containing various amounts of MgO nanoparticles were produced from solutions. The samples were evaluated or structural changes using FTIR spectroscopy and changes in thermodynamic properties were followed using differential scanning calorimetry. Results show that the amount of MgO could be used to tailor the biodegradation and process-ability of the material.

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**Poster 36**
GR-S / Advanced
Faculty Research Grant

## An Empirical Evaluation of Large Language Models to Generate Unit Test Code for Industrial Automation Controller.

The reliability of industrial automation systems heavily relies on the correctness of Programmable Logic Controller (PLC) programs, often written in Structured Text (ST). While Large Language Models (LLMs) have shown promise in automating test generation for mainstream languages, their effectiveness for the syntactically strict ST language remains underexplored. This paper presents a systematic empirical evaluation of three prominent LLMs—ChatGPT-4o, Gemini Flash, and Claude Sonnet 4—for generating ST

unit tests. We investigate three distinct prompting strategies (Natural Language, Code Language, and Chain-of-Thought) across a curated set of 11 ST function blocks. The quality of the generated tests is assessed using Compilation Success Rate (CSR), Statement Coverage (SC), and Branch Coverage (BC). Our findings indicate that while Claude Sonnet 4 achieves the highest CSR, Gemini Flash consistently produces tests with the highest statement and branch coverage, particularly when guided by code-centric prompts. We provide a detailed analysis and classification of over 100 compilation errors, revealing common failure modes for LLMs in this domain. This study offers the first comprehensive benchmark of modern LLMs for ST unit test generation, providing critical insights into their capabilities and limitations in the context of industrial automation.

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**Poster 31**
GR-S / Advanced
Faculty Research Grant

## Robust or Overfitted? Investigating the Generalization of Pretrained Models in Requirement Classification.

***Background***: Accurate classification of non-functional requirements (NFRs) is essential for aligning stakeholder expectations with system design and ensuring software quality. While transformer-based models such as PRCBERT and NoRBERT have achieved high performance in supervised settings, their generalizability across diverse sources of requirements remains largely unexplored. In practice, requirements originate from heterogeneous platforms, ranging from structured specification documents to informal developer discussions on forums like Stack Overflow. ***Aim***: This study provides the first comprehensive, bidirectional cross-dataset evaluation of domain-specific, embedding-based, and prompt-based large language models (LLMs) for NFR classification across two contrasting platforms: PROMISE (structured) and NFR-SO (informal). ***Method***: We evaluate domain-specific fine- tuned models, sentence embedding models, and prompt-based LLMs (including GPT-4o) in both zero-shot and few-shot settings. Performance is measured both in-domain and in cross-platform transfer scenarios to assess generalization with minimal or no labeled data. ***Results***: Domain-specific fine-tuned models, although effective in-domain, exhibit substantial performance degradation when transferred across platforms. In contrast, LLMs, particularly GPT-4o in few-shot mode, consistently outperform other approaches in cross-platform scenarios, achieving strong generalization with minimal labeled data. In zero-shot mode, GPT-4o also demonstrates robust performance without any supervision. ***Conclusions****:* Traditional supervised models face limitations in cross-platform NFR classification. Prompt-based LLMs offer a scalable, low-supervision solution for diverse requirement sources.

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**Poster 37**
UG-S / In-progress

## Physics students' geometric conceptions of complex analysis: A comparative case study.

While there has been extensive research conducted about students' mathematical thinking there has been little to no research on how physics students adapt to an advanced mathematics course. The purpose of this case study is to examine the thought processes of physics students in a complex analysis course using Tall's (2013) three worlds of mathematics as a theoretical perspective. This poster highlights some of the mathematical strategies possessed by physics students who take an advanced mathematics course such as complex analysis, including their differences in mathematical thinking, and ways they go about solving complex mathematical problems.

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**Poster 38**
UG-S / Early phase
High-School project

## MOTION - An Immersive Augmented Reality Platform Integrating Biomechanical Feedback for Chronic Musculoskeletal Rehabilitation.

Chronic musculoskeletal disorders affect more than 1.7 billion people in the world and are the leading causes of long-term disability and loss of functional mobility. The treatment of these conditions requires regular exercise and supervision by a clinician, while simultaneously providing precise real-time feedback. MOTION provides a 3D augmented reality environment that increases engagement, precision of movement, and therapeutic feedback during the rehabilitation process.

Developed in Unity, MOTION brings together the three dominant technologies for human motion capture-spatial mapping, skeleton modeling, and depth cameras to capture high-accuracy full-body kinematics. Dynamic exercise targets and visual cues can be projected through interactive augmented reality overlays directly into the user's space. MOTION employs an adaptive feedback algorithm, tracking repetition count, tempo consistency, and range-of-motion targets to allow the system to tailor difficulty and pacing in real time.

The platform introduces a gamified "motion-matching" mechanic where users align their body with a projected silhouette representing optimal movement form. Real-time skeletal alignment feedback encourages users to refine accuracy while providing immediate visual reinforcement.

MOTION focuses on treating chronic conditions like scleroderma, osteoarthritis, and other degenerative musculoskeletal diseases by combining biomechanical precision with motivational design for better, sustained adherence. Its scalable architecture allows for potential integration with home-based therapy and into clinical environments to have remote monitoring and data-driven insights. Combining immersive visualization, adaptive feedback, and accessible motion tracking, the MOTION system redefines the implementation of musculoskeletal rehabilitation.

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**Poster 8**
GR-S / In-progress
Departmental Research

## Exploring the Antifungal Potential of Titanium Dioxide Nanoparticles Against *Candida Tropicalis*.

Candida tropicalis is an opportunistic fungus that, under certain conditions, can act as an opportunistic pathogen, penetrating epithelial barriers and causing a multitude of mucosal and systemic infections, namely candidiasis. While several antibiotics exist, understanding the cells' development of antibiotic resistance may lead to better treatments. This study explores the antifungal potential of titanium dioxide (TiO2) nanoparticles against C. tropicalis. Cells were cultured while exposed to different amounts of TiO2. The cell morphology of exposed samples were observed using optical microscopy, and the lipid composition of the samples was analyzed using gas chromatography (GC). Besides confirming an overall decrease in cell growth, microscopy images revealed the formation of hyphae, first of an aseptate structure, but more of a septate structure at higher TiO2 amounts. GC results suggest that TiO2 nanoparticles disrupt the ergosterol biosynthesis pathway.

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**Poster 9**
GR-S / In-progress
Welch Foundation Research

## Can Zinc Oxide Nanoparticles Affect the Biosynthetic Production of Ergosterol in Candida Species?

Candida species such as Candida albicans and Candida parapsilosis are opportunistic fungal pathogens responsible for various infections in people with weak immune systems. Under certain circumstances, they become pathogenic requiring the development of antifungal drugs. These drugs target the ergosterol biosynthetic pathway, but drug resistance is becoming a problem. Our goal is to seek to understand this pathway better to establish different drug targets. Candida a. and Candida p. cells were separately grown in the presence of different amounts of ZnO nanoparticles, a known sterol pathway inhibitor, and the lipid composition of the cells was evaluated using gas chromatography. Results show that the cell lines react differently and a minimum concentration of ZnO, a significant change in the sterol composition occurs.

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**Poster 18**
UG-S / In-progress
TEAM-UP Research Grant

## Improving the performance of colored filters using polarizers.

Photoelectric effect represents the emission of electrons due to photon absorption by a metal or an alloy surface. Two characteristics are relevant to the process: its cut-off frequency and the kinetic energy of the least bound electrons. The cut-off wavelength for photon detection is 729nm. The kinetic energy of the most energetic electrons depends on the energy of the incident light and can be measured through a stopping potential, where the photocurrent, i, drops to zero. We use five characteristic wavelengths (365,404.7, 435.8, 546.1 and 577nm) emitted by a mercury lamp and select them with narrow band filters for measuring the associated stopping potential, Vs. Using various apertures, wide of 2-, 4- and 8-mm, we find the precision in measuring Vs with our instrumentation, which is of 2 decimals (i.e. for 365nm, Vs is -1.81volts, while in theory it is -1.83eV). Our goal is to test various commercial filters, and thus measure the wavelengths transmitted from the analysis of the characteristic curve, V vs. i, as well as of the Vs. We are looking for finding the lower limit of the transmission bandwidth. Some filters indicate a stopping voltage much wider than their apparent color: for example, a red filter had Vs of -1.68V, and in consequence, the energetic UV photons with □ > 365nm can go through, which is very bad because the red ranges from 580 to 780nm. When a polarizer was introduced in front of this filter, the stopping voltage increased significantly to -1.09V and moved the lower end of the transmission to the blue range of □ > 441nm, thus eliminating the energetic purple and UV photons over almost 80nm. The improvement of optical filters by eliminating with polarizers some of the unwilling energetic photons will be presented in our poster.

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**Poster 23**
GR-S / In-progress
Faculty Research Grant

## Mixed reality simulation training for first responders in hurricane scenarios.

Augmented and mixed reality (AR/MR) technologies have revolutionized professional training by providing immersive, interactive, and cost-effective learning experiences that bridge the gap between theoretical instruction and field practice. This research investigates the application of mixed reality for enhancing hurricane preparedness among first responders (FRs), who must operate in high-risk, unpredictable, and dynamically changing environments. Traditional emergency training is often conducted in static or controlled settings that fail to replicate post-hurricane realities such as flooding, power outages, debris-blocked routes, and high-wind noise—conditions that critically influence situational awareness, decision-making, and task efficiency.

To address these limitations, an MR-based training system was developed using head-mounted displays to immerse trainees in realistic, hurricane-specific scenarios. The system integrates two core components: (1) dynamic environmental simulation of hurricane conditions to strengthen cognitive resilience, task prioritization, and adaptability under stress, and (2) an interactive user interface that enables real-time modification of environmental parameters—such as lighting, ambient sounds, water levels, and physical

obstacles—allowing instructors and researchers to continuously adjust scenario complexity based on user performance or training objectives.

This adaptive simulation framework provides a safe, repeatable, and data-driven environment for first responders to practice critical emergency procedures, resource management, and teamwork coordination. The system aims to bridge the realism gap between conventional tabletop training and field deployments, improving decision-making accuracy, situational awareness, and overall readiness in hurricane response operations.

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**Poster 33**
UG-S / In-progress
2025 SURF Project

## From User Reviews to Code: A Large Language Model Approach to Automated Software Traceability.

This research introduces an automated framework that links user-reported issues from mobile app reviews to corresponding methods in the source code using Large Language Models (LLMs) and Retrieval Augmented Generation (RAG). Mobile apps receive thousands of reviews containing valuable feedback about bugs, crashes, and performance issues, but manually analyzing and mapping these reviews to code is time-consuming and inefficient. The proposed system operates through four integrated phases: (1) classifying and filtering user reviews with fine-tuned LLMs to extract actionable comments such as bug reports, performance issues, and crashes; (2) generating detailed code summaries that form a semantic bridge between natural language and program logic; (3) constructing a multi-dimensional knowledge base combining keyword, vector, and graph indexes to capture both semantic and structural relationships in the codebase; and (4) implementing a hybrid retrieval mechanism that progressively refines search results through complementary strategies. The approach is expected to achieve approximately 75% traceability accuracy, substantially reduce issue resolution time, and generate open-source datasets for future research. By automating the connection between user feedback and implementation details, this work enhances software quality, boosts developer productivity, and advances data-driven, AI-assisted software maintenance.

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**Poster 29**
GR-S / In-Progress
Faculty Research Grant

## Uncovering Technical Debt in HPC Codebases: A Comment-Centric Analysis of Developer Trade-offs.

Self-Admitted Technical Debt (SATD), comments in code where developers explicitly acknowledge suboptimal implementations poses a significant challenge to the sustainability of High-Performance Computing (HPC) systems. This research presents a novel large-scale empirical study on SATD across HPC codebases, focusing exclusively on code comments to uncover domain-specific patterns and implications. We developed an automated SATD detection framework that integrates historical commit analysis, structural parsing, and domain-driven keyword heuristics, including both general SATD indicators and HPC-specific terms related to parallelism, performance tuning, hardware portability, and scalability constraints. Our multi-repository dataset spans several actively maintained HPC projects, mined over a multi-year timeline. Through this, we not only extracted and categorized SATD instances but also linked them to developer experience levels, code ownership, and removal timelines. The findings reveal a distinct distribution of SATD types in HPC, performance and platform-specific debts dominate, often introduced by experienced contributors during rapid optimization cycles. Interestingly, such debts tend to be resolved faster than others, suggesting intentional short-term compromises to meet computational goals. The study contributes new insights into how SATD manifests in performance-critical software and offers a reproducible methodology for SATD identification in scientific domains. These insights can inform future tooling for intelligent technical debt detection and prioritization in large-scale, computation-intensive projects. Our approach sets the foundation for bridging the gap between software engineering best practices and the evolving demands of HPC development.

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**Poster 15**
GR-S / In-Progress
Departmental Research

## Nano-Enhanced Polystyrene Films: Bridging Antimicrobial Activity and Thermal Stability.

Synthetic polymer materials are commonly used as temporary medical devices such as catheters. These devices need to be flexible, reasonably strong, thermally stable, and capable of undergoing sterilization. When improperly used infections surrounding the devices can cause serious issues. Our objective is to develop a nanocomposite that reduces the possibility of infection while still possessing the physical and thermal properties necessary for medical applications. Polystyrene-based nanocomposite films incorporating ZnO nanoparticles - possessing some antibiotic properties - and MgO nanoparticles - a compatibilizer - were produced as potential candidates. Polystyrene solutions (5%) in toluene were cast on water to form thin films onto which dispersions of ZnO and MgO nanoparticles were deposited in different amounts. The films were characterized using Fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and optical microscopy to evaluate molecular interactions, thermal stability, and confirm particle dispersion. E. coli cells were exposed to nanocomposites as a test of viability. Results suggest that nanoparticle addition improves the thermal stability of the material through increased chain-chain interactions and influence biocompatibility, underscoring the potential of these nanocomposites for biomedical applications.

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**Poster 30**
GR-S / In-Progress
Faculty Research Grant

## Instant Answers, Lasting Impact: Transforming Academic Advising through AI

Academic advising is a cornerstone of student persistence and graduation, yet its effectiveness is often undermined by fragmented information ecosystems. Advisors at many institutions spend upwards of 40% of their time answering routine, procedural questions, creating response delays that correlate with student registration errors and attrition. To address these critical challenges, this proposal outlines the development of VirtualAdviser, an innovative retrieval-augmented generation (RAG) advising platform powered by a Large Language Model (LLM). This system is designed to provide 24/7, personalized, and context-aware guidance by synthesizing university-specific policies, complex degree requirements, and individual student records. A key feature includes a secure Degree Audit Parser, enabling the system to analyze a student's academic progress and provide specific, actionable course recommendations. VirtualAdviser utilizes a RAG pipeline where a comprehensive knowledge base—comprising academic calendars, course catalogs, and policy documents—is indexed in a vector database for efficient semantic retrieval. This retrieved context grounds the LLM's response generation, ensuring factual accuracy and mitigating hallucinations. The platform's performance will be rigorously evaluated using the RAGAS framework (measuring context precision, recall, faithfulness, and relevance) and a System Usability Scale (SUS) survey. Initially deployed for computer science students, this project aims to deliver a highly accurate and usable advising tool, freeing professional advisors to focus on high-impact developmental conversations and ultimately improving student satisfaction and success.

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**Poster 40**
UG-H / Advanced
URG Project

## Asexuals of Color: Experiences of an Invisible Identity.

Asexuality, or the lack of sexual attraction or low sexual interest, is a relatively new and growing orientation within the LGBTQIA+ community. Anthropologists, scientists, and activists study the identity's meaning and related history as the community continues to find acceptance and understanding. As asexuality became more mainstream in Queer and youth culture, the orientation has continued to expand its representation. However, due to the lack of perception, the orientation has become white-centric and overlooked in minority groups. This study delved into the shared experiences and stories of ten participants who identified as an asexual of color. This project utilized interpretative phenomenological analysis- a qualitative methodology that identifies trends in data to create assumptions about a population

or demographic. The study conducted private-personal interviews consisting of eight open-ended questions and found five central trends across the participants' testimonies: (1) Identifying as Asexual, (2) Disclosure of Identity, (3) Sexualization and Fetishization of BIPOC Asexuals, (4) BIPOC Asexuals within Queer and Asexual Communities, (5) Self-Acceptance. This research aims to bring attention to asexuality and the lived experiences and journeys of Asexuals of color.

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**Poster 16**
UG-H / In-progress
2025 SURF Project

## Bridging Disciplines: Integrating Interprofessional into Modern Healthcare Education.

Careers in rehabilitation are vital for addressing patients' physical needs, such as mobility, speech, and coordination. These fields encompass diverse occupations—each requiring specialized skills acquired through rigorous graduate and professional education. Advancements in addressing motor and sensory requirements have broadened the possibilities and applications within the field of rehabilitation. However, the complex interplay of patients' disorders and diseases necessitates interprofessional collaboration (IPC) for holistic and effective care.

Interprofessional collaboration involves consistent networking and cooperation among various health professionals, pooling their expertise to craft optimal care strategies. By fostering communication, teamwork, and shared problem-solving, interprofessional education (IPE) offers a transformative framework for preparing future health professionals to engage in collaborative practice. Evidence suggests that IPE not only enhances students' readiness for interdisciplinary teamwork but also has sustained long-term effects, equipping professionals with collaborative skills that persist throughout their careers.

Additionally, teams trained in IPE have demonstrated improved patient outcomes, such as higher recovery rates, reduced medical errors, and enhanced patient satisfaction. These outcomes stem from improved care coordination and holistic, patient-centered approaches that integrate physical, cognitive, and psychosocial elements of health.

Using a systematic review, this study analyzes existing literature on IPE's role in rehabilitation practice. It explores key trends, barriers, and opportunities, laying the groundwork for future research on the long-term impact of IPE on healthcare education, collaborative practice, and patient outcomes.

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**Poster 26**
GR-H / Advanced
Center of Research

## The Role of Cochlear Implant-Hearing Aid Performance Disparity in Bimodal Benefit: A Controlled SNR Study.

**Background:** Bimodal hearing or using a cochlear implant (CI) in one ear and a hearing aid (HA) in the opposite ear allows users to benefit from electric and acoustic stimulation. While many users benefit from bimodal hearing, some report a lack of benefit. The reasons for this variability are unclear, but several possible causes have been suggested. There is speculation about performance differences between CI and HA ear influencing bimodal benefits, such as greater disparity causing reduced bimodal benefits or interference. In comparison, lesser performance disparity causes greater bimodal benefits. However, studies specifically examining the effect of performance disparity across predetermined or controlled disparity levels are currently lacking. The study aims to investigate the impact of performance disparity between the CI and HA on the bimodal benefit by combining different signal-to-noise ratio levels in the CI and HA ear. **Methods:** Fifteen individuals with typical hearing and native speakers of American English will be subjected to sentence recognition (IEEE) in different listening conditions, viz., HA alone, CI alone, and bimodal. The sentences will be mixed with speech-shaped noise and in various combinations of signal-to-noise ratios across CI and HA ear to simulate different performance disparity levels. **Results:** Linear mixed modeling will be utilized to compare the bimodal benefit across different performance disparity levels created by different SNR combinations. Further, the results will highlight differences in bimodal benefits across conditions of similar HA and CI ear advantages. **Discussion:** The study findings will provide insights into the extent of bimodal benefit expected for individual patients based on their specific performance disparities. Further, a greater understanding of CI and HA ear advantages acting similarly or differently on bimodal benefit will be rendered.

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**Poster 1**
UG-S / Advanced
Departmental Research

## Ultrasensitive Fluorescent Probe for Zinc(II) Detection: Aqueous-Phase Mechanistic Insights, Stoichiometry Studies, and Live-Cell Imaging Applications.

We report on the development of a small-molecule fluorescent probe based on an amidothiourea scaffold that demonstrates high sensitivity and selectivity for metal ion detection, particularly zinc ions, in complex environments. The probe was synthesized via a straightforward reflux method, and its structure was confirmed using standard spectroscopic techniques including NMR, IR, and MS. Photophysical studies revealed dual binding stoichiometries, suggesting flexible coordination behavior. Solvent optimization identified conditions that enhance selectivity, while time and pH-dependent fluorescence studies established optimal sensing parameters. Competitive ion experiments confirmed strong selectivity for zinc over other biologically relevant metal ions. Fluorescence microscopy demonstrated efficient cellular uptake, good biocompatibility, and intracellular localization, indicating strong potential for biological imaging applications. Overall, this probe offers a robust platform for metal ion sensing and bioimaging.

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**Poster 14**
UG-S / Advanced
2025 SURF Project

## Correlation Between Human Foot Traffic and Angel Wing Syndrome in Ducks in Parks.

This research aimed to evaluate the severity of Angel Wing syndrome in the population of domestic waterfowl in urban parks of Southeast Texas and determine if there is a correlation between human foot traffic and the prevalence of Angel Wing syndrome, on the assumption that higher foot traffic is related to how often people feed the waterfowl. Over the summer, 31 community parks were surveyed, recording the duck populations, human traffic, and instances of Angel Wing (AW) syndrome. The findings suggest no significant relationship between human presence and AW, but a significant difference was found between Angel Wing incidence and surrounding greenspace.

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**Poster 20**
UG-S / Advanced
2025 SURF Project

## Rhomboid Proteases as Conserved Engines for Parasite Pathogenesis.

Rhomboid proteases, a family of intramembrane serine proteases, are crucial in various biological processes across different organisms. Rhomboid proteases are highly conserved, indicating their essential role in biological functions. They are involved in critical processes such as cell signaling, host-pathogen interactions, and protein trafficking.

**Purpose:** This research focused on examining the conservation, structural characteristic, and functional roles of rhomboid proteases across the five disease-causing protozoans: Plasmodium, Acanthamoeba, Trichomonas, Toxoplasma, and Leishmania.

**Methods:** Phylogenetic trees were built using MAGAX, sequence homology studies performed using M-Coffee, and protein structure prediction models built using ExPASy to determine areas of conservation.

**Results:** Aligned sequences and structural comparisons reveal conserved motifs and functional domains, indicating evolutionary connections and functional similarities among the studiedprotozoans. Acanthamoeba shared traits with Plasmodium and Toxoplasma, suggesting similar molecular mechanisms in disease causation, while Trichomonas exhibited unique features that highlight its specific biological

requirements. The conservation of rhomboid proteins in Leishmania suggests a role in the parasite's virulence and host-parasite interactions.

Our study highlights the evolutionary significance and potential therapeutic targets of rhomboid proteases in pathogenic protozoa. Understanding their mechanisms can provide insights into developing targeted therapies for diseases caused by these parasites.

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**Poster 32**
GR-S / Advanced
Faculty Research Grant

## An Empirical Analysis of Developer Discussions to Unpack Network Programming Difficulties.

Network programming lies at the core of modern software development, enabling communication across distributed systems, cloud infrastructures, mobile applications, and IoT platforms. Despite its foundational role, the specific challenges network programmers face and the types of questions they ask remain underexplored. This study presents the first large-scale empirical analysis of network programming discussions on Stack Overflow, aiming to (i) identify the major topics developers engage with, (ii) understand the types of questions asked, and (iii) assess the relative difficulty of these topics. We collect and analyze over 40,000 Stack Overflow posts using Latent Dirichlet Allocation (LDA), optimized with Genetic Algorithms. We classify question types, compute difficulty and popularity metrics (e.g., unanswered rate, view count), and visualize longitudinal trends.

We also compare various metrics of the network programming domain with other software engineering domains. Our results reveal that developers predominantly discuss 15 thematically coherent topics and ask "How"-type procedural questions and frequently struggle with platform-specific and containerized networking environments, such as Docker and Python Scripting & Errors. These findings are further supported by a follow-up survey conducted with professional developers experienced in network programming. The temporal trends indicate a shift from core networking to cloud-native paradigms over the last decade. Compared to other domains such as mobile development, security, and big data, network programming posts attract higher viewership but suffer from moderate answer rates, suggesting a complexity-visibility gap. We conclude with actionable insights for educators, tool builders, and researchers to improve support, documentation, and training for network programmers.

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**Poster 3**
GR-S / In-progress
Welch Foundation

## Development of a Stable Phospholipid-Lipid Complex for Controlled Drug Release Applications.

Drug delivery systems are designed to increase the steady bioavailability of hydrophobic or semi-hydrophobic drugs. Such application is determined by the properties of the material which are ultimately related to the chemical structure. We aim to develop a highly stable phospholipid- based delivery systems by controlling interactions between phosphatidylcholine, and cholesterol and hydrocortisone as binding agents. The thermal stability of the systems was evaluated using differential scanning calorimetry. Variations in the transition temperatures and enthalpy changes as the amounts of binding agents increased suggested that the structure of the material underwent changes. These changes were confirmed by the appearance of phospholipids fibers.

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**Poster 22**
UG-S / In-progress
Departmental Research

## Metabolic Analysis of Medically Significant Plants and Spices.

Nuclear Magnetic Resonance (NMR) spectroscopy is a non-destructive tool used to assess the structure, concentration, and behavior of molecules. Star anise (*Illicium verum*), witch hazel (*Hamamelis virginiana*), and cumin (*Cuminum cyminum*) are edible plants that are known to have medicinal properties such as maintaining blood pressure, aiding in digestive health, pain relief, minor skin ailments, and preventing certain diseases. Texas Mountain Laurel (*Dermatophyllum secundiflora*) has historically been used ritualistically to produce hallucinatory effects, as well as medicinally to aid respiratory and digestive problems. Proton (1H) NMR was utilized to analyze the metabolite composition of the samples to understand how these plants achieve therapeutic results. The NMR spectrum provided a total of 42 peaks, which were referenced against the Biological Magnetic Resonance Bank (BMRB). Of those 42 peaks, one did not return results. The obtained data may prove useful in studying the potentially effective metabolites through natural sources, as well as the pathways those metabolites take when introduced to each other and the human body.

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**Poster 24**
UG-S / Advanced
2025 SURF Project

## Evaluating Effects of Process Parameters on Polymer 3-D Printing.

Fused Deposition Modeling (FDM) is a polymer additive manufacturing technique with significant potential for advancing the production of complex, high performance parts across various industries. Its ability to process a broad range of thermoplastic materials makes it a promising technology for innovation in polymer-based manufacturing. However, there is limited research on how the adjustments of process

parameters influence the strength and dimensional accuracy of the printed parts. This research focuses on optimizing the FDM process parameters, infill patterns and layer height, to enhance the mechanical properties and structural integrity of 3D-printed components. Experiments were conducted using PPA GF25, with infill patterns including honeycomb, cubic, triangles, and gyroid and layer height increments of 0.05mm, 0.1mm, 0.2mm, 0.3mm and 0.4mm. Tensile testing and microscopic analysis were used to evaluate the relationship between process variables and material performance, with attention to minimizing defects such as porosity and layer inconsistency. Results showed that a 0.3 mm layer height combined with triangle or cubic infill patterns produced the best balance of strength and stiffness. Although 0.4 mm layer height yielded the highest Ultimate Tensile Strength (UTS), it also introduced surface defects and mechanical inconsistency. Cubic and gyroid infill patterns demonstrated greater ductility, while honeycomb patterns were the least flexible. These findings demonstrate that mechanical performance in FDM-printed PPA GF25 parts can be significantly improved through careful selection of infill geometry and layer height.

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**Poster 27**
UG-S / In-progress
Welch Foundation

## Fluorescent Chemosensor Development for Early Disease Detection *via* Cysteine.

Abnormal cysteine levels are implicated in neurodegenerative, cardiovascular, and cancer-related diseases, underscoring the need for rapid, accurate, and accessible detection in clinical settings. Conventional analytical techniques such as HPLC and mass spectrometry, while highly precise, are often too costly and time-consuming for routine screening. This project aims to develop a simple, reliable, and cost-effective fluorescent chemosensor for early cysteine detection, leveraging a thiol-ene Michael addition reaction for selective recognition. The probe design integrates a maleimide moiety as the reactive site, a naphthalimide fluorophore to report binding events, and a hydrazine linker to couple these functional components. To date, key intermediates have been synthesized and structurally confirmed by NMR and IR spectroscopy, establishing the feasibility of the approach. The proposed sensor architecture is expected to enable efficient and sensitive detection of cysteine, with potential to streamline diagnostic workflows and broaden access to early screening. Ongoing work focuses on probe optimization and performance evaluation in relevant biological matrices, positioning this platform as a promising tool for cysteine-related disease diagnostics.

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UG-S / In-progress
URG Project

## Can Changes in the Environmental Temperature Modify the Optical Characteristic of a Medium?

A material's curve of dispersion shows the dependence of the refractive index, *n*, verses frequency of light, f, and represents the optical signature of a medium. We are interested in understanding this dependence on the environmental temperature, T. Therefore, we study changes in the *n* of flint glass using the minimum deviation method, when the interaction between light and glass is assisted by background energy that changes the T. For a medium in thermal equilibrium at T, the thermal energy kT (k = Boltzmann constant) adds to the energy of the incident light, hf. Thus, the dipoles of the material change their vibrational energy according to hf' = hf + kT. We added kT from a lightbulb placed near the material's surface. Also, we put the prism between two metal plates and sent voltage across. When the background energy is relatively small, the vibration of dipoles can be considered linear. Here, the light-matter interaction is nicely described by Lorentz's dipole oscillating model, where the variation of the *n* can be connected to a Cauchy parameter, C. We assess its changes by measuring the changes in the Cauchy parameter for voltages up to 10 volts. We observed that the value for C changes from 11180 at no voltage, to 11278 at 10 volts, which is about 0.88% change, while the error bar for C is only 0.49% in both cases. This result shows a significant change in C and proves the fact that T induces a variation of n.

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**Poster 17**
UG-S / In-progress
URG Project

## Can Changes in the Environmental Temperature Modify the Optical Characteristic of a Medium?

We study the dependence of the refractive index, n, for flint glass with the change of energy background both in bulk as well as on its surface to incident light assisted by an energy background. An increase in the energy background increases the vibrational frequency of the electric dipole constituents. For a low energy background, which is considered as 30% below the first excitation threshold of 9.6 eV, the vibrations of the dipoles are quasi-linear and the interaction between light and matter can be described by Lorentz's harmonic oscillator model, where n depends on a Cauchy parameter, C.

The reflection of a laser beam at the surface allows us to study the optical response of the surface dipoles. We use a red 650nm laser beam incident of a flint surface near the Brewster angle assisted by a voltage below 2.4 volts, for a perfect harmonic response of the surface dipoles. We study the normalized parallel and perpendicular components of the reflectance in the plane of incidence, which follows a perfect parabolic trend. We are comparing these components for various assisted voltages (of 0, 0.4, 0.8, 1.2, and 1.6 volts) and observe the change in the position of the Brewster Angle and index n associated. We also observe that the C value remains practically the same at 11254, for all voltages below 2.4 volts.

Therefore, we changed our focus of study from reflection at the surface to the transmission of light through glass, using strong vibrations of bulk dipoles. We assess the changes of index n for flint glass by using the minimum deviation method and measuring changes of C when the background energy set up across the glass is large, like 5 to 9.5 volts, so the oscillations of the bulk dipoles are strong, and the non-linear oscillatory regime becomes significant. We observe a large change in C from 11254 at 0 to 5 volts, to 11280 at 9.5 volts. This result proves that an additional energy background can induce a measurable change in the refractive index of glass inside the material, while the surface is much more sensitive to changes in the index for lower external energies. *We acknowledge The Office of Undergraduate Research's URG program for funding this research project for Jason, and the TEAM-UP grant of American Institute of Physics for Christopher.*

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**Poster 34**
UG-S / In-progress
2025 SURF Project

## Self-Learning AI Tools for Molecular Property Prediction.

Accurate prediction of molecular enthalpy at 298 K (H298) is important for reaction modeling and combustion studies, but traditional quantum-chemistry calculations are slow and hard to apply to large molecular datasets. In this project, I explore whether machine learning models can estimate H298 directly from precomputed features in the ThermoG3 dataset. The input features include heat capacity (Cp) values at several temperatures along with other molecular descriptors, and H298 is treated as a continuous regression target. I train three models—Random Forest, Gradient Boosting, and a Multi-Layer Perceptron (MLP)—and evaluate them on a held-out test set using $R^2$, RMSE, and MAE. Among these, the Random Forest model performs best ($R^2 \approx 0.52$, with the lowest RMSE and MAE), suggesting that it can explain a meaningful amount of the variation in H298. Overall, this work shows that general-purpose machine learning methods can provide a cost-effective baseline for molecular property prediction and points toward future improvements using richer structural descriptors and more advanced models.

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Doctoral-S / Advanced
Graduate Studies

## Changing the Reflectivity of a Glass Surface Through Interference Between Two Linearly Polarized Laser Beams.

The interaction between two cw-TEM00 linearly polarized laser beams and silica dipoles of a crown glass surface is analyzed to create an optoelectronic switch. The coherent superposition of two cw-lasers beams of different brightnesses incident on the same surface can inhibit the surface's reflectivity to the weaker

laser beam at several angles of incidence near the Brewster Angle (BA). We report an experimental method for energy retention of a probe laser beam incident on the surface dipoles through coherent interference with a brighter laser beam oriented at normal incidence on the surface and polarized parallel to the plane of incidence, which irradiates simultaneously the surface. We use two Gaussian diode laser beams of 2mm in diameter and long temporal coherence. The interaction between the probe laser and the surface dipoles is analyzed through the parallel component of the probe's reflectance normalized to the total reflectance, which according to our theory has a parabolic variation near BA. The coherent superposition between probe and coupler modulates the parabola with a sinusoidal interference pattern, having minima and maxima of reflectivity evenly spaced. The superposition on the glass surface creates polarizable arrays of surface dipoles. Our results indicate that at certain angles of incidence the reflectivity of the glass surface to the weak probe can efficiently enhance (i.e. at 58.24 deg. for 0V), while for an increase in the voltage (i.e. 0.3 and 1.3V), the reflectivity is diminished, and the energy of the probe is retained on the surface.

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**Poster 39**
UG-S / In-progress
Faculty Research Grant

## Interaction of Trichoderma and Streptomyces co-cultured under alkaline conditions.

Microbial interactions play a critical role in determining growth performance and stress adaptation under unfavorable soil conditions. In this study, we evaluated the growth responses of Trichoderma afroharzianum and Streptomyces griseus cultured on nutrient agar plates under control and alkaline (high-pH) conditions. Both organisms were examined in single culture and co-culture across five time points (Day 1, 3, 5, 7, and 14) to assess colony size and stress tolerance. In single culture, both microbes exhibited progressive colony growth over time, although alkaline stress significantly suppressed expansion at later stages, particularly on Day 14 ($p < 0.05$–$0.01$). Co-cultivation enhanced early-stage growth and partially mitigated alkaline inhibition, suggesting synergistic metabolic interactions or nutrient exchange between the two species. Nevertheless, prolonged alkaline exposure continued to limit colony expansion in both strains. Overall, T. afroharzianum demonstrated greater pH adaptability than S. griseus, highlighting its potential role as a bioinoculant for enhancing microbial resilience and soil health in alkaline environments.

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**Glossary:**

GR means Graduate student.

UG means Undergraduate student

**H** – Humanities, Arts, Social and Behavioral Sciences, Education, and Business

**S** – Science, Technology, Engineering, and Mathematics

UG-H means Undergraduate student in HASBSEB area.

UG-S means Undergraduate student in STEM area.

SURF means Summer Undergraduate Research Fellowship.

URG means Undergraduate Research Fellowship (at Lamar University)

McNair, SURF, Beck, Welch, and other sponsorship programs are indicated.

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GR-S / In-progress
Welch Foundation Research
College of Arts & Sciences
Spring Research Award Project

## Development of Dual-Fluorescence Probes for Selective Targeting of G-Quadruplex DNA.

G-quadruplexes (GQs) are guanine-rich DNA secondary structures located in telomeric and oncogenic regions that regulate telomerase activity. Stabilization of GQs can inhibit telomerase, providing a promising anticancer mechanism. However, most existing fluorescent probes suffer from poor selectivity and single-color emission, limiting their potential in diagnostic and imaging applications.

This study focuses on the synthesis of novel dual-fluorescence probes (MUA1–4) designed to selectively bind and visualize GQ DNA. Photophysical and biological evaluations were conducted to assess optical efficiency and biocompatibility. Molecular docking using AutoDock 4.2 was performed with four telomeric GQ structures (PDB IDs: 1NMZ, 1KF1, 2JPZ, 1XAV) and duplex DNA (1Z3F) as a control.

Docking studies revealed strong and consistent binding of the ligands to all GQ receptors, with the lowest binding energy (ΔG = –9.37 kcal/mol) observed for receptor 1NMZ, indicating a stable complex formation. Key interactions included hydrogen bonding and π–π stacking with guanine tetrads. The coumarin–imide derivative MUA-I-4 exhibited dual fluorescence emission at 360 nm and 460 nm and demonstrated low cytotoxicity (2–50 µM) in MTT assays, confirming its biocompatibility.

MUA-I-4 displays selective and stable binding toward telomeric G-quadruplex ($G_4$) DNA with minimal cytotoxicity, making it a promising candidate for fluorescence-based GQ visualization and cancer diagnostics.

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**Poster 10**
GR-S / In-progress
Departmental Research

## Does Farnesol Inhibit the Formation of Ergosterol in Candida Tropicalis?

Farnesol has been studied as a growth inhibitor of the Candida family of yeasts. The mechanism of this drug is unclear, however, based on previous studies of the sterol metabolic pathway of eukaryotic cells it is possible that farnesol disrupts the ergosterol biosynthetic pathway. To test this hypothesis, Candida tropicalis cells were exposed to different amounts of farnesol. Following extraction, the relative amounts of lipids were evaluated using gas chromatography. Results suggest that while farnesol affects the sterol pathway, it is likely because of a more complex mechanism of activity.

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**Poster 12**
UR-S / In-progress
Faculty Research Grant

## Controls of Methane Emissions in the Coastal Marshes of the Texas Chenier Plain experiencing subsidence and restored by dredge material placement.

Coastal marshes are important sinks for atmospheric $CO_2$, but they can also emit methane, a more potent greenhouse gas. Methane emissions tend to increase when salinity falls below ~18 ppt because limited sulfate availability reduces competition between sulfate-reducing bacteria (SRB) and methanogens. In the Texas Chenier Plain, marsh subsidence and sea-level rise have caused more frequent and prolonged flooding, leading to elevated sulfide, vegetation dieback, and formation of open-water ponds. Current restoration efforts in the Salt Bayou Watershed involve placing dredged sediment to raise marsh elevation and modifying hydrology to lower salinity stress.

This study examined sediment methane and atmospheric methane flux from six coastal marsh sites representing natural, degraded, and restored conditions. Sampling occurred in October 2023 after a severe drought and in July 2024 during a wetter period. Marsh elevation, sediment chemistry, and microbial community composition influenced methane patterns. The greatest sediment methane and emissions were found at the lowest-elevation marsh dieback areas, characterized by toxic sulfide concentrations, reduced dissolved iron, and sparse vegetation. These sites also showed increased abundance of methyl-reducing Methanomassiliicoccales, indicating a methanogenesis pathway less constrained by sulfate reducing bacterial competition. Restoring elevation appears to enhance plant production and reduce methane emissions in degraded marshes.

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**Poster 21**
UG-S / In-progress
CNAS Research

## Heat Shock Protein 70 (HSP70) in the rotifer Adineta Vaga: Genome-Wide Screening, Phylogenetic Annotation, and Expression in Response to Heat Stress.

HSP70, also known as the "Guardians against Stress," is a molecular chaperone responsible for protecting cells against stress-induced damage. By establishing quick interactions with short, hydrophobic peptide regions, they have a significant role in a variety of biological processes. Rotifers, microscopic aquatic animals, are highly adaptive to various stressors in their environment, making them the model organism for researching more on HSP70. In this experiment, we study how the HSP70 gene in Adinetav aga, a class of Rotifers, responds to heat as a stressor. Three A. vaga samples were assigned to different treatments: a control group, a heat-treated group, and a recovery group. The Rotifer samples were incubated at different temperatures. RT-PCR was used to quantify HSP70 expression with specific primers to each variant of the chaperone gene, allowing precise measurement of mRNA changes in response to heat. Our results show that among the A. vaga samples that were tested, those that received heat treatment had significantly higher levels of HSP70 compared to the control and recovery samples, despite varying primers. While heat treatment significantly increased HSP70 levels in all samples, decreases in the recovery of HSP70 levels varied among primers. Overall, these findings demonstrate that HSP70 is strongly induced by heat stress in A. vaga, emphasizing its importance in protecting cells against varied stressors and advancing future research on diligent stress mechanisms. The variation in recovery of HSP70 levels among different primers indicates a possibility of regulation mechanisms during the recovery phase, indicates the need for future investigation.

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**Poster 7**
GR-S / Advanced
Faculty Research Grant

## Highly Selective Schiff Base-Thiourea Fluorescent Probe for Hg2+ and Cu2+ Ions: Quenching Mechanism and Environmental-Biological Applicability.

This study presents the development of a thiourea derivative-based chemo-sensor and its precise fluorometric response to $Hg^{2+}$ and $Cu^{2+}$ ions. The chemo sensor ligand underwent a precise two-step synthesis process and was thoroughly characterized using NMR, IR, and MS techniques. Optimization

experiments established that the sensor achieves maximum fluorescence in a 75% DMSO-water mixture at pH 7.4 and displays remarkable stability across varying pH levels. Selectivity tests revealed significant fluorescence quenching upon interaction with $Hg^{2+}$ and $Cu^{2+}$ ions, though further titration confirmed binding ratio to $Hg^{2+}$ and $Cu^{2+}$ to be 1:1, verified with Job's plot analysis. Competition assays demonstrated the ligand's superior selectivity for $Hg^{2+}$ and $Cu^{2+}$ even in complex matrices. These findings present the ligand as an exacting and reliable chemo-sensor, optimized for detecting $Hg^{2+}$ and $Cu^{2+}$ with unparalleled precision. The study underscores its potential as a critical tool for environmental and industrial and biological applications demanding robust and selective ion detection.

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**Poster 4**
GR-S / In-progress
Departmental Research

## Differentiating Between Synthetic Fibers: A Forensic Evidence Investigation.

In the forensic field, fibers are commonly used as trace evidence since they are easily transferred between a person and the places they have been or the people they have interacted with. The challenge is to find physical or chemical characteristics that can lead to determining the origin of fiber evidence. Synthetic fibers such as nylon are difficult to differentiate. To develop a systematic approach in characterizing synthetic fiber, four test samples and a nylon standard sample were analyzed using Fourier transform spectroscopy (FTIR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and gas chromatography (GC). The combination of TGA and GC looks promising as a differentiation technique.

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**Poster 11**
GR-S / In-progress
Departmental Research

## Effect of TiO2 Nanoparticles on the Sterol Biosynthetic Pathway of Candida parapsilosis.

Candida parapsilosis cells were cultured in YPD broth at 30 °C for 24 h until mid-log phase and exposed to titanium dioxide ($TiO_2$) nanoparticles at concentrations of 5–200 µg/mL for 24 h. Following centrifugation, the pellets were hydrolyzed in 10 % KOH/methanol, and cellular lipids were extracted using hexane. The dried extracts were re-dissolved in methanol and analyzed by gas chromatography (Agilent 8860 GC, HP-5 column, TCD detector).

Microscopic imaging was used to observe morphological changes and cell density, while gas-chromatographic data were collected to quantify sterol composition, including cholesterol, ergosterol, and lanosterol peaks.

Microscopy revealed reduced cell density and the appearance of hyphal forms at ≥ 50 µg/mL $TiO_2$. GC analysis showed decreased total lipid content and significant alteration of sterol peak ratios compared with controls, suggesting nanoparticle-induced disruption of the ergosterol biosynthetic pathway.

The antifungal activity of $TiO_2$ nanoparticles against C. *parapsilosis* appears to stem from oxidative stress and interference with membrane sterol synthesis. These findings indicate that $TiO_2$ nanoparticles may serve as effective non-traditional antifungal agents, offering potential for applications in combating biofilm-associated and drug-resistant Candida infections.

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**Poster 25**
GR-S / Advanced
Faculty Research Grant

## Rapid Electroanalysis of Amphetamines in Biofluids: Sensor Development, Characterization and Modification using Nitrogen-Doped Carbon Nanotube/Chitosan Screen-Printed Electrodes.

Here we report simple, cheap and rapid electroanalytical method for the detection of two amphetamines, 3,4- methylenedioxyamphetamine (MDA) and 3,4- methylenedioxymethamphetamine (MDMA). The method used screen-printed electrodes (SPE) modified with N-doped carbon nanotube (N-CNT)/chitosan matrix and square wave voltammetry (SWV) to achieve a rapid method for screening and analysis of the psychoactive stimulants in the biofluids.

Commercial SPEs were drop-coated with aqueous N-CNT/Ch and dried. CV (0.5 mM K3[Fe(CN)6]) and EIS (Nyquist fits) quantified electron-transfer and charge-transfer resistance. SWV was optimized (step 10 mV, amplitude 25 mV, ~30 Hz) in phosphate buffer. Accuracy and matrix effects were assessed by spike-and-recovery of MDA/MDMA in human urine and saliva with minimal pretreatment.

Versus bare SPEs, cathodic peak current increased from ~4.3 to ~14.3 µA; charge-transfer resistance fell from ~383 to ~20 Ω. SWV gave linear ranges to ~50 µM (MDA, $R^2$≈0.998) and ~150 µM (MDMA, $R^2$≈0.992); LODs were ~0.22 µM (MDA) and ~1.2 µM (MDMA). Per-sample time was <1 min. Spike-recovery was 93–99% (MDA) and 82–94% (MDMA) in urine and saliva.

N-CNT/Ch-modified SPEs provide fast electron transfer, low interfacial resistance, and strong analytical performance. With SWV, they enable rapid, sensitive, accurate MDA/MDMA screening in biofluids, supporting portable forensic and clinical workflows at low cost.

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**Poster 19**
UG-S / Advanced
TEAM-UP Research Grant

## Impact of Multiple-Intelligences on Student Performance and Confidence in Preparatory Physics Course.

This study explores how multiple intelligence (MI) impact academic performance and confidence in the Preparatory Physics Foundation (PPF) Course. Using Howard Gardner's MI framework, 268 students were classified as analytical, introspective, or interactive. Findings show that over 51% of students identified as having introspective intelligence, 23% analytical and 26% interactive. By the end of the course, nearly half 47% experienced a decrease in confidence, 31% remained unchanged, and 22% reported increased confidence. Performance data revealed that analytical students excelled on early exams, whereas introspective and interactive learners scored lower initially. All groups experienced declines on the final exam. Statistical analysis, including Chi-square and Ordinal Regression, indicated no significant correlation between MI type and confidence change or overall performance. These findings suggest that while MI influences initial academic patterns, it does not serve as a reliable predictor of confidence or success, highlighting the complex nature of learning styles in PPF.

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**Poster 6**
UG-S / In-progress
Faculty Research Grant

## In Silico Analysis of a Novel Dual-Emission Fluorescent Ligand Targeting Telomeric G-Quadruplex DNA.

Telomeric DNA consists of guanine-rich sequences capable of forming G-quadruplex ($G_4$) structures, which regulate genomic stability and inhibit telomerase—an enzyme often overexpressed in cancer cells. Stabilizing these $G_4$ structures represents a promising anticancer strategy. This study reports the design, synthesis, and in silico characterization of a novel dual-emission ligand, MUA-I-4, for probing telomeric $G_4$ DNA. The ligand was synthesized via a Knoevenagel condensation between 3-formylchromone and 1,3-indandione, yielding a chromone–indandione scaffold exhibiting dual fluorescence emission at 360 nm and 430 nm. Molecular docking was conducted using AutoDock 4.2 against four telomeric $G_4$ DNA receptors (PDB IDs: 1NMZ, 1KF1, 2JPZ, 1XAV). Binding interactions were visualized with UCSF Chimera, and binding energies (ΔG) were used to evaluate stability and selectivity. MUA-I-4 demonstrated favorable and consistent binding affinities across all $G_4$ receptors, with the strongest interaction observed for 1NMZ (ΔG = −9.37 kcal/mol), supported by hydrogen bonding and π–π stacking with guanine tetrads. These findings indicate that MUA-I-4 selectively binds and stabilizes telomeric G-quadruplexes, supporting its potential use as a dual-emission fluorescent probe for telomeric imaging and structural studies. Future work will

involve molecular dynamics simulations and live-cell imaging to assess probe stability and biological applicability.

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**Poster 28**
UG-S / In-progress
Faculty Research Grant

## Assessing Domain Interactions in Fusion Proteins Through Structural Modeling.

Chromosomal rearrangements can generate oncogenic gene fusions that alter protein structure and function. We investigated the FGFR3-KHSRP fusion, found to be present in pancreatic tumors, to understand the physical consequences of the fusion on domain interactions and antibody accessibility. Using AlphaFold, we predicted three-dimensional structures of FGFR3, KHSRP, and the fusion protein, validating their reliability through alignment with Protein Data Bank structures with the structures in good agreement. To understand the interactions between domains we used ZDock, a rigid-body docking algorithm that samples rotational and translational configurations in phase space and scores their binding likelihood using statistical potentials. Docking analysis suggested strong interactions between FGFR3 domain 4 and KHSRP domains 1 and 2, with higher scores than our control interactions. This analysis suggests the domain binding may introduce excluded-volume effects that reshape the free-energy landscape of protein–antibody interactions. These results provide an explanation for experiments that show KHSRP antibodies do not bind to the FGFR3-KHSRP fusion. This work emphasizes the value of physics-based modeling in uncovering how fusion proteins may bypass therapeutic recognition.

*Key words: Genetics, Gene fusions, Pancreatic Cancer, Protein-Protein Docking, AlphaFold, ZDock*

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**Poster 35**
GR-S / In-progress
Departmental Research

## Development of Chroman–Rhodamine-Based Fluorescent Probes for Selective Targeting of G-Quadruplex DNA.

G-quadruplexes (G4s) are unique four-stranded DNA structures formed in guanine-rich genomic regions. They play critical roles in gene regulation and are closely associated with cancer development. Identifying small molecules that selectively bind to G4s can provide valuable tools for studying their biological functions and developing new strategies for cancer detection.

In this study, four chroman–rhodamine–based compounds were designed and synthesized to evaluate their binding affinity toward G-quadruplex DNA compared to conventional double-stranded DNA. Molecular docking studies with various G4 topologies revealed that these compounds exhibited strong and selective binding interactions with G-quadruplex structures.

Fluorescence microscopy demonstrated efficient cellular uptake and predominant nuclear localization, consistent with the intracellular distribution of G4s. Notably, the probes produced a pronounced fluorescence "turn-on" response upon binding to nuclear G-quadruplexes. Cytotoxicity assays using HeLa cells confirmed that the compounds are non-toxic within the concentration range of 2–12 µM.

Overall, these findings suggest that the newly developed chroman–rhodamine probes are promising, biocompatible tools for live-cell imaging of G-quadruplex DNA. Future work will focus on enhancing their selectivity and photophysical properties for advanced imaging and potential applications in cancer diagnostics.

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**Poster 5**
UG-S / In-progress
Departmental Research

## Does Hydrocortinone Affect Lipid Biosynthesis Pathways in Eukaryotic Cells?

Lipids, particularly steroids and sterols, are an important component in the metabolic pathway of opioids. Understanding changes in the lipid biosynthetic pathways can lead to the potential development of novel drug targets to minimize unwanted side effects of opioid consumption. Hydrocortisone, a glucocorticoid hormone, and *Pinus palustris* plant cells were used as proxies for opioids and eukaryotic cells due to accessibility. This study investigates the effects of hydrocortisone metabolism in *Pinus palustris* cells. Following cell exposure to 1% hydrocortisone, the cell lipids were extracted and analyzed using gas chromatography (GC) to determine appropriate metabolites. Preliminary results suggests complex metabolite formation.

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**Poster 13**
UG-S / In-progress
Faculty Research Grant

## Beneficial Fungus Trichoderma afroharzianum T22 Promotes Salinity Tolerance in Sorghum (Sorghum bicolor).

Salinity is a major environmental stress that limits sorghum (*Sorghum* bicolor) productivity by impairing growth, physiology, and yield. Beneficial soil microbes such as *Trichoderma afroharzianum* T22 have been recognized for their ability to promote plant growth and enhance stress tolerance through multiple mechanisms. However, its role in sorghum salinity response remains unexplored. In this study, sorghum

plants were grown in soil under control and saline conditions, with or without inoculation of *T. afroharzianum* T22, to evaluate its role in mitigating salt-induced stress. Results showed that salinity significantly reduced shoot height, fresh biomass, and root length compared with control plants. However, *T. afroharzianum* T22 inoculation markedly improved plant growth parameters under saline conditions, as evidenced by increased shoot and root biomass and improved overall vigor. Visual observations further indicated that T22-treated plants maintained better leaf greenness and shoot development compared to non-inoculated plants under salinity stress. These findings suggest that *T. afroharzianum* T22 holds strong potential as a bioinoculant to alleviate salt stress in sorghum, thereby contributing to agricultural sustainability in saline-prone environments.

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**Poster 2**
UG-S / In-progress
Center of Research

## Controlling Polylactic Acid Degradation Using MgO Nanoparticles for Biomedical Applications.

Magnesium-based biomaterials and biodegradable polymers, like polylactic acid (PLA), are increasingly appealing for temporary biomedical purposes due to their biocompatibility and ability to degrade. The challenge is to control degradation while managing the physical properties and conserving the biodegradability. This study focuses on evaluating the potential of PLA-MgO nanocomposite as a material for medical applications. Films of PLA containing various amounts of MgO nanoparticles were produced from solutions. The samples were evaluated or structural changes using FTIR spectroscopy and changes in thermodynamic properties were followed using differential scanning calorimetry. Results show that the amount of MgO could be used to tailor the biodegradation and process-ability of the material.

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**Poster 36**
GR-S / Advanced
Faculty Research Grant

## An Empirical Evaluation of Large Language Models to Generate Unit Test Code for Industrial Automation Controller.

The reliability of industrial automation systems heavily relies on the correctness of Programmable Logic Controller (PLC) programs, often written in Structured Text (ST). While Large Language Models (LLMs) have shown promise in automating test generation for mainstream languages, their effectiveness for the syntactically strict ST language remains underexplored. This paper presents a systematic empirical evaluation of three prominent LLMs—ChatGPT-4o, Gemini Flash, and Claude Sonnet 4—for generating ST

unit tests. We investigate three distinct prompting strategies (Natural Language, Code Language, and Chain-of-Thought) across a curated set of 11 ST function blocks. The quality of the generated tests is assessed using Compilation Success Rate (CSR), Statement Coverage (SC), and Branch Coverage (BC). Our findings indicate that while Claude Sonnet 4 achieves the highest CSR, Gemini Flash consistently produces tests with the highest statement and branch coverage, particularly when guided by code-centric prompts. We provide a detailed analysis and classification of over 100 compilation errors, revealing common failure modes for LLMs in this domain. This study offers the first comprehensive benchmark of modern LLMs for ST unit test generation, providing critical insights into their capabilities and limitations in the context of industrial automation.

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**Poster 31**
GR-S / Advanced
Faculty Research Grant

## Robust or Overfitted? Investigating the Generalization of Pretrained Models in Requirement Classification.

***Background***: Accurate classification of non-functional requirements (NFRs) is essential for aligning stakeholder expectations with system design and ensuring software quality. While transformer-based models such as PRCBERT and NoRBERT have achieved high performance in supervised settings, their generalizability across diverse sources of requirements remains largely unexplored. In practice, requirements originate from heterogeneous platforms, ranging from structured specification documents to informal developer discussions on forums like Stack Overflow. ***Aim***: This study provides the first comprehensive, bidirectional cross-dataset evaluation of domain-specific, embedding-based, and prompt-based large language models (LLMs) for NFR classification across two contrasting platforms: PROMISE (structured) and NFR-SO (informal). ***Method***: We evaluate domain-specific fine- tuned models, sentence embedding models, and prompt-based LLMs (including GPT-4o) in both zero-shot and few-shot settings. Performance is measured both in-domain and in cross-platform transfer scenarios to assess generalization with minimal or no labeled data. ***Results***: Domain-specific fine-tuned models, although effective in-domain, exhibit substantial performance degradation when transferred across platforms. In contrast, LLMs, particularly GPT-4o in few-shot mode, consistently outperform other approaches in cross-platform scenarios, achieving strong generalization with minimal labeled data. In zero-shot mode, GPT-4o also demonstrates robust performance without any supervision. ***Conclusions****:* Traditional supervised models face limitations in cross-platform NFR classification. Prompt-based LLMs offer a scalable, low-supervision solution for diverse requirement sources.

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**Poster 37**
UG-S / In-progress

## Physics students' geometric conceptions of complex analysis: A comparative case study.

While there has been extensive research conducted about students' mathematical thinking there has been little to no research on how physics students adapt to an advanced mathematics course. The purpose of this case study is to examine the thought processes of physics students in a complex analysis course using Tall's (2013) three worlds of mathematics as a theoretical perspective. This poster highlights some of the mathematical strategies possessed by physics students who take an advanced mathematics course such as complex analysis, including their differences in mathematical thinking, and ways they go about solving complex mathematical problems.

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**Poster 38**
UG-S / Early phase
High-School project

## MOTION - An Immersive Augmented Reality Platform Integrating Biomechanical Feedback for Chronic Musculoskeletal Rehabilitation.

Chronic musculoskeletal disorders affect more than 1.7 billion people in the world and are the leading causes of long-term disability and loss of functional mobility. The treatment of these conditions requires regular exercise and supervision by a clinician, while simultaneously providing precise real-time feedback. MOTION provides a 3D augmented reality environment that increases engagement, precision of movement, and therapeutic feedback during the rehabilitation process.

Developed in Unity, MOTION brings together the three dominant technologies for human motion capture-spatial mapping, skeleton modeling, and depth cameras to capture high-accuracy full-body kinematics. Dynamic exercise targets and visual cues can be projected through interactive augmented reality overlays directly into the user's space. MOTION employs an adaptive feedback algorithm, tracking repetition count, tempo consistency, and range-of-motion targets to allow the system to tailor difficulty and pacing in real time.

The platform introduces a gamified "motion-matching" mechanic where users align their body with a projected silhouette representing optimal movement form. Real-time skeletal alignment feedback encourages users to refine accuracy while providing immediate visual reinforcement.

MOTION focuses on treating chronic conditions like scleroderma, osteoarthritis, and other degenerative musculoskeletal diseases by combining biomechanical precision with motivational design for better, sustained adherence. Its scalable architecture allows for potential integration with home-based therapy and into clinical environments to have remote monitoring and data-driven insights. Combining immersive visualization, adaptive feedback, and accessible motion tracking, the MOTION system redefines the implementation of musculoskeletal rehabilitation.

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**Poster 8**
GR-S / In-progress
Departmental Research

## Exploring the Antifungal Potential of Titanium Dioxide Nanoparticles Against *Candida Tropicalis*.

Candida tropicalis is an opportunistic fungus that, under certain conditions, can act as an opportunistic pathogen, penetrating epithelial barriers and causing a multitude of mucosal and systemic infections, namely candidiasis. While several antibiotics exist, understanding the cells' development of antibiotic resistance may lead to better treatments. This study explores the antifungal potential of titanium dioxide (TiO2) nanoparticles against C. tropicalis. Cells were cultured while exposed to different amounts of TiO2. The cell morphology of exposed samples were observed using optical microscopy, and the lipid composition of the samples was analyzed using gas chromatography (GC). Besides confirming an overall decrease in cell growth, microscopy images revealed the formation of hyphae, first of an aseptate structure, but more of a septate structure at higher TiO2 amounts. GC results suggest that TiO2 nanoparticles disrupt the ergosterol biosynthesis pathway.

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**Poster 9**
GR-S / In-progress
Welch Foundation Research

## Can Zinc Oxide Nanoparticles Affect the Biosynthetic Production of Ergosterol in Candida Species?

Candida species such as Candida albicans and Candida parapsilosis are opportunistic fungal pathogens responsible for various infections in people with weak immune systems. Under certain circumstances, they become pathogenic requiring the development of antifungal drugs. These drugs target the ergosterol biosynthetic pathway, but drug resistance is becoming a problem. Our goal is to seek to understand this pathway better to establish different drug targets. Candida a. and Candida p. cells were separately grown in the presence of different amounts of ZnO nanoparticles, a known sterol pathway inhibitor, and the lipid composition of the cells was evaluated using gas chromatography. Results show that the cell lines react differently and a minimum concentration of ZnO, a significant change in the sterol composition occurs.

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**Poster 18**
UG-S / In-progress
TEAM-UP Research Grant

## Improving the performance of colored filters using polarizers.

Photoelectric effect represents the emission of electrons due to photon absorption by a metal or an alloy surface. Two characteristics are relevant to the process: its cut-off frequency and the kinetic energy of the least bound electrons. The cut-off wavelength for photon detection is 729nm. The kinetic energy of the most energetic electrons depends on the energy of the incident light and can be measured through a stopping potential, where the photocurrent, i, drops to zero. We use five characteristic wavelengths (365,404.7, 435.8, 546.1 and 577nm) emitted by a mercury lamp and select them with narrow band filters for measuring the associated stopping potential, Vs. Using various apertures, wide of 2-, 4- and 8-mm, we find the precision in measuring Vs with our instrumentation, which is of 2 decimals (i.e. for 365nm, Vs is -1.81volts, while in theory it is -1.83eV). Our goal is to test various commercial filters, and thus measure the wavelengths transmitted from the analysis of the characteristic curve, V vs. i, as well as of the Vs. We are looking for finding the lower limit of the transmission bandwidth. Some filters indicate a stopping voltage much wider than their apparent color: for example, a red filter had Vs of -1.68V, and in consequence, the energetic UV photons with □ > 365nm can go through, which is very bad because the red ranges from 580 to 780nm. When a polarizer was introduced in front of this filter, the stopping voltage increased significantly to -1.09V and moved the lower end of the transmission to the blue range of □ > 441nm, thus eliminating the energetic purple and UV photons over almost 80nm. The improvement of optical filters by eliminating with polarizers some of the unwilling energetic photons will be presented in our poster.

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**Poster 23**
GR-S / In-progress
Faculty Research Grant

## Mixed reality simulation training for first responders in hurricane scenarios.

Augmented and mixed reality (AR/MR) technologies have revolutionized professional training by providing immersive, interactive, and cost-effective learning experiences that bridge the gap between theoretical instruction and field practice. This research investigates the application of mixed reality for enhancing hurricane preparedness among first responders (FRs), who must operate in high-risk, unpredictable, and dynamically changing environments. Traditional emergency training is often conducted in static or controlled settings that fail to replicate post-hurricane realities such as flooding, power outages, debris-blocked routes, and high-wind noise—conditions that critically influence situational awareness, decision-making, and task efficiency.

To address these limitations, an MR-based training system was developed using head-mounted displays to immerse trainees in realistic, hurricane-specific scenarios. The system integrates two core components: (1) dynamic environmental simulation of hurricane conditions to strengthen cognitive resilience, task prioritization, and adaptability under stress, and (2) an interactive user interface that enables real-time modification of environmental parameters—such as lighting, ambient sounds, water levels, and physical

obstacles—allowing instructors and researchers to continuously adjust scenario complexity based on user performance or training objectives.

This adaptive simulation framework provides a safe, repeatable, and data-driven environment for first responders to practice critical emergency procedures, resource management, and teamwork coordination. The system aims to bridge the realism gap between conventional tabletop training and field deployments, improving decision-making accuracy, situational awareness, and overall readiness in hurricane response operations.

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**Poster 33**
UG-S / In-progress
2025 SURF Project

## From User Reviews to Code: A Large Language Model Approach to Automated Software Traceability.

This research introduces an automated framework that links user-reported issues from mobile app reviews to corresponding methods in the source code using Large Language Models (LLMs) and Retrieval Augmented Generation (RAG). Mobile apps receive thousands of reviews containing valuable feedback about bugs, crashes, and performance issues, but manually analyzing and mapping these reviews to code is time-consuming and inefficient. The proposed system operates through four integrated phases: (1) classifying and filtering user reviews with fine-tuned LLMs to extract actionable comments such as bug reports, performance issues, and crashes; (2) generating detailed code summaries that form a semantic bridge between natural language and program logic; (3) constructing a multi-dimensional knowledge base combining keyword, vector, and graph indexes to capture both semantic and structural relationships in the codebase; and (4) implementing a hybrid retrieval mechanism that progressively refines search results through complementary strategies. The approach is expected to achieve approximately 75% traceability accuracy, substantially reduce issue resolution time, and generate open-source datasets for future research. By automating the connection between user feedback and implementation details, this work enhances software quality, boosts developer productivity, and advances data-driven, AI-assisted software maintenance.

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**Poster 29**
GR-S / In-Progress
Faculty Research Grant

## Uncovering Technical Debt in HPC Codebases: A Comment-Centric Analysis of Developer Trade-offs.

Self-Admitted Technical Debt (SATD), comments in code where developers explicitly acknowledge suboptimal implementations poses a significant challenge to the sustainability of High-Performance Computing (HPC) systems. This research presents a novel large-scale empirical study on SATD across HPC codebases, focusing exclusively on code comments to uncover domain-specific patterns and implications. We developed an automated SATD detection framework that integrates historical commit analysis, structural parsing, and domain-driven keyword heuristics, including both general SATD indicators and HPC-specific terms related to parallelism, performance tuning, hardware portability, and scalability constraints. Our multi-repository dataset spans several actively maintained HPC projects, mined over a multi-year timeline. Through this, we not only extracted and categorized SATD instances but also linked them to developer experience levels, code ownership, and removal timelines. The findings reveal a distinct distribution of SATD types in HPC, performance and platform-specific debts dominate, often introduced by experienced contributors during rapid optimization cycles. Interestingly, such debts tend to be resolved faster than others, suggesting intentional short-term compromises to meet computational goals. The study contributes new insights into how SATD manifests in performance-critical software and offers a reproducible methodology for SATD identification in scientific domains. These insights can inform future tooling for intelligent technical debt detection and prioritization in large-scale, computation-intensive projects. Our approach sets the foundation for bridging the gap between software engineering best practices and the evolving demands of HPC development.

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**Poster 15**
GR-S / In-Progress
Departmental Research

## Nano-Enhanced Polystyrene Films: Bridging Antimicrobial Activity and Thermal Stability.

Synthetic polymer materials are commonly used as temporary medical devices such as catheters. These devices need to be flexible, reasonably strong, thermally stable, and capable of undergoing sterilization. When improperly used infections surrounding the devices can cause serious issues. Our objective is to develop a nanocomposite that reduces the possibility of infection while still possessing the physical and thermal properties necessary for medical applications. Polystyrene-based nanocomposite films incorporating ZnO nanoparticles - possessing some antibiotic properties - and MgO nanoparticles - a compatibilizer - were produced as potential candidates. Polystyrene solutions (5%) in toluene were cast on water to form thin films onto which dispersions of ZnO and MgO nanoparticles were deposited in different amounts. The films were characterized using Fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and optical microscopy to evaluate molecular interactions, thermal stability, and confirm particle dispersion. E. coli cells were exposed to nanocomposites as a test of viability. Results suggest that nanoparticle addition improves the thermal stability of the material through increased chain-chain interactions and influence biocompatibility, underscoring the potential of these nanocomposites for biomedical applications.

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**Poster 30**
GR-S / In-Progress
Faculty Research Grant

## Instant Answers, Lasting Impact: Transforming Academic Advising through AI

Academic advising is a cornerstone of student persistence and graduation, yet its effectiveness is often undermined by fragmented information ecosystems. Advisors at many institutions spend upwards of 40% of their time answering routine, procedural questions, creating response delays that correlate with student registration errors and attrition. To address these critical challenges, this proposal outlines the development of VirtualAdviser, an innovative retrieval-augmented generation (RAG) advising platform powered by a Large Language Model (LLM). This system is designed to provide 24/7, personalized, and context-aware guidance by synthesizing university-specific policies, complex degree requirements, and individual student records. A key feature includes a secure Degree Audit Parser, enabling the system to analyze a student's academic progress and provide specific, actionable course recommendations. VirtualAdviser utilizes a RAG pipeline where a comprehensive knowledge base—comprising academic calendars, course catalogs, and policy documents—is indexed in a vector database for efficient semantic retrieval. This retrieved context grounds the LLM's response generation, ensuring factual accuracy and mitigating hallucinations. The platform's performance will be rigorously evaluated using the RAGAS framework (measuring context precision, recall, faithfulness, and relevance) and a System Usability Scale (SUS) survey. Initially deployed for computer science students, this project aims to deliver a highly accurate and usable advising tool, freeing professional advisors to focus on high-impact developmental conversations and ultimately improving student satisfaction and success.

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**Poster 40**
UG-H / Advanced
URG Project

## Asexuals of Color: Experiences of an Invisible Identity.

Asexuality, or the lack of sexual attraction or low sexual interest, is a relatively new and growing orientation within the LGBTQIA+ community. Anthropologists, scientists, and activists study the identity's meaning and related history as the community continues to find acceptance and understanding. As asexuality became more mainstream in Queer and youth culture, the orientation has continued to expand its representation. However, due to the lack of perception, the orientation has become white-centric and overlooked in minority groups. This study delved into the shared experiences and stories of ten participants who identified as an asexual of color. This project utilized interpretative phenomenological analysis- a qualitative methodology that identifies trends in data to create assumptions about a population

or demographic. The study conducted private-personal interviews consisting of eight open-ended questions and found five central trends across the participants' testimonies: (1) Identifying as Asexual, (2) Disclosure of Identity, (3) Sexualization and Fetishization of BIPOC Asexuals, (4) BIPOC Asexuals within Queer and Asexual Communities, (5) Self-Acceptance. This research aims to bring attention to asexuality and the lived experiences and journeys of Asexuals of color.

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**Poster 16**
UG-H / In-progress
2025 SURF Project

## Bridging Disciplines: Integrating Interprofessional into Modern Healthcare Education.

Careers in rehabilitation are vital for addressing patients' physical needs, such as mobility, speech, and coordination. These fields encompass diverse occupations—each requiring specialized skills acquired through rigorous graduate and professional education. Advancements in addressing motor and sensory requirements have broadened the possibilities and applications within the field of rehabilitation. However, the complex interplay of patients' disorders and diseases necessitates interprofessional collaboration (IPC) for holistic and effective care.

Interprofessional collaboration involves consistent networking and cooperation among various health professionals, pooling their expertise to craft optimal care strategies. By fostering communication, teamwork, and shared problem-solving, interprofessional education (IPE) offers a transformative framework for preparing future health professionals to engage in collaborative practice. Evidence suggests that IPE not only enhances students' readiness for interdisciplinary teamwork but also has sustained long-term effects, equipping professionals with collaborative skills that persist throughout their careers.

Additionally, teams trained in IPE have demonstrated improved patient outcomes, such as higher recovery rates, reduced medical errors, and enhanced patient satisfaction. These outcomes stem from improved care coordination and holistic, patient-centered approaches that integrate physical, cognitive, and psychosocial elements of health.

Using a systematic review, this study analyzes existing literature on IPE's role in rehabilitation practice. It explores key trends, barriers, and opportunities, laying the groundwork for future research on the long-term impact of IPE on healthcare education, collaborative practice, and patient outcomes.

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**Poster 26**
GR-H / Advanced
Center of Research

## The Role of Cochlear Implant-Hearing Aid Performance Disparity in Bimodal Benefit: A Controlled SNR Study.

**Background:** Bimodal hearing or using a cochlear implant (CI) in one ear and a hearing aid (HA) in the opposite ear allows users to benefit from electric and acoustic stimulation. While many users benefit from bimodal hearing, some report a lack of benefit. The reasons for this variability are unclear, but several possible causes have been suggested. There is speculation about performance differences between CI and HA ear influencing bimodal benefits, such as greater disparity causing reduced bimodal benefits or interference. In comparison, lesser performance disparity causes greater bimodal benefits. However, studies specifically examining the effect of performance disparity across predetermined or controlled disparity levels are currently lacking. The study aims to investigate the impact of performance disparity between the CI and HA on the bimodal benefit by combining different signal-to-noise ratio levels in the CI and HA ear. **Methods:** Fifteen individuals with typical hearing and native speakers of American English will be subjected to sentence recognition (IEEE) in different listening conditions, viz., HA alone, CI alone, and bimodal. The sentences will be mixed with speech-shaped noise and in various combinations of signal-to-noise ratios across CI and HA ear to simulate different performance disparity levels. **Results:** Linear mixed modeling will be utilized to compare the bimodal benefit across different performance disparity levels created by different SNR combinations. Further, the results will highlight differences in bimodal benefits across conditions of similar HA and CI ear advantages. **Discussion:** The study findings will provide insights into the extent of bimodal benefit expected for individual patients based on their specific performance disparities. Further, a greater understanding of CI and HA ear advantages acting similarly or differently on bimodal benefit will be rendered.

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**Poster 1**
UG-S / Advanced
Departmental Research

## Ultrasensitive Fluorescent Probe for Zinc(II) Detection: Aqueous-Phase Mechanistic Insights, Stoichiometry Studies, and Live-Cell Imaging Applications.

We report on the development of a small-molecule fluorescent probe based on an amidothiourea scaffold that demonstrates high sensitivity and selectivity for metal ion detection, particularly zinc ions, in complex environments. The probe was synthesized via a straightforward reflux method, and its structure was confirmed using standard spectroscopic techniques including NMR, IR, and MS. Photophysical studies revealed dual binding stoichiometries, suggesting flexible coordination behavior. Solvent optimization identified conditions that enhance selectivity, while time and pH-dependent fluorescence studies established optimal sensing parameters. Competitive ion experiments confirmed strong selectivity for zinc over other biologically relevant metal ions. Fluorescence microscopy demonstrated efficient cellular uptake, good biocompatibility, and intracellular localization, indicating strong potential for biological imaging applications. Overall, this probe offers a robust platform for metal ion sensing and bioimaging.

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**Poster 14**
UG-S / Advanced
2025 SURF Project

## Correlation Between Human Foot Traffic and Angel Wing Syndrome in Ducks in Parks.

This research aimed to evaluate the severity of Angel Wing syndrome in the population of domestic waterfowl in urban parks of Southeast Texas and determine if there is a correlation between human foot traffic and the prevalence of Angel Wing syndrome, on the assumption that higher foot traffic is related to how often people feed the waterfowl. Over the summer, 31 community parks were surveyed, recording the duck populations, human traffic, and instances of Angel Wing (AW) syndrome. The findings suggest no significant relationship between human presence and AW, but a significant difference was found between Angel Wing incidence and surrounding greenspace.

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**Poster 20**
UG-S / Advanced
2025 SURF Project

## Rhomboid Proteases as Conserved Engines for Parasite Pathogenesis.

Rhomboid proteases, a family of intramembrane serine proteases, are crucial in various biological processes across different organisms. Rhomboid proteases are highly conserved, indicating their essential role in biological functions. They are involved in critical processes such as cell signaling, host-pathogen interactions, and protein trafficking.

**Purpose:** This research focused on examining the conservation, structural characteristic, and functional roles of rhomboid proteases across the five disease-causing protozoans: Plasmodium, Acanthamoeba, Trichomonas, Toxoplasma, and Leishmania.

**Methods:** Phylogenetic trees were built using MAGAX, sequence homology studies performed using M-Coffee, and protein structure prediction models built using ExPASy to determine areas of conservation.

**Results:** Aligned sequences and structural comparisons reveal conserved motifs and functional domains, indicating evolutionary connections and functional similarities among the studiedprotozoans. Acanthamoeba shared traits with Plasmodium and Toxoplasma, suggesting similar molecular mechanisms in disease causation, while Trichomonas exhibited unique features that highlight its specific biological

requirements. The conservation of rhomboid proteins in Leishmania suggests a role in the parasite's virulence and host-parasite interactions.

Our study highlights the evolutionary significance and potential therapeutic targets of rhomboid proteases in pathogenic protozoa. Understanding their mechanisms can provide insights into developing targeted therapies for diseases caused by these parasites.

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**Poster 32**
GR-S / Advanced
Faculty Research Grant

## An Empirical Analysis of Developer Discussions to Unpack Network Programming Difficulties.

Network programming lies at the core of modern software development, enabling communication across distributed systems, cloud infrastructures, mobile applications, and IoT platforms. Despite its foundational role, the specific challenges network programmers face and the types of questions they ask remain underexplored. This study presents the first large-scale empirical analysis of network programming discussions on Stack Overflow, aiming to (i) identify the major topics developers engage with, (ii) understand the types of questions asked, and (iii) assess the relative difficulty of these topics. We collect and analyze over 40,000 Stack Overflow posts using Latent Dirichlet Allocation (LDA), optimized with Genetic Algorithms. We classify question types, compute difficulty and popularity metrics (e.g., unanswered rate, view count), and visualize longitudinal trends.

We also compare various metrics of the network programming domain with other software engineering domains. Our results reveal that developers predominantly discuss 15 thematically coherent topics and ask "How"-type procedural questions and frequently struggle with platform-specific and containerized networking environments, such as Docker and Python Scripting & Errors. These findings are further supported by a follow-up survey conducted with professional developers experienced in network programming. The temporal trends indicate a shift from core networking to cloud-native paradigms over the last decade. Compared to other domains such as mobile development, security, and big data, network programming posts attract higher viewership but suffer from moderate answer rates, suggesting a complexity-visibility gap. We conclude with actionable insights for educators, tool builders, and researchers to improve support, documentation, and training for network programmers.

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**Poster 3**
GR-S / In-progress
Welch Foundation

## Development of a Stable Phospholipid-Lipid Complex for Controlled Drug Release Applications.

Drug delivery systems are designed to increase the steady bioavailability of hydrophobic or semi-hydrophobic drugs. Such application is determined by the properties of the material which are ultimately related to the chemical structure. We aim to develop a highly stable phospholipid- based delivery systems by controlling interactions between phosphatidylcholine, and cholesterol and hydrocortisone as binding agents. The thermal stability of the systems was evaluated using differential scanning calorimetry. Variations in the transition temperatures and enthalpy changes as the amounts of binding agents increased suggested that the structure of the material underwent changes. These changes were confirmed by the appearance of phospholipids fibers.

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**Poster 22**
UG-S / In-progress
Departmental Research

## Metabolic Analysis of Medically Significant Plants and Spices.

Nuclear Magnetic Resonance (NMR) spectroscopy is a non-destructive tool used to assess the structure, concentration, and behavior of molecules. Star anise (*Illicium verum*), witch hazel (*Hamamelis virginiana*), and cumin (*Cuminum cyminum*) are edible plants that are known to have medicinal properties such as maintaining blood pressure, aiding in digestive health, pain relief, minor skin ailments, and preventing certain diseases. Texas Mountain Laurel (*Dermatophyllum secundiflora*) has historically been used ritualistically to produce hallucinatory effects, as well as medicinally to aid respiratory and digestive problems. Proton (1H) NMR was utilized to analyze the metabolite composition of the samples to understand how these plants achieve therapeutic results. The NMR spectrum provided a total of 42 peaks, which were referenced against the Biological Magnetic Resonance Bank (BMRB). Of those 42 peaks, one did not return results. The obtained data may prove useful in studying the potentially effective metabolites through natural sources, as well as the pathways those metabolites take when introduced to each other and the human body.

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**Poster 24**
UG-S / Advanced
2025 SURF Project

## Evaluating Effects of Process Parameters on Polymer 3-D Printing.

Fused Deposition Modeling (FDM) is a polymer additive manufacturing technique with significant potential for advancing the production of complex, high performance parts across various industries. Its ability to process a broad range of thermoplastic materials makes it a promising technology for innovation in polymer-based manufacturing. However, there is limited research on how the adjustments of process

parameters influence the strength and dimensional accuracy of the printed parts. This research focuses on optimizing the FDM process parameters, infill patterns and layer height, to enhance the mechanical properties and structural integrity of 3D-printed components. Experiments were conducted using PPA GF25, with infill patterns including honeycomb, cubic, triangles, and gyroid and layer height increments of 0.05mm, 0.1mm, 0.2mm, 0.3mm and 0.4mm. Tensile testing and microscopic analysis were used to evaluate the relationship between process variables and material performance, with attention to minimizing defects such as porosity and layer inconsistency. Results showed that a 0.3 mm layer height combined with triangle or cubic infill patterns produced the best balance of strength and stiffness. Although 0.4 mm layer height yielded the highest Ultimate Tensile Strength (UTS), it also introduced surface defects and mechanical inconsistency. Cubic and gyroid infill patterns demonstrated greater ductility, while honeycomb patterns were the least flexible. These findings demonstrate that mechanical performance in FDM-printed PPA GF25 parts can be significantly improved through careful selection of infill geometry and layer height.

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**Poster 27**
UG-S / In-progress
Welch Foundation

## Fluorescent Chemosensor Development for Early Disease Detection *via* Cysteine.

Abnormal cysteine levels are implicated in neurodegenerative, cardiovascular, and cancer-related diseases, underscoring the need for rapid, accurate, and accessible detection in clinical settings. Conventional analytical techniques such as HPLC and mass spectrometry, while highly precise, are often too costly and time-consuming for routine screening. This project aims to develop a simple, reliable, and cost-effective fluorescent chemosensor for early cysteine detection, leveraging a thiol-ene Michael addition reaction for selective recognition. The probe design integrates a maleimide moiety as the reactive site, a naphthalimide fluorophore to report binding events, and a hydrazine linker to couple these functional components. To date, key intermediates have been synthesized and structurally confirmed by NMR and IR spectroscopy, establishing the feasibility of the approach. The proposed sensor architecture is expected to enable efficient and sensitive detection of cysteine, with potential to streamline diagnostic workflows and broaden access to early screening. Ongoing work focuses on probe optimization and performance evaluation in relevant biological matrices, positioning this platform as a promising tool for cysteine-related disease diagnostics.

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UG-S / In-progress
URG Project

## Can Changes in the Environmental Temperature Modify the Optical Characteristic of a Medium?

A material's curve of dispersion shows the dependence of the refractive index, *n*, verses frequency of light, f, and represents the optical signature of a medium. We are interested in understanding this dependence on the environmental temperature, T. Therefore, we study changes in the *n* of flint glass using the minimum deviation method, when the interaction between light and glass is assisted by background energy that changes the T. For a medium in thermal equilibrium at T, the thermal energy kT (k = Boltzmann constant) adds to the energy of the incident light, hf. Thus, the dipoles of the material change their vibrational energy according to hf' = hf + kT. We added kT from a lightbulb placed near the material's surface. Also, we put the prism between two metal plates and sent voltage across. When the background energy is relatively small, the vibration of dipoles can be considered linear. Here, the light-matter interaction is nicely described by Lorentz's dipole oscillating model, where the variation of the *n* can be connected to a Cauchy parameter, C. We assess its changes by measuring the changes in the Cauchy parameter for voltages up to 10 volts. We observed that the value for C changes from 11180 at no voltage, to 11278 at 10 volts, which is about 0.88% change, while the error bar for C is only 0.49% in both cases. This result shows a significant change in C and proves the fact that T induces a variation of n.

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**Poster 17**
UG-S / In-progress
URG Project

## Can Changes in the Environmental Temperature Modify the Optical Characteristic of a Medium?

We study the dependence of the refractive index, n, for flint glass with the change of energy background both in bulk as well as on its surface to incident light assisted by an energy background. An increase in the energy background increases the vibrational frequency of the electric dipole constituents. For a low energy background, which is considered as 30% below the first excitation threshold of 9.6 eV, the vibrations of the dipoles are quasi-linear and the interaction between light and matter can be described by Lorentz's harmonic oscillator model, where n depends on a Cauchy parameter, C.

The reflection of a laser beam at the surface allows us to study the optical response of the surface dipoles. We use a red 650nm laser beam incident of a flint surface near the Brewster angle assisted by a voltage below 2.4 volts, for a perfect harmonic response of the surface dipoles. We study the normalized parallel and perpendicular components of the reflectance in the plane of incidence, which follows a perfect parabolic trend. We are comparing these components for various assisted voltages (of 0, 0.4, 0.8, 1.2, and 1.6 volts) and observe the change in the position of the Brewster Angle and index n associated. We also observe that the C value remains practically the same at 11254, for all voltages below 2.4 volts.

Therefore, we changed our focus of study from reflection at the surface to the transmission of light through glass, using strong vibrations of bulk dipoles. We assess the changes of index n for flint glass by using the minimum deviation method and measuring changes of C when the background energy set up across the glass is large, like 5 to 9.5 volts, so the oscillations of the bulk dipoles are strong, and the non-linear oscillatory regime becomes significant. We observe a large change in C from 11254 at 0 to 5 volts, to 11280 at 9.5 volts. This result proves that an additional energy background can induce a measurable change in the refractive index of glass inside the material, while the surface is much more sensitive to changes in the index for lower external energies. *We acknowledge The Office of Undergraduate Research's URG program for funding this research project for Jason, and the TEAM-UP grant of American Institute of Physics for Christopher.*

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**Poster 34**
UG-S / In-progress
2025 SURF Project

## Self-Learning AI Tools for Molecular Property Prediction.

Accurate prediction of molecular enthalpy at 298 K (H298) is important for reaction modeling and combustion studies, but traditional quantum-chemistry calculations are slow and hard to apply to large molecular datasets. In this project, I explore whether machine learning models can estimate H298 directly from precomputed features in the ThermoG3 dataset. The input features include heat capacity (Cp) values at several temperatures along with other molecular descriptors, and H298 is treated as a continuous regression target. I train three models—Random Forest, Gradient Boosting, and a Multi-Layer Perceptron (MLP)—and evaluate them on a held-out test set using $R^2$, RMSE, and MAE. Among these, the Random Forest model performs best ($R^2 \approx 0.52$, with the lowest RMSE and MAE), suggesting that it can explain a meaningful amount of the variation in H298. Overall, this work shows that general-purpose machine learning methods can provide a cost-effective baseline for molecular property prediction and points toward future improvements using richer structural descriptors and more advanced models.

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Doctoral-S / Advanced
Graduate Studies

## Changing the Reflectivity of a Glass Surface Through Interference Between Two Linearly Polarized Laser Beams.

The interaction between two cw-TEM00 linearly polarized laser beams and silica dipoles of a crown glass surface is analyzed to create an optoelectronic switch. The coherent superposition of two cw-lasers beams of different brightnesses incident on the same surface can inhibit the surface's reflectivity to the weaker

laser beam at several angles of incidence near the Brewster Angle (BA). We report an experimental method for energy retention of a probe laser beam incident on the surface dipoles through coherent interference with a brighter laser beam oriented at normal incidence on the surface and polarized parallel to the plane of incidence, which irradiates simultaneously the surface. We use two Gaussian diode laser beams of 2mm in diameter and long temporal coherence. The interaction between the probe laser and the surface dipoles is analyzed through the parallel component of the probe's reflectance normalized to the total reflectance, which according to our theory has a parabolic variation near BA. The coherent superposition between probe and coupler modulates the parabola with a sinusoidal interference pattern, having minima and maxima of reflectivity evenly spaced. The superposition on the glass surface creates polarizable arrays of surface dipoles. Our results indicate that at certain angles of incidence the reflectivity of the glass surface to the weak probe can efficiently enhance (i.e. at 58.24 deg. for 0V), while for an increase in the voltage (i.e. 0.3 and 1.3V), the reflectivity is diminished, and the energy of the probe is retained on the surface.

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**Poster 39**
UG-S / In-progress
Faculty Research Grant

## Interaction of Trichoderma and Streptomyces co-cultured under alkaline conditions.

Microbial interactions play a critical role in determining growth performance and stress adaptation under unfavorable soil conditions. In this study, we evaluated the growth responses of Trichoderma afroharzianum and Streptomyces griseus cultured on nutrient agar plates under control and alkaline (high-pH) conditions. Both organisms were examined in single culture and co-culture across five time points (Day 1, 3, 5, 7, and 14) to assess colony size and stress tolerance. In single culture, both microbes exhibited progressive colony growth over time, although alkaline stress significantly suppressed expansion at later stages, particularly on Day 14 ($p < 0.05$–$0.01$). Co-cultivation enhanced early-stage growth and partially mitigated alkaline inhibition, suggesting synergistic metabolic interactions or nutrient exchange between the two species. Nevertheless, prolonged alkaline exposure continued to limit colony expansion in both strains. Overall, T. afroharzianum demonstrated greater pH adaptability than S. griseus, highlighting its potential role as a bioinoculant for enhancing microbial resilience and soil health in alkaline environments.