Oral Presentation Abstracts

Session 1

1. **Exploring Habitability and Life Detection: Insights from Microbial Biofilms in Serpentinizing Mars Analog Environments**
   Sarah Gonzalez-Henao, B.Sc Biology(ICESI University)/MsC Biotechnology (ICESI University),/current PhD Student (Michigan State University), Department of Earth and Environmental Sciences, Department of Microbiology and Molecular Immunology Michigan State University. Matthew O. Schrenk, B.Sc. Geology & Geophysics (University of Wisconsin)/Ph.D in Oceanography (University of Washington)/Associate Professor at Michigan State University, Department of Earth and Environmental Sciences, Department of Microbiology and Molecular Immunology Michigan State University.

   Serpentinization is a geochemical process that occurs in ultramafic rocks that produces molecular hydrogen (H,ÇÇ) and methane (CH,ÇÑ), providing energy for microbial life. The Santa Elena Ophiolite (SEO) in Costa Rica, is terrestrial serpentinizing site that harbors hyperalkaline springs characterized by a pH up to 11.25 and CH,ÇÑ vents (24.3% v/v). Due to its unique conditions, SEO serves as a Mars analog, making it significant for astrobiological research. This project focuses on analyzing microbial biofilms from SEO which thrive in these extreme environments and consist of an organized aggregate of microorganisms living within a self-produced matrix of Extracellular Polymeric Substances (EPS) attached to a surface. Therefore, through the combination of advanced microscopic and genomic approaches, we aim to develop a holistic understanding of the microbial biofilm samples collected from the SEO. Preliminary results show community composition shifting along a pH gradient, highlighting potential implications for understanding habitability in extreme environments.

2. **Temporal Analysis of Neutron Star Low Mass X-ray Binary GX 13+1**
   Mohamad Ali Kaddouh, studying for Bachelors in Physics and Astronomy at Wayne State University

   Neutron star (NS) low mass X-ray binaries (LMXBs) are systems that consist of a neutron star accreting material from a low mass companion star. These systems

are phenomenologically rich and have temporal variability in the timescale of seconds to years. A temporal analysis of NICER satellite observations of the persistent NS LMXB GX 13+1 will be presented. The classification of this source as either a Z or atoll NS LMXB has remained ambiguous to date. While the source has always traced out a ‚ÄòŒΩ‚Äô shaped track in the hardness intensity diagram in previous studies, this investigation saw the source tracing out the entire Z track with distinct horizontal, normal and flaring branches. A band limited noise appears to be present in the power density spectra when the source is in the flaring branch. Results will be compared with the behavior of the source in the harder energy bands.

3. **Formalizing Motion Plan Legibility Using Empirical Manual Takeover Data in Autonomous Spacecraft Docking**
Hannah Larson, M.S. (University of Michigan Department of Mechanical Engineering), Leia Stirling Ph.D. (University of Michigan Department of Industrial & Operations Engineering, Department of Robotics)

   As space missions look towards Mars, workload of astronauts will increase as larger communication delays inhibit the real-time support mission control can provide. Tasks can be reallocated to automation to limit the added workload placed on the astronaut, but automation will require careful design to support appropriate use and safety. Spacecraft docking maneuvers are one task that has become increasingly automated, but still requires astronaut monitoring to take over control in a failure scenario. This research experimentally examines how the motion trajectory of a spacecraft during docking influences decisions to manually take over control. Thirty-three participants monitored multiple simulated autonomous docking maneuvers and asserted manual control when they believed failure to be imminent. Results showed that motion plan characteristics of initial condition and path curvature significantly influenced if and when takeover was performed. Knowledge gained from these results can inform spacecraft motion planners to support the astronaut in decision-making tasks.

4. **Batch manufacturing of polyelectrolyte biomaterial capsules with tailored internal micro-environments through use of electrospray technologies.**
Rafael Ramos, MS, MD-PhD Candidate, Wayne State University Department of Biomedical Engineering, Wayne State University / Wayne State University School of Medicine. Howard Matthew, PhD Professor, Department of Chemical Engineering and Materials Science, Wayne State University

   Studying the physiological effects of space travel creates a need for high fidelity, in vitro models of complex tissues. Tissue constructs engineered using a bottom-up modular approach offer a solution to this problem. Here, we expand on a previously reported method of cell encapsulation using glycosaminoglycan-stabilized chitosan membranes generated by polyanion-polycation interactions. The resulting hollow capsules allow for cellular growth and organization within a defined spherical volume, and the internal environment can be tailored through

inclusion of extracellular matrix based biomaterials. We have enhanced this technology through an electrospray method that extends the feasible range of capsule sizes down to 200-50 um. This size regime allows encapsulation of cells at densities of >107 cells/ml while minimizing diffusion limitations and the likelihood of central necrosis in cellular spheroids. These electrospray capsules may serve as ideal modular units in the development of tissue constructs for physiological modeling using lab-on-a-chip and bioreactor approaches.

5. **Strengthening under-resourced Michigan student engagement in science through astrophysics research**
Rhianna Taub, Undergraduate physics and astronomy student, Student Research Assistant, WSU physics & astronomy department; Kristen Dage, PhD in astrophysics, Student research Mentor, lecturer at Curtin Institute for Radio Astronomy and co-chair of Rubin Observatory's Stars, Milky Way and Local Volume Collaboration; Edward Cackett, WSU representative, Associate Dean of the College of Liberal Arts & Sciences and Distinguished Service Professor, Dept. of Physics & Astronomy at WSU.

   The metro-Detroit area is home to a large number of colleges and universities. In this talk I will introduce the Dead Stars Society, a student oriented research group based at Henry Ford College, and how we provide research opportunities to students from a wide range of backgrounds. I will discuss my involvement in the program as an undergraduate student researcher and how we are creating student focused research manuals probing astronomy at a variety of wavelengths from optical to gamma ray.

6. **Empowering the Next Generation of Space Scientists: Utilizing NASA STEM Initiatives to Establish the Astrobiology STEM Activation Program (ASAP)**
Margaret E. Hitt, Undergraduate Engineering Freshmen & Egleston Scholar, Columbia University, Founder of Dow High Space Farmers, NASA Intern; Sophie Cai, Vice President of Dow High Space Farmers, NASA Intern, Herbert Henry Dow High School; Sanvi Patel, Chief Science Officer, Herbert Henry Dow High School; Lisa S. Tsay, NASA GBE and HUNCH Mentor, Saginaw Valley State University

   The Dow High Space Farmers have collaborated with NASA STEM Programs (GBE, HUNCH, and GeneLab) to contribute to astrobiology, biomedical, and health research that supports astronaut mission health within and beyond Low Earth Orbit. Our focus areas include developing a wearable sweat cortisol biosensor with wireless capabilities, conducting light experiments to improve space diets, and establishing the ASAP program. The biosensor, developed with support from the Electrical and Computer Engineering department at Western Michigan University, can provide tailored countermeasures against spaceflight stressors and potentially be used to evaluate the psychological benefits of space farming. Expanding on these partnerships and research, we,Äôve developed ASAP, a four-week program that aligns with the Michigan Science Standards and

IB PYP for K-5 students. The ASAP engages students in applying their knowledge from the plant science unit to explore space science, astrobiology research, and aerospace engineering, aiming to inspire the future generation of space scientists.

Session 2

1. **Collagen organization of mouse tendons and mechanotransduction gene expression of mouse tendon fibroblasts are dependent on HIF1-alpha and oxygen tension**
   Stephanie S. Steltzer, BS, PhD Candidate, Molecular and Integrative Physiology, Orthopaedic Surgery, University of Michigan, Ann Arbor, MI, USA. Seung-Ho (Ben) Bae, BS, MD Student, Michigan Medicine, University of Michigan, Ann Arbor, MI, USA. Tessa Phillips, BS, MD Student, College of Medicine, University of Toledo, Toledo, OH, USA, University of Michigan, Ann Arbor, MI, USA. Yatrik Shah, PhD, Professor, Molecular and Integrative Physiology, Internal Medicine, University of Michigan, Ann Arbor, MI, USA. Adam C. Abraham, PhD, Assistant Professor, Orthopaedic Surgery, University of Michigan, Ann Arbor, MI, USA. Megan L. Killian, PhD, Associate Professor, Orthopaedic Surgery, University of Michigan, Ann Arbor, MI, USA

   A major challenge in regenerating tendons lies in their dense, extracellular matrix (ECM). Tendon progenitor cells (TPCs) form and organize the ECM that is required for its mechanical function and cellular mechanotransduction. Collagen deposition is controlled in part by hypoxia inducible factor-1a (Hif1a). We tested the hypothesis that both hypoxia and loss of Hif1a contribute to ECM organization in vivo and mechanotransductive gene expression in vitro. Control (WT) and Hif1a-floxed; ScxCre+ (Hif1acKO) mice were used to study tendon ECM organization of developing and mature Achilles tendons. Hif1acKO Achilles tendons had poor ECM organization compared to WT tendons regardless of age. When cultured in hypoxia, WT TPCs had downregulated gene expression of genes affiliated with ECM deposition and mechanotransduction compared to normoxia, with an exacerbated effect in Hif1acKO cells. Our findings support our hypothesis that Hif1a and hypoxia are regulators of ECM organization in vivo and TPC mechanotransduction in mouse tendons.

2. **Settling and Clustering Behavior of Polydisperse Gas-Solid Flows: Applications to Pyroclastic Density Currents**
   Emily Foster, M.S mechanical engineering, School of Engineering and Computer Science Oakland University

   Pyroclastic density currents (PDCs) are fast-moving, gravity-driven flows of particulate matter resulting from the collapse of an ejected volcanic column. PDCs are the most destructive volcanic process and can cause extensive damage to human settlements, infrastructure, and ecosystems. Understanding the physics behind pyroclastic density currents (PDCs) and accurately predicting

their behavior is essential due to their impact on society and the environment. However, because PDCs are inherently complex due to the challenges associated with multiphase flows (i.e. mesoscale clustering, turbulent scales, interphase-coupling), predicting them is challenging, and formulating accurate models that capture important phenomena has remained elusive. In this work, an analysis of the clustering and settling behavior observed in statistical data from high-fidelity Euler-Lagrange simulations is presented. This work represents the most highly-resolved study of polydisperse clustering and settling behavior to date and an initial step toward improved reduced-order models for hazard prediction.

3. **Nuclear Level Densities: How Important Are They in the Quest to Understand the Elemental Abundancies?**
   Sofia Karampagia, PhD, Associate Professor, Physics, GVSU

   The prediction of elemental abundances requires knowledge of the nuclear properties of thousands of short-lived, neutron-rich nuclides. The predicted elemental abundance distributions are significantly affected by how well the neutron capture rates are modeled. Among the nuclear data used to model neutron capture rates are models of nuclear level densities. We present calculations of neutron capture reaction cross-sections and astrophysical reaction rates using shell model nuclear level densities. Comparisons with results derived using other nuclear level density models and existing neutron capture reaction rate data help assess the reliability of the implemented nuclear level densities.

4. **Machine learning to advance Compton scatter tomography**
   Jeffery Martin, PhD, Assistant Professor of Mathematics Instruction, Department of Mathematics and Statistics, Hope College. Dominic Cugliari, Student, Research Assistant, Department of Mathematics, Hope College. Sydney Olander, Student, Research Assistant, Department of Engineering, Hope College. Karsten Wiegerink, Student, Research Assistant, Department of Engineering, Hope College

   Compton scatter tomography (CST) is a technique for non-invasively generating tomographic images of electron density in materials using Compton scattered gamma rays. Electron density is an indicator of density or composition changes in a material, so this technique has potential to advance nondestructive inspection and evaluation. The technique has the additional advantage of allowing tomographic imaging from one side of a large object, unlike widely used computed tomography (CT). The nonlinear integration paths inherent in CST makes reconstructing images more challenging than in CT. Artificial neural network (ANN) and convolutional neural network (CNN) approaches have been investigated for CST image reconstruction.

5. **Net-GPT: A LLM-Empowered Man-in-the-Middle Chatbot for Unmanned Aerial Vehicle**
   Brett Piggott, Computer Science and Engineering, Oakland University. Rajdeep Mukherjee, Computer Science and Engineering, University of Michigan. Guohuan Feng, Computer Science and Engineering, Oakland University. Ibrahim Odat, MS, Computer Science and Engineering, Oakland University. Balakrishnan Dharmalingam, MS, Computer Science and Engineering, Oakland University. Anyi Liu, Ph.D. Associate Professor, Computer Science and Engineering, Oakland University

   Integrating Artificial Intelligence (AI) and Large Language Models (LLMs) into Unmanned Aerial Vehicles (UAVs) holds great promise for enhancing both cybersecurity and mission capabilities. However, UAVs are constrained to limited power and computational resources, and the need for real-time performance, making LLM deployment challenging. This project aims to overcome these barriers by creating LLM cohorts designed for resource-limited environments. The innovation lies in the ability to leverage a multi-domain LLM cohort that is controlled by an autonomous agent. By utilizing optimized small-scale models for embedded systems, state-of-the-art fine-tuning methods utilizing datasets specialized for specific aspects of UAV control, the autonomous agent will be able to accurately coordinate all small-scale models efficiently for specific tasks, allowing for the UAV to complete a vast range of difficult missions and increasing the reliability of the autonomous UAV. Furthering the advancements of AI into aerospace cybersecurity.

6. **On the parameter tuning challenge of plain and scalable spectral clustering methods**
   Guangliang Chen, Associate Professor, Department of Mathematics and Statistics, Hope College. Valen Feldmann, Irene Seo, and Eli Edwards-Parker, Undergraduate students in the Department of Mathematics and Statistics, Hope College

   Spectral clustering is an exciting, attractive modern clustering approach, with many successful applications such as document clustering and image segmentation. However, it is not without challenges such as high computational complexity and parameter tuning. Ever since its introduction, much effort has been spent on making spectral clustering scalable (in both memory and speed) to large data sets while there is little work on parameter tuning. In this paper, we address the parameter tuning challenge of spectral clustering (including the landmark-based scalable methods). Specifically, we propose new criteria for tuning two kinds of parameters: (1) the scale parameter used in a similarity function such as Gaussian and cosine (2) the number of landmark points that are used in landmark-based scalable methods. Experiments demonstrate the effectiveness of the tuning techniques.

Session 3

1. **Urbanization Effects on Stress and Auditory-Visual Processing in House Sparrows (Passer domesticus)**
   Natalie Leake, Undergraduate Researcher, Biology, Hope College Emma Yonker, Undergraduate Researcher, Biology, Hope College. Kelly Ronald, PhD, Primary Investigator, Biology, Hope College

   Urban expansion presents numerous challenges for wildlife, including habitat fragmentation, novel predators, and pollution. These factors can disrupt animal communication and increase stress levels. This study investigates the physiological impacts of urban stressors on house sparrows (Passer domesticus). We focus on how urbanization influences the anti-stress hormone corticosterone (CORT) and its effects on auditory and visual processing. Sparrows were collected from rural, suburban, and urban areas around Holland, MI. Blood samples were analyzed to determine baseline and elevated CORT levels. Auditory processing was assessed using auditory brainstem responses, measuring sound detection across various frequencies and intensities. Visual processing was evaluated through electroretinogram tests, which gauge motion detection ability by determining flicker fusion frequency. We hypothesize that urban sparrows will exhibit higher chronic CORT levels and differences in sensory processing compared to rural birds. This research aims to enhance understanding of animal communication amidst urban growth and inform conservation strategies to mitigate human impact on wildlife.

2. **Isolating Tiny Earth Strains and Testing for Antimicrobial Production**
   Shruti Attili, High school Student at Washtenaw International High School and Summer Research student at EMU (presenter). Paul A. Price PhD, Biology Department at EMU and Corteva Agrisciences INC., Indianapolis, IN. Emily Tran, EMU

   Deaths from antibiotic-resistant bacterial infections are increasing, estimated to reach 10 million annually by 2050*. New antibiotics are needed, and bacterial secondary metabolites offer resources for new molecules in drug discovery. We studied how different bacterial soil isolates restricted the growth of Escherichia coli, Staphylococcus aureus, Mycobacterium smegmatis, Acinetobacter baylyi, and Saccharomyces cerevisiae. Extracts from these soil bacteria were tested for antimicrobial properties based on their zone of inhibition (ZOI), indicating that extracts taken from these bacterial strains are effective in inhibiting pathogens. The largest ZOI was for S. aureus (10mm). ZOIs were most prevalent for M. smegmatis, with 6 colonies displaying antibacterial properties. The ZOI was absent for all colonies of S. cerevisiae, showing potential safety for eukaryotes. This research illustrates that bacterial extracts possess antimicrobial properties effective against S. aureus and M. smegmatis, highlighting the potential of soil-derived bacterial strains as a source of new antibiotics.

   *de Kraker, Marlieke E A, et al. ‚ÄúWill 10 Million People Die a Year Due to

Antimicrobial Resistance by 2050?,Äù PLoS Medicine, U.S. National Library of Medicine, 29 Nov. 2016, www.ncbi.nlm.nih.gov/pmc/articles/PMC5127510/.

3. **Evaluating the Success of a Native Tree Planting along a Tributary to Plaster Creek**
   Marjorie Styf: Undergraduate Bachelor of Science in Environmental Science, Student, Biology, Calvin University

   In the fall of 2020, over 200 native trees from 8 different species were planted along the banks of Schooley Drain, a rural tributary of Plaster Creek in Dutton Township. The objectives of this project include intercepting stormwater runoff, filtering excess nutrients, and discouraging growth of the invasive Reed Canary Grass. Planting was done in same-species clusters (replicates) of 4 trees each. Plaster Creek Stewards researchers have been collecting data on growth and transpiration rates from this experimental array for 4 years (2021-2024). The question guiding this research is: Which native tree species are best to use for intercepting storm water runoff before it gets into Plaster Creek?

4. **Public outreach and interdisciplinary collaboration through art workshops**
   Orion Wakeman, BfA, Preserve Fellow, Calvin Ecosystem Preserve and Native Gardens, Calvin University

   Intersections between art and science are far more extensive than the academic separation of disciplines would lead you to believe. Bridging the gap opens up opportunities for students like me, who straddle the line between artist and scientist. After my graduation with a Bachelor of Fine Arts and interdisciplinary science major, I worked through the summer of 2024 at Calvin University,Äôs Ecosystem Preserve and Native Gardens offering observational drawing workshops to faculty and staff of the university ,Äì especially those in science disciplines who I had learned so much from. You,Äôll hear how professors, student researchers, and other university employees responded to learning gesture drawings and sketching techniques, as well as the workshop,Äôs roots in the plant taxonomy class that I was the TA for.

5. **Understanding biological adaptations to Ocean World analog conditions by studying the proteomic response of Maridesulfovibro hydrothermalis to high pressure**
   Ella Cardoza, B.Sc. Integrative Biology, minor in Environment and Sustainability Studies, 1st Year Environmental Geosciences Masters Student and Graduate Research Assistant, Earth and Environmental Sciences, Michigan State University. Matthew Schrenk, B.Sc. Geology & Geophysics, M.Sc. Oceanography, Ph.D. Oceanography (Certificate in Astrobiology), Assistant Professor & Principal Investigator, Department of Earth and Environmental Science and Department of Microbiology, Genetics, and Immunology, Michigan State University. Aude Picard, B.Sc. Life and Earth Sciences, M.Sc. Microbial

Ecology, Ph.D. Geomicrobiology. Assistant Research Professor and Principal Investigator. Department of Life Sciences, University of Las Vegas Nevada.

A particularly attractive target for astrobiological exploration is the icy Ocean Worlds of the outer solar systems (e.g., Europa, Enceladus, Titan), where high pressure (HP) may intersect with permissive temperatures and energy sources introduced through hydrothermal circulation or water-rock reactions. Unfortunately, studies of microbial responses to high hydrostatic pressure are relatively limited, focused primarily on survival and growth rather than activity. The proteomic response of a model piezophilic bacteria, Maridesulfovibrio hydrothermalis AM13, was investigated as a function of pressure stress to explore the relationship between HP microbial activity and physiological adaptations and consider its consequences for astrobiological exploration. The results of this work are informative of how microbial populations are adapted to high pressure extreme environments and depictive of subsurface ocean environments with influential physiochemical parameters. This work could help identify a framework of novel, piezophile-specific biosignatures that can be targeted in HP Ocean World habitats.