Presentation Number: 100
Presentation Title: Nanogels for Oncological Drug Delivery Produced from Thermophile-derived Biopolymers

Student Name: Nathaniel Strickland
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Advisor: Dipayan Samanta
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Abstract: Nanogels utilizing a core-shell structure with a thermophile-derived biopolymer corona were studied for successful synthesis. A simple, green synthesis involving biocompatible polymers was utilized, resulting in a two-step synthesis with large up-scaling potential. Biopolymers derived from thermophilic bacteria grown within a minimal salt media with corn stover or soy hull as a carbon source. Casein micelle structures were stabilized with calcium crosslinking before incorporation of EPS was introduced through accumulation. Core Shell nanogels were characterized with SEM, AFM-IR, and DLS; while additional encapsulation, release and swell studies were carried out with curcumin as a model drug. The hydrophobic inner domains of the casein micelles and hydrophilic core-shell interface presents potential for a high drug loading environment, while the hydrophilic shell aids in stabilization within a physiological environment. These core-shell nanogels serve potential in the field of oncology as modifiable vehicles for targeted and responsive release.

Poster Presentation
Undergraduate Student

Presentation Number: 101
Presentation Title: Effect of Ablation Angle from Laser Ablation for Space Debris Removal

Student Name: Hannah Duncan
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Advisor: Dr. Prasoon Diwakar
Mechanical Engineering

Abstract: Space-based laser ablation is an efficient active removal method for space debris in low Earth orbit. Plasma generated from the process of laser ablation can be used to initiate the transfer of debris into the Earth's atmosphere for termination. This presentation will explore the use of nanosecond-pulsed laser ablation to change the trajectory of space debris through momentum transfer. This presentation will focus on how the ablation angle affects the amount of momentum that can be transferred in a single pulse for various energies.

Poster Presentation
Undergraduate Student

Presentation Number: 102
Presentation Title: Comparison of the performance of Soil Moisture Sensors

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Advisor: Mengistu Geza Nisrani
Civil and Environmental Department

Abstract: Accurate soil moisture data are essential for developing a Decision Support Tool (DST) to support crop and livestock management and machine learning–based forage estimation under climate variability. This study compares three soil moisture measurement methods, Hobo sensors, Hydrosense probes, and the oven-drying gravimetric method, to evaluate their accuracy, reliability, and suitability for real-time applications. The Hobo sensors were set up and tested. Measurements were benchmarked against oven-dried samples, and performance was assessed using statistical indicators of agreement. While oven drying provided the highest accuracy, it was labor-intensive and unsuitable for continuous monitoring or real-time data transmission. Hydrosense sensors require manual operation, limiting their efficiency for large-scale deployment. In contrast, Hobo sensors enabled continuous, spatially distributed monitoring and demonstrated strong correlation with gravimetric measurements. Results indicate that calibrated wireless sensors are well-suited for integration into machine learning models, real-time modeling, and operational decision support tools for sustainable crop and livestock management

Poster Presentation
Undergraduate Student

Presentation Number: 103
Presentation Title: Effects of Design Variables on Viscous Rayleigh-Taylor Growth to Study Plasma Viscosity

Student Name: John Wonka
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Leslie A. Rose Department of Mechanical Engineering

Advisor: Dr. Sonya Dick
Leslie A. Rose Department of Mechanical Engineering

Abstract: In attempts to make Inertial Fusion Energy (IFE) a more practical solution to the fusion energy concept, studying the growth of hydrodynamic instabilities in high-energy-density (HED) plasmas at extreme conditions during laser compression can provide information about the transport properties, such as viscosity, of IFE-relevant materials. In this work an analytical model for viscous linear Rayleigh-Taylor growth is employed to study the behavior of hydrodynamic instability growth of viscous of HED plasmas under high temperature and pressure. Through this model, a parameterization study can be conducted to find ideal values of amplitude, wavelength, material densities, and laser acceleration for experimental design.

The growth of hydrodynamic instabilities in HED plasmas can be modelled using the Rayleigh-Taylor Instability (RTI) equation, which is dependent on the viscosity and density of various materials. In this work, an in-house MATLAB code that solves the viscous RTI equation was used to find the ideal materials and values of governing variables, that leads to the largest sensitivity between different material kinematic viscosities for experimental design. The primary challenge associated with this approach is establishing reasonable bounds of each variable given experimental limitations of laser facilities, such as the National Ignition Facility. These limitations include diagnostic resolutions, small experimental timescales, and laser power limitations.

Poster Presentation
Undergraduate Student

Presentation Number: 104
Presentation Title: Devising a Tunable Stiffness Hydrogel Material to Overcome Ineffective Wound Closure in Simulated Microgravity Environments

Student Name: Mitchel Masters
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Mechanical Engineering

Advisor: Dr. Tugba Ozdemir
Nanoscience and Biomedical Engineering

Abstract: Introduction
Effective wound healing is significantly impaired in microgravity, leading to an increased risk of complications during spaceflights. Human dermal fibroblasts (HDFs) are critical for the healing process, as they are responsible for the cell contractility and collagen deposition necessary for new tissue formation. In simulated microgravity (SMG) environments, these processes are diminished. However, research suggests that mechanical signals from substrate stiffness can be used to change fibroblast behavior. In this study we proposed using the tunable stiffness of polydimethylsiloxane (PDMS) to match the mechanical properties in SMG. Through tracking the displacement of embedded fluorescent beads into the PDMS, we propose to measure force vectors that re exerted to the underlying substrate from HDF using traction force microscopy (TFM). We will tune the cell generated forces through altering stiffness of our future wound dressing materials.
Methods
To make the polydimethylsiloxane (PDMS) substrates, a silicone elastomer and curing agent were mixed in a 1:10 ratio, and spin-coated onto glass disks at 500 RPM for 30 seconds. The disks were cured at 80°C then treated with a 5% APTES solution to facilitate bead conjugation. A 0.05% carboxylate fluorescent nanobead solution was sonicated at 50Hz, filtered through a 0.45-micron filter, and incubated on the PDMS surface. After a Tris solution added on the disks, the substrates were coated with collagen to support cell adhesion and sterilized with 1% Pluronic. Final substrates were washed with 1xPBS and stored at 4°C before cell culture.
Results
The nanobead coverage on the disk is homogenous across the PDMS surface with a average density of 34,000 beads per image of disk at 20x magnification. Initial cell studies confirm that adult human dermal fibroblast (AHDF) cells are capable of proliferation and adhesion to the disks. TFM procedure is still being optimized and adjusted to ensure correct quantification.

Poster Presentation
Undergraduate Student

Presentation Number: 105
Presentation Title: Characterization of Flavone synthase II (FNS2) in Citrus sinensis

Student Name: Taylee Schramm
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CBHS

Advisor: Daniel Owens
CBHS

Abstract: Flavone synthase II (FNS2) is a membrane-bound cytochrome p450 that is involved in the flavonoid metabolic pathway. FNS2 synthesizes flavones from flavanones by catalyzing a double bond between C2 and C3 in the C-ring heterocyclic skeleton, this includes liquiritigenin to7,4'-dehydroxyflovone, naringenin to apigenin, and eriodyctiol to luteolin. The Citrus sinensis FNS2 gene was isolated from leaf mRNA and converted to cDNA by RT-PCR. Cloned into the Gateway system, with the entry vector pENTR D-TOPO, recombination into the expression vector pET-DEST42, and the transformation into the expression platform BL21. The synthesis of a co-polymer to be used in the solubilization of discrete lipid-based discoidal particles will allow for detergent free elution and purification of FNS2. The co-polymer will be synthesized with a standard reflux reaction of styrene and maleic anhydride to produce the styrene maleic acid (SMA) co-polymer, that will then be applied to membrane fraction following enzyme expression and cell homogenization to produce SMA lipid particles (SMALP). Following this, purification of enzymes will be done by way of metal affinity chromatography. Finally, enzyme characterization of FNS2 will be conducted with several assays: relative activity, thermostability, pH, temperature, co-factor concentration and enzyme kinetics. Quantitative analysis will be done by way of high-pressure liquid chromatography (HPLC).

Poster Presentation
Undergraduate Student

Presentation Number: 106
Presentation Title: Investigation Into Analytic Solutions of Corrugated Shock-Wave Oscillations

Student Name: Nolan Anderson
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Advisor: Dr. Sonya Dick
Mechanical Engineering

Abstract: Shock waves are a necessary component in most IFE designs. Shock waves can evolve from being axisymmetric to developing a corrugation in the shock front when interacting with target defects. Recent work has also shown the development of a shock front traveling through printed foam geometries proposed for future IFE target designs. However, the behavior of these shock fronts, especially in viscous fluids, have not been well characterized. Specifically, comparisons between theory, simulation, and experiments are lacking in the high-energy-density regime.

In a paper titled “Shock-wave viscosity measurement,” an analytic model is proposed for the oscillatory decay of a corrugated shock wave’s amplitude in a viscous fluid. (1) This model has potential to be used for experiment design and analysis in high energy density regimes. Unfortunately, the equation of interest and associated plots presented in (1) do not match. Through use of a plot digitizer to extract data from the published plots and MATLAB code that implements the equation of interest, we can show the discrepancy quantitatively.

Additionally, through continued effort to implement the full eigenvector solution that Miller and Ahrens present, we hope to present a thorough review of this model. This continued effort of validating the variety of models presented in Miller and Ahrens will provide confidence in a theoretical tool to predict shockwave amplitude decay in a viscous fluid. Doing so has far reaching implications, from designing experiments to measure the viscosity of high energy-density materials, to better predicting the behavior of corrugated shockwaves generated in structured foam targets.

*This work is supported by the South Dakota Mines Nelson Research Grant.

[1] Gregory H. Miller and Thomas J. Ahrens, “Shock-wave viscosity measurement,” Reviews of Modern Physics, Vol. 63, 919 (1991).

Poster Presentation
Undergraduate Student

Presentation Number: 107
Presentation Title: Evaluation of grape pomace pretreatment methods to improve fermentable sugars and nitrogen values for L. plantarum (ATCC 8014) fermentation

Student Name: Anika Main
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CBE

Advisor: Dr. Salmeron
CBE

Abstract: Grape pomace, consisting primarily of grape seeds and skins, is the major solid waste generated from the wine industry, accounting for 25% of the total grape weight. Lactic acid bacteria, which form the monomer that makes up polylactic acid, are widely used in industry for the design of biopolymers. The feedstocks research can be 40-70% of production costs, thus the demand for cost-effective alternatives. This study aims to characterize the profiles of reducing sugars and nitrogen of grape pomace and quantify the changes in their levels during lactic acid production. The lactic acid strain used in the grape pomace media was L. plantarum (ATCC 8014). Media was developed through different pretreatment methods to increase sugar and nitrogen values. The grape pomace was acidified and heat-treated to determine the most effective way of liberating sugars. The thermal hydrolysis was at 60°C for 1-h, and for the acid pretreatment, 0.5% sulfuric acid was used. Additionally, a green strategy involving supercritical CO2 pretreatment was employed. Fermentation trials monitored the growth of the lactic acid strain in comparable media by measuring pH values, cell growth, total reducing sugars, and free amino nitrogen levels over a 48-h period. Preliminary findings indicate that thermal hydrolysis optimizes the media, yielding the highest levels of sugars (10 g/L) and free amino nitrogen (287 mg/L) while supporting similar cell growth (3x10^8 CFU/mL) among pretreatments. Available sugars, cell growth, sugar consumption, and lactic acid production will be evaluated to assess the most effective pretreatment method to achieve higher lactic acid yields.

Poster Presentation
Undergraduate Student

Presentation Number: 108
Presentation Title: Implementation of a deep eutectic solvent system for sustainable lignin extraction from corn stover using AI and Machine Learning

Student Name: Joel Tettey
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Nano and Biomedical Engineering

Advisor: Salmeron Ivan Ochoa
Chemical and Biological Engineering

Abstract: Joel Tettey, Daniel Tobias-Soria, Kazi Khoda, Ivan Salmerón

Lignocellulosic biomass such as corn stover represents a promising renewable feedstock for sustainable materials and green chemicals. This work presents an integrated experimental data-driven framework for optimizing lignin extraction and cellulose preservation using deep eutectic solvents (DESs). DES systems based on choline chloride combined with formic acid, lactic acid, and 1,4-butanediol were synthesized and applied to corn stover under controlled pretreatment conditions (80–120 °C, 2 h, 1:20 w/v). Lignin was recovered via antisolvent precipitation, and cellulose-rich solids were characterized using FTIR and SEM to assess structural and morphological changes. Experimental data were curated into a structured dataset linking DES composition, molar ratio, temperature, and process variables to lignin extraction efficiency and cellulose retention. Supervised machine learning models were developed to construct nonlinear surrogate relationships between solvent chemistry, operating conditions, and extraction performance. Model benchmarking and feature importance analysis identified temperature, DES acidity, and solvent-to-biomass ratio as dominant factors governing lignin solubilization and selectivity. The predictive models enabled data-driven optimization of DES formulations and operating windows, providing experimentally consistent guidance for maximizing lignin recovery while preserving cellulose integrity. By coupling systematic experimentation with interpretable machine learning, this study establishes a scalable methodology for intelligent solvent and process design in lignocellulosic biorefineries, advancing sustainable and circular biomass valorization strategies.

Poster Presentation
Undergraduate Student

Presentation Number: 109
Presentation Title: Prehistoric Films and Science: A Blurring of Fact and Fiction

Student Name: Paul Roques
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Humanities

Advisor: Christy Tidwell
Humanities

Abstract: This poster presentation explores the historical and psychological relationship between paleontology and its representation in film, specifically focusing on the blurring of scientific fact and fictional narrative. While movies serve as significant learning tools, the speculative nature of paleontology allows filmmakers to make creative choices that often deviate from established scientific knowledge. By tracing the evolution of dinosaur portrayals, from early "movie monsters" to the "animalized" creatures of the dinosaur renaissance, this analysis highlights the profound cultural impact of the "Jurassic Park Effect.” It also utilizes psychological and philosophical frameworks to examine how fictional narratives possess a persuasive power that can alter public beliefs and attitudes more easily than factual stories, arguing that the popularity of franchises like Jurassic Park has created false narratives and unrealistic expectations regarding both the appearance of prehistoric life and the reality of paleontological work. These fictional narratives have been further exacerbated by poor communication within the scientific community and the speculative tendencies of modern "documentaries.” Ultimately, the presentation advocates a new media approach that balances creative fiction with scientific factuality to better align with contemporary discoveries and enhance public understanding of science.

Poster Presentation
Undergraduate Student

Presentation Number: 110
Presentation Title: Optimizing Time-Zero in Germanium Detectors of LEGEND-200

Student Name: Ryan Cantz
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Physics

Advisor: Cabot-Ann Christofferson
Chemistry

Abstract: LEGEND-200 is searching for neutrinoless double-beta decay (0vBB) in germanium-76 using high-purity germanium detectors (GeDs) submerged in an active liquid argon veto system. The discovery of 0vBB would prove that the neutrino is a majorana particle (i.e., its own antiparticle) and provide a possible explanation for the imbalance of matter and antimatter in the universe. Accurate signal start time (t0) determination in GeDs is crucial for precise data analysis of events in LEGEND-200. The current t0 in GeDs is subject to uncertainties arising from signal propagation effects and electronic noise, among other factors. To improve timing accuracy, the t0 provided by the silicon photomultipliers (SiPMs), which exhibits superior timing resolution compared to the GeDs, will be utilized. By comparing the GeDs t0 to the SiPMs t0, the error in the GeDs t0 measurement can be directly determined. Additionally, other parameters are investigated that affect t0 in GeDs, including pulse shape, energy, and drift time. Correlating these relationships through statistical analysis can, in later work, improve the precision of LEGEND's analysis parameters used to separate signals from backgrounds.

Poster Presentation
Undergraduate Student

Presentation Number: 111
Presentation Title: Analysis of Radon Emanation from Titanium to Enable Future Dark Matter Searches

Student Name: Ruccus Schauer
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Physics

Advisor: Richard W Schnee
Physics

Abstract: The components of the dark matter research experiment LUX-ZEPLIN (LZ) require minimal radioactivity. Radioactive signals can mimic those of dark matter events, leading to potential misinterpretations in the experiment. The Titanium used in the LZ cryostat chamber is susceptible to radium contamination, making it a significant source of background radiation we have observed. This necessitates developing a specific surface treatment method, such as acid etching, to reduce radium concentration in the Titanium.

The experiment analyzed radon emanation from titanium samples to assess the radium background in the material prior to any treatment. As radium 226 in the titanium decays, it releases atoms of radon 222. Those radon 222 nuclei get transferred to our detection chamber. We measure the amount of radon daughters, polonium 218 and 214, by observing their alpha decays.

The baseline for our titanium contamination is approximately 0.85 mBq. Moreover, conducting measurements at low pressure shows that at least half of the radium is at the surface of the sample titanium. Further experiments will determine the effectiveness of acid etching in reducing radium levels in our samples. An effective surface treatment would allow for future dark matter experiments with better sensitivity.

Poster Presentation
Undergraduate Student

Presentation Number: 112
Presentation Title: Communicating Climate

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AES & STS

Advisor: Dr. Kayla Pritchard
STS

Abstract: Since the Industrial Revolution, people have been producing more greenhouse gases than ever before. This has caused expedited changes within our environment and atmosphere. As a result, we are seeing more detrimental impacts on our society. Though the Earth has dealt with natural fluctuations before, these changes are vastly different and have a much bigger impact. The issue is very large, and should it be addressed, it will require collaboration from people of all walks of life. There are three parts to this research that need to be answered: how do we communicate the impacts of climate issues effectively, how can we as scientists educate and provide people with actionable items about these issues, and how do we as scientists communicate uncertainty? This project will explore those ideas. There are many current obstacles to overcome, such as political partisanship, cost-effective solutions, and fair distribution of justice and burdens. It will be up to us as scientists to learn how to effectively communicate the urgency and importance of these issues. Understanding where people have knowledge gaps, and learning as scientists how we can best fill in those gaps, will be of utmost importance in the coming decades, as climate issues will only worsen. While there is no perfect solution, and there is no one specific area that solely needs to be addressed, this issue will require large-scale, pragmatic, and holistic solutions that address these issues as best as they can while promoting the well-being of everyone, as everyone will be impacted by climate issues in one way or another.

Poster Presentation
Undergraduate Student

Presentation Number: 113
Presentation Title: Assessing the effects of differing acid digestion methods on bulk carbonate trace element analyses

Student Name: Riley Kortenbusch
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Department of Geology and Geological Engineering

Advisor: Sarah W. Keenan(1), Scott R. Beeler(2)
1: Department of Geology and Geological Engineering, 2: Engineering and Mining Experiment Station

Abstract: The major and trace element compositions of carbonate rocks (limestone and dolomite) provide critical archives of past environments as proxies for past temperatures, biological productivity, and water provenance and mixing. One frequent method of analysis employed is acid digestion, allowing ion release into solution, paired with inductively coupled plasma mass spectrometry (ICP-MS). Despite the extensive utilization of this approach, carbonate digestion methodology varies widely between studies. Common variables include acid type and concentration, digestion temperature and duration, sample mass, stepwise digestion, and sample pre-treatment. The digestion methodology variation causes issues to arise, as the methodology selection may result in the digestion of detrital minerals, notably silicates, whose geochemistry is not controlled by climatic or paleoenvironmental conditions. This outside input can impact the resulting geochemical signature measured by the ICP-MS, potentially misleading paleoclimatic and paleoenvironmental interpretations. In this study, we quantitatively compared multiple digestion methods to evaluate how they affect the resulting ICP-MS analyses to determine the most appropriate methodology for examining the major and trace element composition of carbonate rocks. Five differing carbonates ranging from nearly pure calcite to diagenetic carbonates were examined using six differing digestion methods. We determined that digestion methodology affects measured elemental compositions, however, the degree of difference varies depending on sample mineralogy and the element of interest. One example being nitric acid or a digestive microwave use can result in the liberation of elements from clay minerals or potential secondary reactions, which are not representative of the carbonate-bound elements. Our results demonstrate the need for a standardized methodology within the carbonate geochemistry community to ensure the reliable use of geochemical proxies.

Poster Presentation
Undergraduate Student

Presentation Number: 114
Presentation Title: Computational Image Analysis of Cellulose Synthase Complexes

Student Name: Claire Foster
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Biomedical Engineering & Nanoscience

Advisor: Steve Smith
Biomedical Engineering & Nanoscience

Abstract: Title: Computational Image Analysis of Cellulose Synthase Complexes
Student: Claire Foster: Department of Biomedical Engineering and & Nanoscience
Mentors: Steve Smith: Department of Biomedical Engineering and & Nanoscience; Shi-You Ding, Department of Plant Biology, Michigan State University

This research investigates the function and motility of cellulose synthase complexes (CSCs). These synthase complexes are responsible for building the primary structural component of plants, cellulose nanofibrils, thus they are vital in maintaining plant structure and integrity. These complexes move through via microtubules, hollow tubes composed of proteins, key in intracellular transport. CSCs take the shape of a rosette with 6 lobes, with each lobe being composed of 3 cellulose synthase proteins. Fluorescent fusion CSCs are studied through single molecule localization microscopy (SMLM) live cell imaging and tracking of CSCs formed in root tissue obtained from Arabidopsis thaliana. These images were taken in our lab and at Michigan State University in collaboration with Dr. Shi You Ding. The images were collected after genetically tagging the complexes with fluorescent proteins and imaged in our SMLM microscope. Computational analysis in ImageJ/Fiji of single molecule trajectories comparing complexes C3, C5, and C6 fluorescent fusion CSCs, where different component enzymes were fused with either green fluorescent protein (GFP) or yellow fluorescent protein (YFP), show differences in motility between complexes, including differences in speed, distance travelled, and confinement ratio (linearity/straightness).

Poster Presentation
Undergraduate Student

Presentation Number: 115
Presentation Title: Survey of Ord's Kangaroo Rat (Dipodomys ordii) in Buffalo Gap National Grassland

Student Name: Edward Wendt
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Chemistry, Biology & Health Sciences

Advisor: Kelsey Gilcrease
Chemistry, Biology & Health Sciences

Abstract: Kangaroo rats (Dipodomys) are arid-specialists and burrowing rodents that inhabit the arid and semi-arid regions of North America. Ord's kangaroo rat (Dipodomys ordii) ranges from the Desert West into the Great Plains and is the only kangaroo rat species found within South Dakota. Their presence at specific sites within the state is not well documented, and the species is not locally monitored. This project surveyed their presence within a location at Buffalo Gap National Grassland (BGNG). An additional objective was to correlate South Dakota kangaroo rat presence to soil type as soil composition is essential to the viability of their burrow construction. From September to December 2025, five trail cameras were used to capture video for presence identification. Camera locations were changed approximately every week and placed within USDA soil codes upon sparsely vegetated locations favorable to kangaroo rat movement. Kangaroo rats were detected at three different camera locations on the CuD (Conata-Hisle complex, 6 to 25 percent slopes) and Bb (Badland) soil codes. No kangaroo rat sightings were found in the camera placed within the MyE (Midway silty clay loam, 9 to 35 percent slopes) soil code. This survey successfully confirmed and documented the presence of Ord's kangaroo rat in BGNG. However, while a correlation between sighting and soil type was present, more data and potentially other survey methods are needed to draw conclusions with confidence. Many other species were also identified and captured on video, which allows this project's data to serve as a basic inventory of wildlife within the area.

Poster Presentation
Undergraduate Student

Presentation Number: 116
Presentation Title: Effect of Ablation Energy on Momentum Transfer in Laser-Based Space Debris Removal

Student Name: Krista Burkman
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Mechanical Engineering

Advisor: Dr. Diwakar
Mechanical Engineering

Abstract: Space-based laser ablation is an efficient active removal method for space debris in low Earth orbit. Plasma generated from the process of laser ablation can be used to initiate the transfer of debris into the Earth's atmosphere for termination. This presentation will explore the use of nanosecond-pulsed laser ablation to change the trajectory of space debris through momentum transfer. This presentation will focus on how the ablation energy affects the amount of momentum that can be transferred in a single pulse for various energies.

Poster Presentation
Undergraduate Student

Presentation Number: 117
Presentation Title: Investigating Alterations in Extracellular Matrix Deposition of Diabetic Fibroblasts using Silk Fibroin Films

Student Name: Isabella Holmbo
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Biomedical Engineering

Advisor: Tugba Ozdemir
Nanoscience and Biomedical Engineering

Abstract: Introduction:
Diabetes mellitus is a chronic disease in which the pancreas cannot produce sufficient insulin, which is a vital hormone in glucose metabolism. Excessive glucose remaining in the bloodstream causes abnormal cell activity, notably in the extracellular matrix. Cells cannot function properly and their wound healing properties are decreased or stop completely.
Silk has been highlighted as an optimal biomaterial for use in wound healing because of its versatility. Silk wound dressings have been shown to increase cell proliferation in the extracellular matrix and silk proteins exhibit antibacterial properties. It can be modified to promote healing in different wound types by tuning properties. The goal of this study is to develop an environment in which diabetic fibroblasts exhibit healthy properties.
Methods/Materials:
Silk preparation: Silk cocoons were minced and cooked in a sodium carbonate solution and solubilized with lithium bromide salt. The salt was removed from the solution using dialysis and the final silk fibroin solution was analyzed to determine concentration. A mold was made using a 3-D printer and sterilized. The silk fibroin solution was poured into the mold and left to dehydrate into a film within a sterile environment. The film was cut into discs and were kept in a sterile container until ready to use.
Cell preparation and integration: Adult healthy human dermal fibroblasts and diabetic human dermal fibroblasts were thawed and incubated at 37 degrees Celsius. They were allowed to grow and were monitored for signs of contamination. The cells were cultured on the film discs and monitored for signs of growth.
Results:
We optimized our methodology to fabricate silk films with consistent mechanical properties. Ongoing experiments are focusing on culturing normal and diabetic fibroblasts and extracellular matrix deposition.

Poster Presentation
Undergraduate Student

Presentation Number: 118
Presentation Title: Tensor based Time Series Forecasting

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Mathematics

Advisor: Kyle Caudle
Mathematics

Abstract: This research investigates time series forecasting for tensor-valued data, where observations consist of multidimensional arrays evolving over time. The project focuses on comparing predictive performance across forecasting models and examining how different data representations influence prediction accuracy. Tensor-based forecasting methods allow multiple related variables to be predicted simultaneously, with applications including temperature forecasting, financial data analysis, and other high-dimensional timedependent systems. Forecast accuracy is evaluated by computing the Frobenius norm between predicted and observed tensors at each time step, providing a quantitative measure of overall prediction error.

Poster Presentation
Undergraduate Student

Presentation Number: 119
Presentation Title: IMPROVING MASS TRANSFER IN METHANOTROPHIC BIOREACTORS USING NANOBUBBLE TECHNOLOGY

Student Name: Samantha Harris
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Department of Chemical and Biological Engineering

Advisor: Dr. Rajesh Sani
Department of Chemical and Biological Engineering

Abstract: Products from cultivating methanotrophs are of interest to the biomedical field due to their environmental stability and wide range of utilities. This project focuses on designing a reactor for more efficient processing of methane using methanotrophs and nanobubble technology. Previously, bioprocessing research has shown mass-transfer is particularly inefficient. A limitation is the C-H bond in methane is relatively unreactive and requires a high activation energy to break. This makes the process energy-intensive and more costly. More effective methane processing is needed due to its slow growth rates hindering large-scale bioprocessing. Using nanobubble technology may assist in distributing methane to methanotrophs for more efficient breakdown. They are stable in media for a much longer period of time due to their size and stronger internal pressure. Nanobubbles possess several properties, including high Laplace pressure, high surface area to volume ratios, low buoyancy for suspension time, and negative surface charge for sustainability. Combined, this increases the volumetric mass transfer coefficient through their effect on the concentration of gas near the surface and high internal pressure. Residence is extended through near continuous gas transfer into media, and the boundary layer is reduced due to quickening of gas diffusion. Finding a way to utilize nanobubbles within larger-scale bioreactors efficiently is limited. Nanobubbles possess several properties that improve mass-transfer; however, further research is needed to understand how to more efficiently utilize nanobubbles in a larger-scale bioreactor. There are various difficulties in applying nanobubbles: stability compromise due to organic matter and salts, energy consumed to generate the bubbles, and detecting the bubbles in solution.

Poster Presentation
Undergraduate Student

Presentation Number: 120
Presentation Title: Simulation of Radon Mitigation with Silver Zeolite

Student Name: Victor Hanson
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Physics

Advisor: Dr. Schnee
Physics

Abstract: The decay of radon causes one of the largest backgrounds in rare-event particle physics experiments such as neutrinoless double beta decay and dark matter detection. The current standard for removing radon from the air is activated carbon swing systems. A swing system has two columns, flowing forwards through one at a time, and uses some of the clean air to push the radon out of the other column. Recently, it has been found that silver zeolite is around 500 times better at adsorbing radon than activated carbon, potentially enabling the design and creation of much more effective and less expensive radon-reduction systems. I have edited a preexisting simulation for carbon-based radon mitigation to help design a physical system to measure silver zeolite radon adsorption under different temperatures. For different zeolite masses and air flow rates, the simulation predicts the time it takes radon to break through the zeolite column as well as its measurement uncertainty. As expected, larger masses of silver zeolite and slower flows of air lead to longer breakthrough times as well as lower errors associated with the parameters. For a flow rate of 0.25 standard cubic feet per minute and a mass of 500 grams, the simulation yields a breakthrough time of around 17.5 hours; this is an ideal time for testing many temperatures efficiently in a physical system. Preliminary results from the simulation indicate the precision of the breakthrough time may be as good as 0.4% fractional uncertainty, providing the same fractional uncertainty on the zeolite adsorption coefficient. This simulation should allow for precise and efficient measurements of the properties of zeolite. These better defined parameters will allow the design of a less expensive, much more efficient radon-reduction swing system.

Poster Presentation
Undergraduate Student

Presentation Number: 121
Presentation Title: Evaluation of Remediation Pathways for a Bentonite Mine Site using Remote Sensing

Student Name: Grace Belcher
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Civil and Environmental Engineering

Advisor: Dr. Lisa Kunza
Chemistry, Biology, and Health Sciences

Abstract: Within the mining sector, reclamation practices are often completed during active mining operations, as required by law. However, sites mined prior to the passing of the Surface Mining Control and Reclamation Act of 1977 were often left unremediated. The bentonite mining site, also called the "Moonscape", is an area northwest of Belle Fourche, South Dakota, managed by the Bureau of Land Management (BLM). The BLM has investigated various remediation approaches on the site since the late 1970s. Our research project focused on applying remote sensing and geospatial information systems (GIS) using ArcGIS Pro to identify flow paths that will allow the formation of catchments for fine sediments, organic matter, and water to help soil development and instigate remediation. To assess potential catchment locations, we applied a support vector machine approach classifying National Agriculture Imagery Program (NAIP) near-infrared imagery. We classified vegetative area as 53%, water bodies as 3%, and bare ground as 44% of the total area. Then we used identified locations from the classification to assess flow lines and drainage areas via a deterministic flow direction methodology. We plan to visit the study area to validate our findings. Additionally, we will create a cost-benefit analysis for identified historical remediation approaches. Our goal is to create a cost-effective reclamation approach based on the utilization of natural processes. Future research will utilize this data to characterize sites that will allow soil development and eventual vegetation growth. Overall, the research provides information that will help to define a more efficient, cost-effective approach in which ecosystems can be jump-started to remediate themselves.

Poster Presentation
Undergraduate Student

Presentation Number: 124
Presentation Title: Underground Neutron Background Measurements at Sanford Lab

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Physics

Advisor: Dr. Juergen Reichenbacher
Physics

Abstract: Experiments on the leading edge of particle physics are being conducted almost a mile underground at the Sanford Underground Research Facility (SURF). The particle physics research being conducted at SURF requires the detection of elusive particles, whose signal can be drowned out by the cosmic radiation bombarding Earth's surface. To eliminate this background noise, particle detectors are built underground to shield from cosmic rays. These experiments are the LUX ZEPLIN Dark Matter experiment (LZ), the Deep Underground Neutrino Experiment (DUNE), and the Compact Accelerator System for Performing Astrophysical Research (CASPAR).
Building these detectors underground eliminates the cosmic ray background. However, there is still a substantial radioactive background due to traces of radioactive material in the massive rock and shotcrete. Particularly, neutrons comprise a significant component of SURF's radioactive background for these experiments, looking for elusive neutrinos, dark matter particles, or nuclear fusion reactions, as they could easily mimic such particles or reactions. Despite the underground neutron flux being well over a thousand times smaller than on the surface, the detectors can still see a critically large rate of neutrons. Our underground measurement setup uses helium-3 proportional tubes to
measure the neutrons emitted from the cavern walls and shotcrete. Given the size of the 13" long helium-3 gas-filled tubes, the neutron-induced signals are expected to cause a very low rate of about 0.1 mHz. The challenge then becomes reducing internal tube backgrounds from noise and intrinsic radio-contaminants in the tube materials
to measure this small cavern neutron rate. Results from the first underground neutron background and neutron calibration source measurements will be presented.
Furthermore, the concept of a dedicated signal waveform analysis for pulse shape discrimination of real neutrons from internal background noise is being outlined.

Poster Presentation
Undergraduate Student

Presentation Number: 125
Presentation Title: Linking Speckle Pattern Method to Spatial Resolution in Digital Image Correlation

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Leslie A. Rose Department of Mechanical Engineering

Advisor: Dr. Cassandra Birrenkott
Leslie A. Rose Department of Mechanical Engineering

Abstract: Digital Image Correlation (DIC) is a non-contact optical technique used to measure full-field surface displacement and calculate strain. Accurate DIC measurements require high contrast, random speckle pattern on the surface of interest. While DIC is a widely used strain measurement tool, the relationship between speckle pattern generation strategies and achievable spatial resolution can be time consuming – often determined through trial-and-error processes - yet is incredibly useful for future work with specific equipment. The objective of this project is to identify a speckle patterning method that provides the highest spatial resolution using the 3D DIC system available in the JMP Lab at South Dakota Mines.

For many material characterization applications, strain fields around small structural features (e.g. fibers in a composite or voids in a casting) are of interest. Thus, understanding how spatial resolution depends on pattern characteristics is critical for DIC experiment design. Developing a better understanding of this relationship allows DIC users to intentionally select a patterning method based on the scale of measurement.

To evaluate spatial resolution for the JMP Lab system, two factors were investigated: pattern quality and equipment noise. Pattern quality was quantified using grayscale histograms, estimated mean speckle size, and mean intensity gradient. Equipment noise was assessed through a rigid-body translation experiment, in which a patterned sample was displaced in-plane by a known amount and compared to the displacement measured by DIC. Combining these analyses establishes a relationship between speckle patterning method and spatial resolution. This relationship will be validated using ESC 105, a thermoplastic matrix composite reinforced with discontinuous glass fibers. The outcomes of this work provide practical guidelines for optimizing speckle patterns and improving strain measurement accuracy for microscale material characterization.

Poster Presentation
Undergraduate Student

Presentation Title: High-Fidelity LES Simulation of Supersonic Retropropulsion for Planetary Entry

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Advisor: Dr. Thalakkottor
Mechanical Engineering

Abstract: Supersonic retropropulsion (SRP) is a method used to decelerate spacecraft during entry, descent, and landing (EDL) in thin atmospheres such as Mars. Under these conditions, aerodynamic drag alone cannot provide sufficient braking for a controlled descent of higher mass payloads at higher altitudes. This study implements a high-fidelity wall modeled large eddy simulation (LES) approach with adaptive mesh refinement. Both 2D and 3D domains are analyzed to examine the supersonic flow around the Mars Science Laboratory (MSL-2012) entry capsule in regimes relevant to powered descent and angled entry. The simulations capture transitional flow behavior, shock interactions, and recirculation within the capsule's wake. Flow visualization shows how these structures develop and interact as the flow approaches a steady state. The results improve understanding of the flow physics that govern SRP and capsule aerodynamics, supporting more accurate modeling of future planetary EDL systems.

Poster Presentation
Undergraduate Student