Arizona/NASA Space Grant

Undergraduate Research Internship Program

Thirty-first Annual Statewide Symposium

ARIZONA

SPACE GRANT CONSORTIUM

Presentations by Space Grant Students from:

University of Arizona
Arizona State University
Northern Arizona University
Embry-Riddle Aeronautical University
Casa Grande Union High School
Central Arizona College
Phoenix College
Pima Community College

April 22-23, 2022
Hilton Tucson East, Tucson, AZ

2021-2022 Statewide Arizona NASA Space Grant
Student Research Symposium
April 22-23, 2022

Welcome to the 31st annual Statewide Arizona NASA Space Grant Student Research Symposium!

The Symposium consists of four parallel topical sessions, with a morning break for coffee, afternoon lunch, and refreshments at the end of the day. We encourage you to use these breaks to network with one another, talk to peers and colleagues from other schools, and take time to make connections.

The Symposium will feature talks from 146 students, with 4 students represented "In Title Only". In-person talks will typically last ten minutes each, roughly divided as ~8 minutes for presentations and ~2 minutes for questions from the audience.

This symposium is made possible through a NASA grant awarded to the Arizona Space Grant Consortium. The efforts of managers, mentors, steering committee members and Space Grant representatives at Arizona State University, Northern Arizona University, Embry-Riddle Aeronautical University, Casa Grande Union High School, Central Arizona College, Diné College, Phoenix College, Pima Community College, and The University of Arizona are acknowledged. Students with a variety of academic backgrounds have come together with their mentors to make the program a success, and this Symposium is a tribute to their dedication and spirit of inquiry.

The Arizona NASA Space Grant Student Symposium also recognizes the efforts of many university faculty, private sector, and federal researchers/mentors, who give selflessly of their time and energy to provide leading-edge research experiences to enrich the education of Arizona's Space Grant students. We thank them all for their past, present and future support.

University of Arizona alum and former (1999-2000) Space Grant Fellow, Dr. Carmala Garzione, is our keynote speaker for the Friday symposium banquet. Dr. Garzione has recently returned to the University of Arizona and is now the Dean of the College of Science.

This year marks the 32nd anniversary of NASA's National Space Grant College and Fellowship Program. Across the nation, NASA Space Grant Consortia has had, and continues to have, an extraordinary impact on students in all 50 states, D.C. and Puerto Rico. To learn more about what Space Grant is doing across the nation, visit https://national.spacegrant.org/ .

Timothy Swindle, Director
Arizona Space Grant Consortium, UA

Michelle Coe, Manager
Arizona Space Grant Consortium, UA

Thomas G. Sharp, Associate Director
ASU NASA Space Grant

Desiree D. Crawl, Sr. Coordinator
ASU NASA Space Grant

Saturday, April 23, 2022 Hilton Tucson East

8:30-8:50 a.m. WELCOME & INTRODUCTION

ROSEWOOD BALLROOM
Chandra Holifield Collins, Associate Director UArizona NASA Space Grant Program

Room	Mesquite A	Mesquite B	Ocotillo A	Ocotillo B
TIME (MST)	**Moderators:** Elliott Bryner, ERAU Anne Boettcher, ERAU **Session A** **AERONAUTICS** (9:00 AM – 9:50 AM) ---	**Moderators:** Timothy Swindle, UA Paloma Rose Davidson, NAU **Session B** **EDUCATION & PUBLIC OUTREACH** (9:00 AM – 11:10 AM) ---	**Moderators:** Chandra Holifield Collins, USDA Erin Posthumus, UA **Session C** **EARTH & ENVIRONMENTAL SCIENCE/ENGINEERING** (9:00 AM-1:50 PM) ---	**Moderators:** Thomas Sharp, ASU Ahmed Sulyman, ERAU **Session D** **EXPLORATION SYSTEMS ENGINEERING: BIOLOGICAL, MATERIALS, OPTICAL, AND ELECTRICAL** (9:00 AM-11:30 AM) ---
			Room: Rosewood Ballroom	
	Moderators: Yancy Shirley, UA Timothy Swindle, UA **Session E** **ASTRONOMY & SPACE PHYSICS** (9:50 AM – 3:10 PM)	**Moderators:** Christopher Edwards, NAU Michele Zanolin, ERAU **Session F** **PLANETARY SCIENCE** (11:10 AM-3:10 PM)	**Moderators:** Clayton Jacobs, Northrop Grumman Thomas Sharp, ASU **Session G** **ASCEND** (1:50 PM-3:20 PM)	**Moderators:** Elliott Bryner, ERAU Anne Boettcher, ERAU **Session H** **AEROSPACE TECHNOLOGY: SPACEFLIGHT & ENGINEERING PROGRAMS** (11:30 AM-3:20 PM)

9:00-9:10	[A-1] *David Ordaz Perez* Modeling Rocket Trajectories	[B-1] *Gabriela Roig* Vacuum Chamber Testing	[C-1] *Justin Baez* Can Changes in Hot Spring Composition Reflect Decadal-Scale Deformation of the Yellowstone Caldera?	[D-1] *Kristen Roehling* Studying the Structure and Dynamics of Ammonium Formate with Microwave Spectroscopy
9:10-9:20	[A-2] *Roman Anthis* *Nicolas Tan* Adjustable Supersonic Wind Tunnel Diffuser	[B-2] *Amber Simon* Cause - Effect Matrix and Analysis for Public Opportunities Relating to Space Missions	[C-2] *Eliana Benites* Data Fusion Techniques to Determine Hypolith Colonization and Distribution Patterns	[D-2] *Daniel Henningsen* AWS SKYSURF Processing
9:20-9:30	[A-2] Continued…	[B-3] *Remington Cole Davis* *Jaacob Pledger* Studying Aspects of Teamwork and Communication in a Virtual Reality Environment	[C-3] *Adrianna Matthews* Habitability of Extremophiles	[D-3] *Salma Ly* Electrospun, non-woven, Nano-fibrous Novel Poly (vinyl Alcohol) membranes functionalized with L-Arginine for virus capture
9:30-9:40	[A-3] *Davis Payton* Wing Sweep, Structural Motion and their Effect on Boundary-layer Separation and Transition	[B-4] *Jordan Manlove* Adjusting for Interns	[C-4] *Yamini Patel* Post-Caldera Explosive Eruptions at the Valles Caldera, NM	[D-4] *Santana Solomon* Mars In-Situ Resource Utilization for Health Applications
9:40-9:50	[A-4] *Scott Petersen* Arizona Flyers: Development of a Persistent High-Altitude Earth and Climate Observation Platform	[B-5] *Tristan Donnelly* Arizonza Daily Sun Science Writing Internship	[C-5] *Jackson Macfarlane* A Climatological Analysis of Convection in the Trentino Region of the Italian Alps	[D-5] *Mairely Urias* Space Environment Radiation Testing on Electrical Components
9:50-10:00	[E-1] *Alex Blanche* Characterizing High [OIII]/[OII] Galaxies for LyC Study	[B-6] *April Meadows* Having a Heart for Physics: Experiments Are for Everyone	[C-6] *Kayla Brown* Earth Surface Change	[D-6] *Ethan Carlson* *Arantza Garcia Perez* *Jennifer Inions* Overcoming Physiological Challenges of Microgravity in Space
10:00-10:10	[E-2] *Bryanna Gutierrez-Coatney* Automating Absorption Line Identification in Quasi-Stellar Object Sightlines Using Probabilistic Programming	[B-7] *Tyler Woods* Social Media Growth in Astronomy	[C-7] *Justine Baca* Impacts of natural diatomaceous earth abundance on microarthropods communities at Valles Caldera	[D-6] Continued…
10:10-10:30	**MORNING BREAK IN FOYER**			

10:30-10:40	[E-3] *Jonas Hallstrom* Effects of Property Variation on Planetesimal Thermal Modeling	**Morning Break Continued…**	[C-8] *Jacob Blais* Persistence of soil respiration legacies induced by temporally repackaged summer rainfall in Sonoran Desert grasslands	[D-7] *Parker Landon* Quantizing the Unseen: GIG Undergraduate Optical Research
10:40-10:50	[E-4] *Katie Herrington* Analysis of Ionospheric Variability in EDGES Observations	[B-8] *Koda Benavidez* Science Journalism as an Avenue for Scientific Literacy	[C-9] *Brianne Cooke* Multi-species Fog Cultivation and Trait Measurements of Biocrust to Use For And Inform Restoration Recipes	[D-8] *Liam Berkland* The effect of previous COVID-19 infection on blood pressure control
10:50-11:00	[E-5] *Isabela Huckabee* Characterizing the atmospheres of cloud-freeT-dwarfs using Gaussian processes	[B-9] *Alexia Grant* *Sarah Stamer* Addressing the Pandemic of Science Misinformation on the Internet	[C-10] *DaJae Doral* Direct Air Capture Using a Moisture Swing	[D-9] *Loren Larrieu* Multi-spectral Thermal Infrared imager for UAV-based remote sensing
11:00-11:10	[E-6] *Emily Linden* On a Novel Superconducting On-Chip Fourier Transform Spectrometer	[B-9] Continued…	[C-11] *Robin Heide* Germination of the Endangered Bear Poppy	[D-10] *Mikela Petersen* Magnetic Shape Memory Alloy Composite Research
11:10-11:20	[E-7] *Thomas Redford* Identification of Thiol Function Group in Carbonaceous chondrites which are meteorite analogs of Bennu	[F-1] *Claire Blaske* Impactor-Atmosphere Interactions Above the Surface of Venus	[C-12] *Nelly McCuistion* Moss Pellets: Exploring New Regenerative Methods in Degraded Grassland Ecosystems	[D-11] *Maxwell Weiss* Emerging Non-Volatile Memory: Resistive Switching Behaviors in Amorphous Tungsten Oxide Dielectric
11:20-11:30	[E-8] *Caleb Redshaw* Seeing-Sorted U-band Imaging of the Extended Groth Strip	[F-2] *Christian Kroemer* Tissintite-II and other High Pressure-Temperature Minerals in Lunar Meteorite NWA 13967	[C-13] *Eliot Baker* Soil organic matter improving the bioremediation of insensitive munitions compounds	[D-12] *Raphaelle Therese Guinanao* Enabling Part-Process Design for Metal Additive Manufacturing
11:30-11:40	[E-9] *Andi Swirbul* Analyzing Star-Galaxy Separation Methods for SKYSURF	[F-3] *Shradhanjli Ravikumar* Nitrogen Storage in the Deep Interiors of Rocky Planets	[C-14] *Brooke Carruthers* Exploring the Evolutionary History of Nitrogenase's G Subunit	[H-1] *Darius Hampton-Ross* Synthesis of 2D Ti3C2Tx MXene Flakes from Ti3AlC2 MAX Phases for electronic property analysis
11:40-11:50	[E-10] *Reynier Squillace* Nitrogen Isotopic Fractionation in Prestellar Core L43-E	[F-4] *Lucas Reynoso* Characterization of organic materials in table salt	[C-15] *Jacob Henry* Analyzing Uranium Contamination in Rainwater from National Atmospheric Deposition Program	[H-2] *Benjamin Black* The effects of equivalence ratio during shutdown of a rocket engine on hardware longevity

			sites	
11:50-12:00	[E-11] *Logan Caudle* *Shannon Moore* Small Arm-Length Interferometry For U-Class Spacecraft	[F-5] *Claire Gibson* Is there fine-grained material under the surface of Bennu?	[C-16] *Annalisa Minke* Investigating the Correlation Between Inversion Strength Proxies and Cloud Fraction	[H-3] *Zoe Brand* Injector Face Thermal Analysis for a Liquid Rocket Engine
12:00-1:30	**LUNCH IN ROSEWOOD BALLROOM**			
1:30-1:40	[E-12] *Jennifer James* *Janessa Slone* New Short-Range Tests of Gravity	[F-6] *Johnelle Gonzales* A Signal Within the Sediments: Using Biological Stoichiometry as a Potential Biosignature on Martian Sediments	[C-17] *Erin Phelps* Legacy Effects of Ecological Structure and Hydrologic Function in Pinyon and Juniper Woodlands	[H-4] *Shane Howe* EagleSat-2 Memory Degradation Experiment
1:40-1:50	[E-13] *Marina Beltran* *Becca Spejcher* What Drives the Variability in Luminous Blue Variable Stars?	[F-7] *Gabrielle Jones* Detectability of Surface Biosignatures for Directly Imaged Exoplanets	[C-18] *Kristen Saban* Diet of the tiger rattlesnake, Crotalus tigris, in Southern Arizona	[H-5] *Joshua Parmenter* *Hayden Roszell* EagleSat II - Satellite Communication Development in an Undergraduate Environment
1:50-2:00	[E-14] *Skylar Kemper* *Yuka Lin* Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection	[F-8] *Kendall Koga* The Portable Goniometer	[G-1] *Genevieve Cooper* *David Lopez* *Surya Madan* *Anyell Mata* *David Rodriguez* *Ben Weber* Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation	[H-5] Continued…
2:00-2:10	[E-15] *Isaac AshLind* The Missing S in EXPRES: Stellar Activity Index Derived Using the Extreme PREcison Spectrometer	[F-9] *Beau Prince* Space Weathering of Carbonaceous Asteroids	[G-2] *Neal Ryan Allado* *Merick Carlisi* *Angel Gonzalez* *Sophia Mhae Jorda* *Jonathan Lawson* *Danika Liebhart* *Elijah Ramirez* *Elias Razo* *Aidan Schairer* High Altitude Payload	[H-6] *Grayson Peeler* EagleSat II- ADCS

2:10-2:20	[E-16] *Tracey Begaye* STEM Exposure on Reservations in Arizona	[F-10] *Hope Wetzstein* Lab Analyses of Olivine-Carbonate Mixtures as observed on Mars	[G-2] Continued…	[H-7] *Lillian Sudkamp* The EagleSat 2: Fabrication Team Finalizations
2:20-2:30	[E-17] *Mary Bolling* Analyzing OH/H2O on Near Earth Objects	[F-11] *Shea DeFour-Remy* Analysis of Callisto's Multi-Ring Impact Basins	[G-3] *Alex Aguilar* *Robert Brewington* *William Gyrulf* *Alexandria Hayes* *Isai Patena Ortiz* *Michael Plummer* *Denise Ryder* *Joshua Ryder* Atmospheric Conditions Affecting Surface Temperature	[H-8] *Julian Treat* Assessing the Viability of Asteroid Refuelling on the Way to Mars
2:30-2:40	[E-18] *Melissa Valenzuela* The Story of Pluto	[F-12] *Alexia Kubas* Giordano Bruno: Secondary impact cratering processes on the Moon	[G-4] *Callista Clemons* *Will Cohen* *Jose Cruz Jr.* *Jacqueline Do* *Sydnee Farnsworth* *Grant Fulleton* *Ivan Gonzalez Lopez* *Keivyn Lopez* *Vivien Frances Pabuna* *Andrew Sherant* *Joshua Torres* Optimization of Payload Design and Systems	[H-9] *Rebekah Weigand* Design and Characterization of Liquid Fuel Spray Injector
2:40-2:50	[E-19] *Nicholas Foo* Gravitational Lensing by Galaxy Clusters to Study the Early Universe	[F-13] *Maia Willis-Reddick* Mapping and characterization of subsurface deposits in Planum Boreum, Mars, using radar sounding	[G-4] Continued…	[H-10] *Ethan Shoemaker* Towards Improved Physics-Informed Machine Learning
2:50-3:00	[E-20] *Carl Ingebretsen* Exozodiacal Dust in the Epsilon Eridani System	[F-14] *Jacob van der Leeuw* Mapping Lunar Crustal Magnetic Fields in the Polar Regions	[G-5] *Zachary Howe* *Nicodemus Phaklides* Investigation of Long-Distance Video and Telemetry Streaming	[H-11] *Cameron Fernandez* Modeling of Thermal Protection Systems during Re-Entry
3:00-3:10	[E-21] *Magnus Magnusson* PhoSim: Visualizing What JWST/NIRCam Will See	[F-15] *Dayana Moreno Huerta* Coordinated Microanalysis of Lunar Soils in Preparation for Future Returned Samples	[G-6] *Brody Dyer* Team D.A.N.E.S Ascend Project	[H-12] *Shae Henley* CatSat: Integration and Testing for a University of Arizona CubeSat

3:10-3:20	**Afternoon Break Begins…**	**Afternoon Break Begins…**	[G-7] *Sarina Blanchard* *Nicolas Blanchard* *Isela Burruel* *Grace Halferty* *Daniel McConville* *Arsh Nadkarni* *Paul O'Brien Sylvester* Profiling High-Altitude Radiation with a General Data Logger	[H-13] *Nina Mackey* Shock Tube Method for Dynamic Calibration of Pressure Transducers
3:20 -	**AFTERNOON REFRESHMENTS & NETWORKING IN FOYER**			
3:25-3:35	**[Optional] Eclipse 2023 & 2024 Event Planning Session – Rosewood Ballroom**			

Program Schedule

Session A:
Aeronautics

Moderators:
Anne Boettcher, Embry-Riddle Aeronautical University
Elliott Bryner, Embry-Riddle Aeronautical University

[A-1] **Modeling Rocket Trajectories**, David Ordaz Perez, (Junior, Aerospace Engineering, School for Engineering of Matter, Transport & Energy). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University.

[A-2] **Adjustable Wind Tunnel Diffuser**, Roman Anthis, (Junior, Aerospace Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[A-2] **Adjustable Supersonic Wind Tunnel Diffuser**, Nicolas Tan, (Senior, Aerospace Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[A-3] **Wing Sweep, Structural Motion and their Effect on Boundary-layer Separation and Transition**, Davis Payton, (Senior, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[A-4] **Arizona Flyers: Development of a Persistent High-Altitude Earth and Climate Observation Platform**, Scott Petersen, (Junior, Geosciences). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona.

[A-In Title Only] **Upper Limit Performance Specifications of the Ramjet Cycle**, Dustin Eilers, (Junior, Aerospace Engineering, Fulton Schools of Engineering). Mentor: Timothy Takahashi, Fulton Schools of Engineering, Arizona State University.

Program Schedule

Session B:
Education and Public Outreach

Moderators:
Paloma Rose Davidson, Northern Arizona University
Timothy Swindle, University of Arizona

[B-1] **Vacuum Chamber Testing**, Gabriela Roig, (Junior, Exploration Systems Design, School of Earth & Space Exploration). Mentor: Danny Jacobs, School of Earth & Space Exploration, Arizona State University.

[B-2] **Cause - Effect Matrix and Analysis for Public Opportunities Relating to Space Missions**, Amber Simon, (Senior, Astrobiology & Biogeosciences, School of Earth & Space Exploration). Mentor: Cassie Bowman, School of Arts and Liberal Sciences, Arizona State University.

[B-3] **Studying Aspects of Teamwork and Communication in a Virtual Reality Environment**, Remington Cole Davis, (Senior, Industrial Organizational Psychology, Behavioral & Social Sciences). Mentor: Heather Lum, Behavioral & Social Sciences, Embry-Riddle Aeronautical University.

[B-3] **Studying Aspects of Teamwork and Communication in a Virtual Reality Environment**, Jaacob Pledger, (Senior, Human Factors Psychology, Behavioral & Social Sciences). Mentor: Heather Lum, Behavioral & Social Sciences, Embry-Riddle Aeronautical University.

[B-4] **Adjusting for Interns**, Jordan Manlove, (Senior, Journalism, Strategic Communications). Mentor: Angelita Denny, Department of Energy, Legacy Management.

[B-5] **Arizonza Daily Sun Science Writing Internship**, Tristan Donnelly, (Junior, Multidisciplinary Engineering). Mentor: Chris Etling, Arizona Daily Sun.

[B-6] **Having a Heart for Physics: Experiments Are for Everyone**, April Meadows, (Sophomore, Physics & Astrophysics, Mathematics, Applied Physics, Materials Science). Mentor: John Kistler, Applied Physics & Materials Science, Northern Arizona University.

[B-7] **Social Media Growth in Astronomy**, Tyler Woods, (Sophomore, Astronomy, Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University.

[B-8] **Science Journalism as an Avenue for Scientific Literacy**, Koda Benavidez, (Sophomore, Applied Mathematics, Theatre Arts). Mentor: Daniel Stolte, Marketing & Communications, University of Arizona.

[B-9] **Applications of Machine Learning in the Fight Against Misinformation and Fake News**, Alexia Grant, (Sophomore, Systems Engineering, Engineering). Mentor: Christopher Impey, Astronomy, University of Arizona.

[B-9] **Addressing the Pandemic of Science Misinformation on the Internet**, Sarah Stamer, (Sophomore, Astronomy, Physics). Mentor: Christopher Impey, Astronomy, University of Arizona.

[B-In Title Only] **Phenology Based Pollinator Restoration in the South-Central Region**, Hayley Limes, (Senior, Environmental Science). Mentor: Erin Posthumus, School of Natural Resources and the Environment, University of Arizona.

Program Schedule

Session C:
Earth and Environmental Science and Engineering

Moderators:
Chandra Holifield Collins, USDA Southwest Watershed Research Center
Erin Posthumus, University of Arizona

[C-1] **Can Changes in Hot Spring Composition Reflect Decadal-Scale Deformation of the Yellowstone Caldera?** Justin Baez, (Senior, Geological Sciences, School of Earth & Space Exploration). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University.

[C-2] **Data Fusion Techniques to Determine Hypolith Colonization and Distribution Patterns**, Eliana Benites, (Senior, Astrobiology, Biogeoscience, School of Earth & Space Exploration). Mentor: Heather Throop, School of Earth & Space Exploration, Arizona State University.

[C-3] **Habitability of Extremophiles**, Adrianna Matthews, (Senior, Astrobiology, Biogeoscience, School of Earth & Space Exploration). Mentor: Elizabeth Trembath-Reichert, School of Earth & Space Exploration, Arizona State University.

[C-4] **Post-Caldera Explosive Eruptions at the Valles Caldera, NM**, Yamini Patel, (Junior, Geological Sciences, School of Earth & Space Exploration). Mentor: Amanda Clarke, School of Earth & Space Exploration, Arizona State University.

[C-5] **A Climatological Analysis of Convection in the Trentino Region of the Italian Alps**, Jackson Macfarlane, (Junior, Applied Meteorology, Applied Aviation Sciences). Mentor: Curtis James, Applied Aviation Sciences, Embry-Riddle Aeronautical University.

[C-6] **Earth Surface Change**, Kayla Brown, (Senior, Civil Engineering, Engineering). Mentor: Angelita Denny, Department of Energy, Legacy Management.

[C-7] **Impacts of natural diatomaceous earth abundance on microarthropods communities at Valles Caldera**, Justine Baca, (Senior, Biology, Biological Sciences). Mentor: Anita Antoninka, Forestry, Northern Arizona University.

[C-8] **Persistence of soil respiration legacies induced by temporally repackaged summer rainfall in Sonoran Desert grasslands**, Jacob Blais, (Junior, Natural Resources, School of Natural Resources and the Environment). Mentor: Nathan Pierce, School of Natural Resources and the Environment, University of Arizona.

[C-9] **Multi-species Fog Cultivation and Trait Measurements of Biocrust to Use For And Inform Restoration Recipes**, Brianne Cooke, (Senior, Biological Sciences, College of the Environment, Forestry, & Natural Sciences). Mentor: Jasmine Anenberg, School of Forestry, Northern Arizona University.

[C-10] **Direct Air Capture Using a Moisture Swing**, DaJae Doral, (Senior, Mechanical Engineering). Mentor: Jennifer Wade, Mechanical Engineering, Northern Arizona University.

[C-11] **Germination of the Endangered Bear Poppy**, Robin Heide, (Senior, Ecology & Evolutionary Biology, School of Forestry). Mentor: Anita Antoninka, Forestry, Northern Arizona University.

[C-12] **Moss Pellets: Exploring New Regenerative Methods in Degraded Grassland Ecosystems**, Nelly McCuistion, (Senior, Environmental & Sustainability Studies, School of Earth & Sustainability). Mentor: Jasmine Anenberg, School of Forestry, Northern Arizona University.

[C-13] **Soil organic matter improving the bioremediation of insensitive munitions compounds**, Eliot Baker, (Senior, Chemical Engineering, Chemical & Environmental Engineering). Mentor: Reyes Sierra-Alvarez, Chemical & Environmental Engineering, University of Arizona.

[C-14] **Exploring the Evolutionary History of Nitrogenase's G Subunit**, Brooke Carruthers, (Junior, Molecular & Cellular Biology). Mentor: Betül Kacar, Bacteriology, The University of Wisconsin - Madison.

[C-15] **Analyzing Uranium Contamination in Rainwater from National Atmospheric Deposition Program sites**, Jacob Henry, (Senior, Chemical Engineering, Environmental Science). Mentor: Monica Ramirez-Andreotta, Environmental Science, University of Arizona.

[C-16] **Investigating the Correlation Between Inversion Strength Proxies and Cloud Fraction**, Annalisa Minke, (Sophomore, Biosystems Engineering, Atmospheric Sciences). Mentor: Xubin Zeng, Hydrology & Atmospheric Sciences, University of Arizona.

[C-17] **Legacy Effects of Ecological Structure and Hydrologic Function in Pinyon and Juniper Woodlands**, Erin Phelps, (Senior, Environmental Science). Mentor: Jason Williams, United States Department of Agriculture.

[C-18] **Diet of the tiger rattlesnake, Crotalus tigris, in Southern Arizona**, Kristen Saban, (Junior, Ecology & Evolutionary Biology). Mentor: Matt Goode, School of Natural Resources and the Environment, University of Arizona.

Program Schedule

Session D:
Exploration Systems Engineering: Biological, Materials, Optical, and Electrical

Moderators:
Ahmed Sulyman, Embry-Riddle Aeronautical University
Thomas Sharp, Arizona State University

[D-1] **Studying the Structure and Dynamics of Ammonium Formate with Microwave Spectroscopy**, Kristen Roehling, (Sophomore, Chemistry, Applied Math, Chemistry & Biochemistry). Mentor: Stephen Kukolich, Chemistry & Biochemistry, University of Arizona.

[D-2] **AWS SKYSURF Processing**, Daniel Henningsen, (Junior, Physics, Astrophysics, School of Earth & Space Exploration). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University.

[D-3] **Electrospun, non-woven, Nano-fibrous Novel Poly (vinyl Alcohol) membranes functionalized with L-Arginine for virus capture**, Salma Ly, (Junior, Chemical Engineering). Mentor: Matthew Green, Chemical Engineering, Arizona State University.

[D-4] **Mars In-Situ Resource Utilization for Health Applications**, Santana Solomon, (Senior, Medical Studies, College of Health Solutions). Mentor: Sara Walker, School of Earth & Space Exploration, Arizona State University.

[D-5] **Space Environment Radiation Testing on Electrical Components**, Mairely Urias, (Junior, Electrical Engineering, School of Electrical, Computer & Energy Engineering). Mentor: Hugh Barnaby, School of Electrical, Computer & Energy Engineering, Arizona State University.

[D-6] **Overcoming Physiological Challenges of Microgravity in Space**, Ethan Carlson, (Senior, Aerospace Engineering). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University.

[D-6] **Overcoming Physiological Challenges of Microgravity in Space**, Arantza Garcia Perez, (Senior, Forensic Biology, Biology & Chemistry). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University.

[D-6] **Overcoming Physiological Challenges of Microgravity in Space**, Jennifer Inions, (Senior, Applied Biology, Biology & Chemistry). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University.

[D-7] **Quantizing the Unseen: GIG Undergraduate Optical Research**, Parker Landon, (Senior, Computer Engineering, Space Physics, Electrical, Computer, & Software Engineering; Physics & Astronomy). Mentor: John Pavlina, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[D-8] **The effect of previous COVID-19 infection on blood pressure control**, Liam Berkland, (Junior, Biomedical Science, Biological Sciences). Mentor: Sara Jarvis, Biological Sciences, Northern Arizona University.

[D-9] **Multi-spectral Thermal Infrared imager for UAV-based remote sensing**, Loren Larrieu, (Senior, Electrical Engineering, College of Engineering, Informatics, & Applied Science). Mentor: Christopher Edwards, Astronomy & Planetary Science, Northern Arizona University.

[D-10] **Magnetic Shape Memory Alloy Composite Research**, Mikela Petersen, (Senior, Mechanical Engineering). Mentor: Constantin Ciocanel, Mechanical Engineering, Northern Arizona University.

[D-11] **Emerging Non-Volatile Memory: Resistive Switching Behaviors in Amorphous Tungsten Oxide Dielectric**, Maxwell Weiss, (Senior, Electrical Engineering, School of Informatics, Computing, & Cybersecurity). Mentor: Ying-Chen Chen, School of Informatics, Computing, & Cybersecurity, Northern Arizona University.

[D-12] **Enabling Part-Process Design for Metal Additive Manufacturing**, Raphaelle Therese Guinanao, (Junior, Computer Science, Systems & Industrial Engineering). Mentor: Hannah Budinoff, Systems & Industrial Engineering, University of Arizona.

[D-In Title Only] **Identification of Fire-Retardant Chemical Treatments via Instrumental Analysis**, Caitlin Dillon, (Junior, Forensic Biology, Biology & Chemistry). Mentor: Rachael Schmidt, Biology and Chemistry, Embry-Riddle Aeronautical University.

Program Schedule

Session E:
Astronomy and Space Physics

Moderators:
Yancy Shirley, University of Arizona
Timothy Swindle, University of Arizona

[E-1] **Characterizing High [OIII]/[OII] Galaxies for LyC Study**, Alex Blanche, (Junior, Astrophysics, Cosmology). Mentor: Rogier Windhorst, Cosmology, Arizona State University.

[E-2] **Automating Absorption Line Identification in Quasi-Stellar Object Sightlines Using Probabilistic Programming**, Bryanna Gutierrez-Coatney, (Senior, Astrophysics, School of Earth & Space Exploration). Mentor: Sanchayeeta Borthakur, School of Earth & Space Exploration, Arizona State University.

[E-3] **Effects of Property Variation on Planetesimal Thermal Modeling**, Jonas Hallstrom, (Junior, Physics). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[E-4] **Analysis of Ionospheric Variability in EDGES Observations**, Katie Herrington, (Sophomore, Physics, Aerospace Engineering, School of Earth & Space Exploration). Mentor: Judd Bowman, School of Earth & Space Exploration, Arizona State University.

[E-5] **Characterizing the atmospheres of cloud-freeT-dwarfs using Gaussian processes**, Isabela Huckabee, (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Michael Line, School of Earth & Space Exploration, Arizona State University.

[E-6] **On a Novel Superconducting On-Chip Fourier Transform Spectrometer**, Emily Linden, (Sophomore, Physics). Mentor: Philip Mauskopf, School of Earth & Space Exploration, Department of Physics, Arizona State University.

[E-7] **Identification of Thiol Function Group in Carbonaceous chondrites which are meteorite analogs of Bennu**, Thomas Redford, (Senior, Physics, Mathematics, English). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[E-8] **Seeing-Sorted U-band Imaging of the Extended Groth Strip**, Caleb Redshaw, (Senior, Mechanical Engineering, School for Engineering of Matter, Transport & Energy). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University.

[E-9] **Analyzing Star-Galaxy Separation Methods for SKYSURF**, Andi Swirbul, (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University.

[E-10] **Nitrogen Isotopic Fractionation in Prestellar Core L43-E**, Reynier Squillace, (Junior, Astronomy). Mentor: Yancy Shirley, Astronomy, University of Arizona.

[E-11] **Small Arm-Length Interferometry For U-Class Spacecraft**, Logan Caudle, (First-Year, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-11] **Small Arm-Length Interferometry For U-Class Spacecraft**, Shannon Moore, (First-Year, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-12] **New Short-Range Tests of Gravity**, Jennifer James, (Senior, Space Physics, Physics & Astronomy). Mentor: Quentin Bailey, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-12] **New Short-Range Tests of Gravity**, Janessa Slone, (Junior, Space Physics, Physics & Astronomy). Mentor: Quentin Bailey, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-13] **What Drives the Variability in Luminous Blue Variable Stars?** Marina Beltran, (Junior, Astronomy, Physics & Astronomy). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-13] **What Drives the Variability in Luminous Blue Variable Stars?** Becca Spejcher, (Sophomore, Astronomy, Physics & Astronomy). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-14] **Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**, Skylar Kemper, (Senior, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-14] **Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**, Yuka Lin, (Senior, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-15] **The Missing S in EXPRES: Stellar Activity Index Derived Using the Extreme PREcison Spectrometer**, Isaac AshLind, (Junior, Astrophysics, Mathematics, Physics). Mentors: Joe Llama and Jeff Hall, Lowell Observatory.

[E-16] **STEM Exposure on Reservations in Arizona**, Tracey Begaye, (Junior, Computer Engineering, Astronomy & Planetary Science). Mentor: Mary Lara, Astronomy & Planetary Science, Northern Arizona University.

[E-17] **Analyzing OH/H2O on Near Earth Objects**, Mary Bolling, (Senior, Astronomy, Astronomy & Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University.

[E-18] **The Story of Pluto**, Melissa Valenzuela, (Senior, History, Astronomy & Planetary Science). Mentor: Lauren Amundson, Lowell Observatory.

[E-19] **Gravitational Lensing by Galaxy Clusters to Study the Early Universe**, Nicholas Foo, (Senior, Astronomy, Physics). Mentor: Brenda Frye, Astronomy, University of Arizona.

[E-20] **Exozodiacal Dust in the Epsilon Eridani System**, Carl Ingebretsen, (Junior, Astronomy). Mentor: Virginie Faramaz, Astronomy, University of Arizona.

[E-21] **PhoSim: Visualizing What JWST/NIRCam Will See**, Magnus Magnusson, (Senior, Astronomy, Statistics & Data Science). Mentor: Eiichi Egami, Astronomy, University of Arizona.

Program Schedule

Session F:
Planetary Science

Moderators:
Christopher Edwards, Northern Arizona University
Michele Zanolin, Embry-Riddle Aeronautical University

[F-1] **Impactor-Atmosphere Interactions Above the Surface of Venus**, Claire Blaske, (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Joseph O'Rourke, School of Earth & Space Exploration, Arizona State University.

[F-2] **Tissintite-II and other High Pressure-Temperature Minerals in Lunar Meteorite NWA 13967**, Christian Kroemer, (Senior, Earth & Space Exploration, School of Earth & Space Exploration). Mentor: Meenakshi Wadhwa, Earth & Space Exploration, Arizona State University.

[F-3] **Nitrogen Storage in the Deep Interiors of Rocky Planets**, Shradhanjli Ravikumar, (Junior, Astrobiology, Biogeosciences, School of Earth & Space Exploration). Mentor: Sang-Heon (Dan) Shim, School of Earth & Space Exploration, Arizona State University.

[F-4] **Characterization of organic materials in table salt**, Lucas Reynoso, (Junior, Mechanical Engineering, School for Engineering of Matter, Transport, and Energy). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[F-5] **Is there fine-grained material under the surface of Bennu?** Claire Gibson, (Sophomore, Geology, Astronomy & Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University.

[F-6] **A Signal Within the Sediments: Using Biological Stoichiometry as a Potential Biosignature on Martian Sediments**, Johnelle Gonzales, (Senior, Physics, Astronomy, Astronomy & Planetary Science). Mentor: Christopher Doughty, School of Informatics, Computing, & Cyber Systems, Northern Arizona University.

[F-7] **Detectability of Surface Biosignatures for Directly Imaged Exoplanets**, Gabrielle Jones, (Senior, Astroinformatics, School of Informatics, Computing, & Cyber Systems). Mentor: Tyler Robinson, Astronomy & Planetary Science, Northern Arizona University.

[F-8] **The Portable Goniometer**, Kendall Koga, (Senior, Physics, Astronomy, Astronomy & Planetary Science). Mentor: Will Grundy, Lowell Observatory.

[F-9] **Space Weathering of Carbonaceous Asteroids**, Beau Prince, (Senior, Physics, Mathematics, Applied Physics & Materials Science). Mentor: Mark Loeffler, Astronomy & Planetary Science, Northern Arizona University.

[F-10] **Lab Analyses of Olivine-Carbonate Mixtures as observed on Mars**, Hope Wetzstein, (Senior, Physics, Astronomy). Mentor: Mark Salvatore, Astronomy & Planetary Science, Northern Arizona University.

[F-11] **Analysis of Callisto's Multi-Ring Impact Basins**, Shea DeFour-Remy, (Sophomore, Astronomy, Lunar & Planetary Laboratory). Mentor: Veronica Bray, Lunar & Planetary Laboratory, University of Arizona.

[F-12] **Giordano Bruno: Secondary impact cratering processes on the Moon**, Alexia Kubas, (Senior, Astronomy). Mentor: Christopher Hamilton, Lunar & Planetary Laboratory, University of Arizona.

[F-13] **Mapping and characterization of subsurface deposits in Planum Boreum, Mars, using radar sounding**, Maia Willis-Reddick, (Sophomore, Geology, Geosciences). Mentor: Stefano Nerozzi, Lunar & Planetary Laboratory, University of Arizona.

[F-14] **Mapping Lunar Crustal Magnetic Fields in the Polar Regions**, Jacob van der Leeuw, (Senior, Mathematics, Computer Science). Mentor: Lon Hood, Planetary Sciences, University of Arizona.

[F-15] **Coordinated Microanalysis of Lunar Soils in Preparation for Future Returned Samples**, Dayana Moreno Huerta, (Sophomore, Chemistry, Chemistry & Biochemistry). Mentor: Jessica Barnes, Lunar & Planetary Laboratory, University of Arizona.

Program Schedule

Session G:
ASCEND

Moderators:
Clayton Jacobs, Northrop Grumman
Thomas Sharp, Arizona State University

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, Genevieve Cooper, (Junior, Computer Science, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, David Lopez, (Senior, Meteorology, Climatology, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, Surya Madan, (Junior, Aerospace Engineering, I.R.A. Fulton Schools of Engineering). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, Anyell Mata, (Junior, Electrical Engineering, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, David Rodriguez, (Junior, Electrical Engineering, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-1] **Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation**, Ben Weber, (Sophomore, Aerospace Engineering, Interplantery Initiative). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University.

[G-2] **High Altitude Payload**, Neal Ryan Allado, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Merick Carlisi, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Angel Gonzalez, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Sophia Mhae Jorda, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Jonathan Lawson, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Danika Liebhart, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Elijah Ramirez, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Elias Razo, (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-2] **High Altitude Payload**, Aidan Schairer, (High School Student, Engineering, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Alex Aguilar, (First-Year, Chemistry, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Robert Brewington, (Post-Baccalaureate, Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, William Gyrulf, (High School Student, Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Alexandria Hayes, (Sophomore, Mechanical Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Isai Patena Ortiz, (Sophomore, Associate of Science, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Michael Plummer, (Sophomore, Mechanical Robotics, Aerospace Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Denise Ryder, (Post-Baccalaureate, Mathematics, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-3] **Atmospheric Conditions Affecting Surface Temperature**, Joshua Ryder, (Post-Baccalaureate, Computer Science, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[G-4] **Optimization of Payload Design and Systems**, Callista Clemons, (Sophomore, Computer Sciences). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Will Cohen, (Sophomore, Mechanical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Jose Cruz Jr., (First-Year, Mathematics, Physics). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Jacqueline Do, (Sophomore, Electrical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Sydnee Farnsworth, (First-Year, Material Science & Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Grant Fulleton, (Sophomore, Computer Science). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Ivan Gonzalez Lopez, (Sophomore, Associate of Science, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Keivyn Lopez, (Sophomore, Mechanical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Vivien Frances Pabuna, (Junior, Computer Science). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Andrew Sherant, (Sophomore, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-4] **Optimization of Payload Design and Systems**, Joshua Torres, (Sophomore, Electrical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College.

[G-5] **Investigation of Long-Distance Video and Telemetry Streaming**, Zachary Howe, (Senior, Aeronautical Sciences). Mentors: Douglas Isenberg and Yabin Liao, Mechanical Engineering & Aerospace Engineering, Embry-Riddle Aeronautical University.

[G-5] **Investigation of Long-Distance Video and Telemetry Streaming**, Nicodemus Phaklides, (Senior, Electrical Engineering, Electrical, Computer, & Software Engineering). Mentors: Douglas Isenberg and Yabin Liao, Mechanical Engineering & Aerospace Engineering, Embry-Riddle Aeronautical University.

[G-6] **Team D.A.N.E.S Ascend Project**, Brody Dyer, (High School Student, Undeclared, Physical Sciences). Mentor: AnnMarie Condes, Chemistry, Pima Community College.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Sarina Blanchard, (First-Year, Mechanical Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Nicolas Blanchard, (Junior, Electrical & Computer Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Isela Burruel, (Senior, Systems Engineering, Systems & Industrial Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Grace Halferty, (Senior, Mechanical Engineering, Biology, Aerospace & Mechanical Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Daniel McConville, (Senior, Materials Science & Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Arsh Nadkarni, (Senior, Astronomy, Applied Physics). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[G-7] **Profiling High-Altitude Radiation with a General Data Logger**, Paul O'Brien Sylvester, (Sophomore, Systems Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

Program Schedule

Session H:
Aerospace Technology: Spaceflight and Engineering Programs

Moderators:
Anne Boettcher, Embry-Riddle Aeronautical University
Elliott Bryner, Embry-Riddle Aeronautical University

[H-1] **Synthesis of 2D Ti3C2Tx MXene Flakes from Ti3AlC2 MAX Phases for electronic property analysis**, Darius Hampton-Ross, (Junior, Aerospace Engineering, School for Engineering of Matter, Transport, & Energy). Mentor: Kenan Song, The Polytechnic School, Arizona State University.

[H-2] **The effects of equivalence ratio during shutdown of a rocket engine on hardware longevity**, Benjamin Black, (Senior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-3] **Injector Face Thermal Analysis for a Liquid Rocket Engine**, Zoe Brand, (Junior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-4] **EagleSat-2 Memory Degradation Experiment**, Shane Howe, (Junior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[H-5] **EagleSat II - Satellite Communication Development in an Undergraduate Environment**, Joshua Parmenter, (Senior, Computer Engineering, Electrical, Computer, & Software Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[H-5] **EagleSat II - Satellite Communication Development in an Undergraduate Environment**, Hayden Roszell, (Junior, Software Engineering, Electrical, Computer, & Software Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[H-6] **EagleSat II- ADCS**, Grayson Peeler, (Senior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[H-7] **The EagleSat 2: Fabrication Team Finalizations**, Lillian Sudkamp, (Junior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University.

[H-8] **Assessing the Viability of Asteroid Refuelling on the Way to Mars**, Julian Treat, (Senior, Aerospace Engineering). Mentor: Davide Conte, College of Engineering, Embry-Riddle Aeronautical University.

[H-9] **Design and Characterization of Liquid Fuel Spray Injector**, Rebekah Weigand, (Junior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-10] **Towards Improved Physics-Informed Machine Learning**, Ethan Shoemaker, (Senior, Mechanical Engineering). Mentor: Amirhossein Arzani, Mechanical Engineering, Northern Arizona University.

[H-11] **Modeling of Thermal Protection Systems during Re-Entry**, Cameron Fernandez, (Senior, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Kyle Hanquist, Aerospace & Mechanical Engineering, University of Arizona.

[H-12] **CatSat: Integration and Testing for a University of Arizona CubeSat**, Shae Henley, (Sophomore, Aerospace Engineering). Mentor: Dathon Golish, Lunar & Planetary Laboratory, University of Arizona.

[H-13] **Shock Tube Method for Dynamic Calibration of Pressure Transducers**, Nina Mackey, (Sophomore, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Alex Craig, Aerospace & Mechanical Engineering, University of Arizona.

[H-In Title Only] **CatSat**, Raquelle Denetso, (Senior, Electrical & Computer Engineering). Mentor: Dathon Golish, Lunar & Planetary Laboratory, University of Arizona.

2021-22 Arizona NASA Space Grant Student Abstracts

Organized by presenter's last name

Aguilar, Alex (First-Year, Chemistry, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Allado, Neal Ryan (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Anthis, Roman (Junior, Aerospace Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [A-2]

ADJUSTABLE WIND TUNNEL DIFFUSER

Various geopolitical factors have increased interest in sustained high-speed flight in recent years. Wind tunnels are crucial for the development of both commercial and military systems. This research focuses on expanding the capabilities of the University of Arizona's Indraft Supersonic Wind Tunnel (ISWT). More specifically, it involves modifying the current manually adjustable diffuser into an automatically adjustable diffuser. Current run times in ISWT are approximately 15 seconds. The new diffuser would allow ISWT to run at different Mach numbers repeatably and for longer duration (potentially a factor of 2x). This is crucial for certain measurement techniques like particle image velocimetry which requires large data sets (e.g. 1000 samples) but has limited sampling rates (typically 10 Hz).

AshLind, Isaac (Junior, Astrophysics, Mathematics, Physics). Mentors: Joe Llama and Jeff Hall, Lowell Observatory. [E-15]

THE MISSING S IN EXPRES: STELLAR ACTIVITY INDEX DERIVED USING THE EXTREME PRECISON SPECTROMETER

Cool stars, including the Sun, exhibit magnetic activity that reflects the stellar interior's physical processes. This activity includes periodic behavior that evolves throughout the stellar lifecycle. We can track sunspots and plage activity to characterize these cycles for the Sun. For the unresolved stars, we need another activity indicator. One such indicator is the chromospheric flux seen in calcium H and K spectral lines. A standard metric for this quantity is the Mount Wilson S-index recorded from the 1960s to the 1990s. Lowell Observatory has continued to make this observation over the last couple of decades with the Solar Stellar Spectrograph (SSS). As SSS is retired, we aim to derive the same index using the Yale-built EXtreme PREcision Spectrometer (EXPRES) on the 4.3-meter Lowell Discovery Telescope. In this work, we share the first EXPRES-derived solar S-index results.

Baca, Justine (Senior, Biology, Biological Sciences). Mentor: Anita Antoninka, School of Forestry, Northern Arizona University. [C-7]

IMPACTS OF NATURAL DIATOMACEOUS EARTH ABUNDANCE ON MICROARTHROPODS COMMUNITIES AT VALLES CALDERA

Arthropods have cuticle layers that can be damaged from contact with fossil diatoms, which is why diatomaceous earth is often applied to soil as an insecticide. However, little is known about how naturally occurring surface diatomaceous earth deposits can affect microarthropod communities. We hypothesized that higher diatom abundances negatively affect microarthropod communities. We examined communities along a natural gradient of diatom abundance at Valles Caldera National Preserve, New Mexico. Diatom concentration were measured with the biogenic silica analysis method and microarthropods were extracted, quantified, and categorized as mites, springtails, and others. Soil texture and soil organic matter were not well correlated with diatoms. Microarthropod counts are underway. Our results will inform community assembly of microarthropods in stressful environments and provide information for management at Valles Caldera.

Baez, Justin (Senior, Geological Sciences, School of Earth & Space Exploration). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University. [C-1]

CAN CHANGES IN HOT SPRING COMPOSITION REFLECT DECADAL-SCALE DEFORMATION OF THE YELLOWSTONE CALDERA?

The large Yellowstone Caldera, at the geographic center of Yellowstone National Park, WY, has been observed to cyclically rise and subside by a few millimeters per year over the previous 2.5 decades of continuous GPS measurement collection. This rapid deformational activity has been proposed to be a consequence of either the movement of magma deep beneath the caldera surface or to be derived from the circulation of hydrothermal fluids at a more shallow depth. By using field measurements of hot springs within the Greater Obsidian Pool Area (GOPA) that chronologically overlap with the deformational activity, we attempt to investigate a potential correlation between the displacement of the caldera and the change in geochemical composition of hot springs. Time-series graphs depicting changes in the pH of multiple GOPA hot springs suggest that the deformational activity likely relates to the quantity of gas being released into the hot springs.

Baker, Eliot (Senior, Chemical Engineering, Chemical & Environmental Engineering). Mentor: Reyes Sierra-Alvarez, Chemical & Environmental Engineering, University of Arizona. [C-13]

SOIL ORGANIC MATTER IMPROVING THE BIOREMEDIATION OF INSENSITIVE MUNITIONS COMPOUNDS

Insensitive munitions compounds (IMCs) are nitro-compounds developed by the military to replace traditional explosives, such as TNT, due to IMCs' lower likelihood of accidental explosions. However, the manufacturing and use of these new nitro-compounds require exploring new methods for their environmental remediation. Bioremediation driven by bacteria respiring (and consequently reducing) nitroaromatics has only been confirmed for a limited number of compounds. However, crucial soil microorganisms can respire natural organic matter (NOM) by reducing its quinone moieties to hydroquinones. Therefore, the scope of this research was to investigate the combination of NOM-respiration with the chemical reduction of nitroaromatics using the hydroquinones formed. Through this pathway, a bacterial enrichment culture containing mostly Geobacter anodireducens was able to respire a wide range of nitroaromatics. This process can be implemented as a bioremediation strategy to clean up IMCs-contaminates sites, provided that enough NOM is available for microorganisms in the soil.

Begaye, Tracey (Junior, Computer Engineering, Astronomy & Planetary Science). Mentor: Mary Lara, Astronomy & Planetary Science, Northern Arizona University. [E-16]

STEM EXPOSURE ON RESERVATIONS IN ARIZONA

The American Indian Mobile Educational Resources (AIMER) project is a collaboration between NAU/NASA Space Grant, the Department of Astronomy & Planetary Science, and the College of Engineering, Forestry & Natural Sciences to address the issue of low STEM proficiency on the reservation and increase exposure to STEM opportunities. On rural Indian reservations in Arizona, the project delivers STEM education, research, and outreach to Native American kids in kindergarten through twelfth grade. With an emphasis on astronomy, the project incorporates hands-on space science lessons/activities, telescopes, and star parties to make STEM more relatable and accessible for students. We have touched on lunar phases, Mars helicopter Ingenuity, liquid nitrogen, and more. I've noticed a significant boost in attention span, conceptual understanding, and interest after the completion of our lessons. Without this initiative, these students would have minimal exposure to STEM subjects due to the reservation's low resources.

Beltran, Marina (Junior, Astronomy, Physics & Astronomy). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-13]

WHAT DRIVES THE VARIABILITY IN LUMINOUS BLUE VARIABLE STARS?

Luminous blue variable stars (LBVs) are evolved massive stars with strong winds and large variability. The variability of these stars is not yet well understood. We are using photometric data from NASA's Transiting Exoplanet Survey Satellite (TESS) to study 30 LBV candidates in the Large and Small Magellanic Clouds. The light curves extracted from TESS will be compared to the All-Sky Automated Survey for SuperNovae (ASAS-SN) light curves of the same stars. This is to rule out any instrumental errors with TESS. We can then perform Fourier Transforms on the corrected TESS data which allows us to find the time scales of variability. Using the results from the Fourier analysis we can begin to understand the driving mechanisms of our candidates by comparing them to known LBVs such as P Cygni.

Benavidez, Koda (Sophomore, Applied Mathematics, Theatre Arts). Mentor: Daniel Stolte, Marketing & Communications, University of Arizona. [B-8]

SCIENCE JOURNALISM AS AN AVENUE FOR SCIENTIFIC LITERACY

For the last six months, I have been working as a science writing intern, with my mentor, Daniel Stolte, a science writer with the University of Arizona's central marketing and communications office. The purpose of my work is to translate complex research and scientific advances made by UArizona scientists into engaging stories that appeal to lay audiences. By generating news releases about scientific publications that we consider newsworthy, we strive to entice journalists to set up interviews and pursue their own stories about work done by UArizona researchers. We accomplished all of the former by coordinating such interviews with various researchers across a variety of disciplines within the natural sciences and other STEM fields, where we ask provoking questions about the significance of the researchers' findings and brainstorm different ways to communicate these findings to the public.

Benites, Eliana (Senior, Astrobiology, Biogeoscience, School of Earth & Space Exploration). Mentor: Heather Throop, School of Earth & Space Exploration, Arizona State University. [C-2]

DATA FUSION TECHNIQUES TO DETERMINE HYPOLITH COLONIZATION AND DISTRIBUTION PATTERNS

In drylands, microbes can thrive under semi-translucent quartz rocks. These microbial communities (termed hypoliths) provide ecosystem services such as soil stabilization and biogeochemical cycling. In addition, hypoliths can account for a considerable fraction of photosynthetic biomass. Thus, uncovering patterns in hypolithic distribution could reveal critical information about dryland ecosystem functions and can aid in astrobiological applications. In this project, methods were developed for automated estimation of broad spatial scale hypolith distribution. Twelve areas of interest were chosen in two different locations of the Sonoran Desert, AZ. Photographs were taken of ~680 individual quartz rocks to analyze structural traits and colorimetry. Furthermore, photographs were used to investigate the spatial distribution of hypoliths with FIJI (an image processing package). With hypoliths being a detectable source of primary productivity, this project aims to find relationships in colonization patterns, which could potentially be useful in the search for life on other planetary bodies.

Berkland, Liam (Junior, Biomedical Science, Biological Sciences). Mentor: Sara Jarvis, Biological Sciences, Northern Arizona University. [D-8]

THE EFFECT OF PREVIOUS COVID-19 INFECTION ON BLOOD PRESSURE CONTROL

The purpose was to determine the effect of a previous COVID-19 infection on blood pressure (BP) regulation during laboratory challenges. The control and COVID-19 groups underwent a cold pressure test (CPT) and tilt-table test (TILT). For CPT, there were no changes in heart rate (HR). BP (systolic, SBP; diastolic, DBP) increased during CPT. HR was higher during TILT than BL. Cardiac output (Qc) and stroke volume (SV) at BL were higher in CV-19. Among the few subjects, CPT responses and tilt times were similar between groups. CV-19 had a higher Qc and SV at BL.

Black, Benjamin (Senior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-2]

THE EFFECTS OF EQUIVALENCE RATIO DURING SHUTDOWN OF A ROCKET ENGINE ON HARDWARE LONGEVITY

During the shutdown or purge period after firing of a rocket engine it is critical to understand what equivalence ratios are desirable and implement a shutdown sequence so that the hardware is subjected to the lowest thermal and mechanical loading. Furthermore, it is essential that hazards to the test technicians caused by this method be minimized. The initial study was conducted into combustion mechanics, to understand how the reactants would ideally behave at varying equivalence ratios and in both pre-mixed and diffusion flame combustion. Using this foundation an analytical model for Propane-Oxygen flame temperature was created and tested using a scale combustion chamber. Finally, the chamber pressure and chamber wall temperature data will be used to create a standard for shutdown parameters to be implemented for further full-scale testing on a Kerosine-LOX liquid rocket engine.

Blais, Jacob (Junior, Natural Resources, School of Natural Resources and the Environment). Mentor: Nathan Pierce, School of Natural Resources and the Environment, University of Arizona. [C-8]

PERSISTENCE OF SOIL RESPIRATION LEGACIES INDUCED BY TEMPORALLY REPACKAGED SUMMER RAINFALL IN SONORAN DESERT GRASSLANDS

Soil respiration of CO_2, an important component of ecosystem carbon balance with the atmosphere, comes from plant roots and microbial decomposition. In the Sonoran Desert, it is becoming increasingly common for summer monsoon growing season precipitation to come in fewer, larger events. Here we assess what effects the temporal repackaging of summer precipitation has on soil respiration in future seasons. We measured legacy effects of fewer, larger summer precipitation events in Sonoran Desert grasslands over the subsequent winter and spring using automated in-situ chambers at a multi-year rainfall manipulation experimental site (RainManSR). We find that repackaging summer rainfall into fewer, larger events suppressed summer respiration, but that these carbon balance differences were at least partly compensated by greater respiration during subsequent seasons. Future work will evaluate the mechanistic controls of cool-season soil respiration to better explain the observed legacy effects.

Blanchard, Sarina (First-Year, Mechanical Engineering, Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. Inside, these small electronics are susceptible to the high-energy radiation present in orbit, so it is important to understand radiation intensities at different altitudes. This project is a proof-of-concept to study the radiation profile of the Earth's atmosphere, particularly exploring radiation intensity as a function of altitude. Within the bounds of a standard 1U CubeSat, the UArizona ASCEND! payload housed a digital geiger counter and atmospheric profiling system to measure the amount of ionizing radiation present in Earth's atmosphere up to approximately 100,000 feet above MSL.

Blanchard, Nicolas (Junior, Electrical & Computer Engineering, Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

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Blanche, Alex (Junior, Astrophysics, Cosmology). Mentor: Rogier Windhorst, Cosmology, Arizona State University. [E-1]

CHARACTERIZING HIGH [OIII]/[OII] GALAXIES FOR LYC STUDY

This project took a combined spectral catalog of galaxies in the GOODS North field and filtered it down to specifically look for [OIII]/[OII] emissions with the future goal of Lyman Continuum photon (LyC) study. Studying these galaxies and their ionizing radiation escape fractions hopes to better understand why a high percentage of galaxies with high LyC escape fractions contain spectral lines of ionized oxygen ([OII] and [OIII]). This project, out of 700+ spectra, returned 81 spectra with varying degrees of [OII] and/or [OIII] line strength. Those with strong lines have had line fluxes calculated from line fits. This sorted data sets with verified redshifts and line fluxes is planned for research for LyC study and [OIII]/[OII] galaxy study.

Blaske, Claire (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Joseph O'Rourke, School of Earth & Space Exploration, Arizona State University. [F-1]

IMPACTOR-ATMOSPHERE INTERACTIONS ABOVE THE SURFACE OF VENUS

The weather and history of Venus is poorly understood, and the surface is hidden to visible imagery by thick clouds of sulfuric acid. Meteors passing through the dense atmosphere will severely ablate or explode before hitting the surface, in contrast to the atmosphere-less Moon and Mars that are heavily cratered. Meteors exploding near the surface produce shockwaves that create radar-dark, craterless splotches. If they explode at higher altitudes, meteors produce optical flashes that could be mistaken for lightning by instruments. By understanding the amount of energy that is released by an impactor during an explosion, we will be able to use statistics to model the amount of optical flashes we expect to see from meteors in a given timeframe. We can compare the results to flash observations made by instruments aboard spacecraft such as the Akatsuki climate orbiter to determine the long-debated existence of lightning in the atmosphere of Venus.

Bolling, Mary (Senior, Astronomy, Astronomy & Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University. [E-17]

ANALYZING OH/H_2O ON NEAR EARTH OBJECTS

Near-Earth objects (NEOs) have long been thought to be devoid of OH/ H_2O. However, recent studies on the Moon and Vesta, which were also previously labeled anhydrous, have identified these elements on their surface. We are searching for OH/ H_2O on the surfaces of other NEOs and to understand more about the interaction of space on airless bodies. The goal is to observe about 30 NEOs as well as 30 Main Belt asteroids so that we can estimate the fraction of NEOs that have OH/ H_2O signatures. Our approach involves measuring the near-infrared spectra of the objects, looking for albedo variations, and comparing our findings with the properties of Main Belt asteroids. The wavelength of the near-infrared spectra analysis is of 2-4 μm.

Brand, Zoe (Junior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-3]

INJECTOR FACE THERMAL ANALYSIS FOR A LIQUID ROCKET ENGINE

Proper analysis of the temperature gradient across a pintle injector face is critical to understanding the lifespan of the hardware. The medium used to secure the temperature sensors during testing can cause a change in thermal resistance around the probe resulting in a discrepancy in temperature readings. The orientation of the temperature sensors can cause areas of concentrated heat and disrupt the flow of thermal energy across the injector face. The goal of this research is to use Computational Fluid Dynamics analysis to understand the effect of sensor orientation on the severity of hot spots and the thermal distribution through the injector face. To test the validity of the analysis, a hot fire will be conducted to retrieve sensor data from the test hardware. Results from this research can be used to improve test and flight duration of liquid rocket engines by increasing the lifespan of the injector.

Brewington, Robert (Post-Baccalaureate, Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Brown, Kayla (Senior, Civil Engineering, Engineering). Mentor: Angelita Denny, Department of Energy, Legacy Management. [C-6]

EARTH SURFACE CHANGE

Disposal cells in the Uranium Mill Tailings Radiation Control Act (UMTRCA) are designed to isolate waste through limiting radon diffusion, reducing water percolation, and controlling erosion. During this virtual internship I was in charge of analyzing annual inspection reports from years 1990 to 2020 in five different sites. The sites include Mexican Hat, L-Bar, Durango, Sherwood, and Gunnison. Annual inspections are performed to identify natural and man-made changes to cover performance. Changes may include erosion by wind and water, growth of vegetation, desiccation and cracking of surface soil, vandalism, etc. Annual inspection reports summarize the integrity of visible features at the site, the status of erosion and revegetation, and determine any need for additional inspections and monitoring. Tracking these changes matter because the disposal cell has an impact on human health and the environment. It helps keep the radiation in the ground from leaking out and causing harm.

Burruel, Isela (Senior, Systems Engineering, Systems & Industrial Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. Inside, these small electronics are susceptible to the high-energy radiation present in orbit, so it is important to understand radiation intensities at different altitudes. This project is a proof-of-concept to study the radiation profile of the Earth's atmosphere, particularly exploring radiation intensity as a function of altitude. Within the bounds of a standard 1U CubeSat, the UArizona ASCEND! payload housed a digital geiger counter and atmospheric profiling system to measure the amount of ionizing radiation present in Earth's atmosphere up to approximately 100,000 feet above MSL.

Carlisi, Merick (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Carlson, Ethan (Senior, Aerospace Engineering). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University. [D-6]

OVERCOMING PHYSIOLOGICAL CHALLENGES OF MICROGRAVITY IN SPACE

Space is a microgravity environment that poses many complex challenges. Among such challenges are the physiological effects of microgravity on the human body, such as bone and muscle atrophy. An exercise apparatus has been designed to combat this dilemma by addressing the physiological and psychological aspects of physical fitness. This apparatus combines different mechanics gives versatility, allowing astronauts to perform a vast range of exercises, mimicking both machine work and free weights. The interactive interface of the apparatus provides a means of motivation and social support during fitness training to parallel working out in a group or with a trainer on Earth. A fitness schedule has also been created to complement the designed exercise apparatus. The fitness schedule focuses on a balance between concentric and eccentric muscle contraction exercises, strengthening over 90% of all human muscle groups that affect the skeletal structure of the astronauts' physical health.

Carruthers, Brooke (Junior, Molecular & Cellular Biology). Mentor: Betül Kacar, Bacteriology, The University of Wisconsin - Madison. [C-14]

EXPLORING THE EVOLUTIONARY HISTORY OF NITROGENASE'S G SUBUNIT

The factors that drive the origins and evolution of molecular innovations over Earth's history remain unclear, particularly for early biogeochemical metabolisms. One such metabolism, biological nitrogen fixation, is catalyzed by metalloenzymes called nitrogenases, which have diversified over ~3 billion years into three forms characterized by their metal dependence. Later-evolved forms contain an additional protein domain, the G subunit, whose emergence might be linked with the diversification of metal use in nitrogen fixation. We used phylogenetic reconstruction to infer the evolutionary path of the subunit and conducted structural modeling of inferred ancestral protein sequences. We show that G subunit proteins diverged early into two metal-specific groups, and we observe structural characteristics that highlight this divergence. These findings illuminate how molecular innovations might drive metal selection in biology as well as the co-evolution of metabolisms with their planetary environments.

Caudle, Logan (First-Year, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-11]

SMALL ARM-LENGTH INTERFEROMETRY FOR U-CLASS SPACECRAFT

Recent developments in space-based laser interferometery have shown that considerable improvements in the sensitivity of gravitational wave observatories can be achieved while mitigating many of the drawbacks encountered in ground-based detectors. The purpose of this study is to evaluate the feasibility of implementing a short-arm length cavity interferometer as a payload for U-Class spacecraft. Placement of the payload in Low Earth Orbit would provide an environment free of any ground vibrational disturbances. However, given the space constraints of U-Class spacecraft, optical configurations, such as the Michelson Fabry-Perot interferometer, will be tested to increase the operating sensitivity of the interferometer. Further analysis will also be done to ensure the integrity and enable in-orbit operation of the experiment. In summary, this research project will analyze the viability and precision of implementing a small-scale interferometer into a U-Class Spacecraft that will be placed in Low Earth Orbit.

Clemons, Callista (Sophomore, Computer Sciences). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Cohen, Will (Sophomore, Mechanical Engineering, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

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Cooke, Brianne (Senior, Biological Sciences, College of the Environment, Forestry, & Natural Sciences). Mentor: Jasmine Anenberg, School of Forestry, Northern Arizona University. [C-9]

MULTI-SPECIES FOG CULTIVATION AND TRAIT MEASUREMENTS OF BIOCRUST TO USE FOR AND INFORM RESTORATION RECIPES

Biological soil crusts (biocrusts) are a biological community creating a skin at the surface of soil that provide various functions such as stabilizing soil against erosion and nutrient cycling. Loss of biocrust due to climate change and land use has led to ecosystem degradation, and there is insufficient research on biocrusts and their potential for cultivation and use in restoration. There is an urgent need to create biocrust cultivation methods and improve our understanding of biocrust characteristics to effectively reintroduce them into degraded ecosystems. We developed a fog chamber for biocrust cultivation and conducted trait experiments on several species of biocrusts. Results showed growth in all species, with Syntrichia ruralis having a >200% increase in healthy tissue. Further development of this biocrust cultivation and groundwork for trait measurements will allow biocrust to be efficiently reintroduced into degraded ecosystems, especially as climate change and land degradation is exacerbated in the future.

Cooper, Genevieve (Junior, Computer Science, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

ANALYSIS OF ATMOSPHERIC DATA AND COLLECTION METHODS THROUGH SIMULTANEOUS EXPERIMENTATION

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Cruz Jr., Jose (First-Year, Mathematics, Physics). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

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Davis, Remington Cole (Senior, Industrial Organizational Psychology, Behavioral & Social Sciences). Mentor: Heather Lum, Behavioral & Social Sciences, Embry-Riddle Aeronautical University. [B-3]

STUDYING ASPECTS OF TEAMWORK AND COMMUNICATION IN A VIRTUAL REALITY ENVIRONMENT

The gaming experience is critical to the development and evolution of games as well as an avenue for studying aspects of human behavior. This study aims to look at levels of immersion in a virtual reality gaming system. Researchers hope to establish an experimental plan that will accurately and reliably measure user engagement in the gaming experience as well as emotional and physiological feedback. All of these factors will give support for a variety of applications beyond this study including, but not limited to, consumer, military, and computer-based training simulations.

DeFour-Remy, Shea (Sophomore, Astronomy, Lunar & Planetary Laboratory). Mentor: Veronica Bray, Lunar & Planetary Laboratory, University of Arizona. [F-11]

ANALYSIS OF CALLISTO'S MULTI-RING IMPACT BASINS

Greater understanding of the evolution of worlds that have been geologically inactive for much of their history, such as Callisto, is important as it provides a baseline for comparison when analyzing more active worlds such as Io, Europa or Ganymede within the Jovian system. Three multi-ring impact basins, one of the largest impact features on outer solar system icy bodies, have been studied using morphometry from Galileo and Voyager mission images. These basins are Valhalla, Asgard and Adlinda in respective order. A ring spacing profile was established along eight transects for each basin, and hydrocode models are intended to be run in order to match these profiles. Once a match occurs along a particular transect when simulating the impact, the subsurface characteristics along that transect can be inferred from the simulation parameters, and a model of each basin's subsurface conditions at the relative times of impact can be made.

Denetso, Raquelle (Senior, Electrical & Computer Engineering, Engineering). Mentor: Dathon Golish, Lunar & Planetary Laboratory, University of Arizona. [H-In Title Only]

CATSAT

Modern cubesat delivery to low earth orbit requires complete optimization of weight because the cubesat is very small. Because of this, most cubesats need to use a small antenna, which limits how much data can be transmitted. CatSat is a 6U cubesat that is expected to launch in the summer of 2022. The mission has two primary purposes. The first is to test a new inflatable antenna for high bandwidth communication from orbit. The data we collect, which will be images of the Earth, will further develop this inflatable technology. CatSat's second goal is to use high frequency radio to study Earth's ionosphere using a Weak Signal Propagation Reporter (WSPR) antenna. Currently, I am assisting with the software development for this cubesat as well as hardware and wiring for the microcontroller on the cubesat. The software tracks the data coming from the cubesat and monitors the status of the cubesat.

Dillon, Caitlin (Junior, Forensic Biology, Biology & Chemistry). Mentor: Rachael Schmidt, Biology and Chemistry, Embry-Riddle Aeronautical University. [D-In Title Only]

IDENTIFICATION OF FIRE-RETARDANT CHEMICAL TREATMENTS VIA INSTRUMENTAL ANALYSIS

Fiber trace evidence is one of the most common forms of evidence found at a crime scene; evidentiary items often have unique flame retardant chemical compositions which can be used to identify the origin of trace fibers. The research presented aims to determine the feasibility of a universal testing protocol to match manufacturers' flame retardant compounds in unknown or trace fiber samples to known or crime scene samples. Fiber samples will be tested using scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM/EDS), Fourier-transform infrared spectroscopy (FTIR), and gas chromatography/ mass spectrometry (GC/MS) using solid-phase microextraction (SPME) and liquid extraction techniques. These instruments and analytical methods were chosen due to their efficiency, sensitivity to chemical compounds, and nondestructive analysis. Preliminary testing to determine and develop methods using these instruments has been successful. Additional results and interpretations will be obtained before the date of presentation.

Do, Jacqueline (Sophomore, Electrical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

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Donnelly, Tristan (Junior, Multidisciplinary Engineering, Engineering). Mentor: Chris Etling, Arizona Daily Sun. [B-5]

ARIZONZA DAILY SUN SCIENCE WRITING INTERNSHIP

Scientific discoveries are made on a daily basis at universities and research facilities around the world. Without science communication, many of these discoveries can go unnoticed by the general public. Through writing, journalists are able to express this information to a wider audience. Journalists communicate with scientists to determine what research is being done and how it can impact the community. Through interviews with scientists, and visits to research facilities, science writers are able to take scientific discoveries and convey them to the public in an understandable way. Some of the topics covered in this project include Dr. Gerrick Lindberg's research into the potential for life on the outer bodies of the solar system and the innovations made by NAU's cybersecurity team in post-quantum cryptography. The articles written over the course of this project have helped to inform the readers of the important research being performed within the community.

Doral, DaJae (Senior, Mechanical Engineering). Mentor: Jennifer Wade, Mechanical Engineering, Northern Arizona University. [C-10]

DIRECT AIR CAPTURE USING A MOISTURE SWING

Carbon capture solutions are increasing in demand as emissions rise. This project explores a method of direct carbon capture, commercial polymer electrolyte membranes. The carbon capture process is driven by moisture swing absorption. From this, polymer electrolyte membranes are able to repeatedly capture carbon dioxide. By using electrochemical impedance spectroscopy, the conductivity of polymer membranes can be calculated. Ultimately, the calculated conductivity informs how effectively the physical processes for carbon dioxide capture occur in these electrolytes throughout the moisture swing.

Dyer, Brody (High School Student, Undeclared, Physical Sciences). Mentor: AnnMarie Condes, Chemistry, Pima Community College. [G-6]

TEAM D.A.N.E.S ASCEND PROJECT

The objective of the weather balloon is to record altitude, pressure, and temperature of the atmosphere via a payload. Recording these three variables, important information can be obtained about the upper atmosphere. In addition, the relationship between various gasses throughout the atmosphere were studied. Concentration data will be collected for Oxygen, Carbon Dioxide and Nitrogen gases through the use of sensors programmed with an Adruino Uno. This determines where in the atmosphere each gas is most abundant. This also determines the maximum altitude of the gasses. The payload will also include a camera, recording the payload's journey throughout the atmosphere, as well as its descent back down.

Eilers, Dustin (Junior, Aerospace Engineering, Fulton Schools of Engineering). Mentor: Timothy Takahashi, Fulton Schools of Engineering, Arizona State University. [A-0]

UPPER LIMIT PERFORMANCE SPECIFICATIONS OF THE RAMJET CYCLE

This project seeks to identify the upper limit performance specifications of a ramjet engine of given geometry. This ability is useful because given an image of a ramjet propelled device, reverse engineering performance can be conducted in order to estimate the useful range of any given device. This allows for stated specifications of a ramjet engine to be roughly verified given an image of the device. In order to accomplish this, first the geometry of the device is estimated using reference lengths and approximate distances which are found using photo-editing software. Then, calculations are performed using Matlab for a range of altitudes and Mach numbers to estimate the thrust under each set of conditions. This data is compared with drag data across the same range of Mach numbers which is created using an EDET model. Finally, the datasets are compared, and an operational range of altitudes and velocities is yielded.

Farnsworth, Sydnee (First-Year, Material Science & Engineering, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

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Fernandez, Cameron (Senior, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Kyle Hanquist, Aerospace & Mechanical Engineering, University of Arizona. [H-11]

MODELING OF THERMAL PROTECTION SYSTEMS DURING RE-ENTRY

Safely returning capsules from space has been an engineering problem since the idea of going to space. OSIRIS-REx journeyed to the asteroid Bennu, where it collected a sample for return to Earth. To safely return this sample to the surface of Earth, it must reenter the atmosphere, where it will be traveling at hypersonic speeds. To understand the performance of the sample return capsule (SRC) testing and analysis are needed. Due to the extreme speed and heating conditions, wind tunnel testing is expensive and impractical. The use of a computational fluid dynamics (CFD) solver can significantly reduce the cost of analysis for reentry vehicles. The project uses the LeMANS CFD solver to determine the thermal conditions experienced by OSIRIS-REx's SRC during its atmospheric reentry.

Foo, Nicholas (Senior, Astronomy, Physics). Mentor: Brenda Frye, Astronomy, University of Arizona. [E-19]

GRAVITATIONAL LENSING BY GALAXY CLUSTERS TO STUDY THE EARLY UNIVERSE

Gravitational lensing is a powerful tool for probing the nature of the dark matter haloes of clusters of galaxies. Dark matter is invisible to us but can be detected indirectly by gravitational lensing effects. By this approach, massive objects such as galaxy clusters can behave as a lens, bending the light rays from galaxies in the background. Furthermore, lensing also boosts the brightness and size of the galaxy images allowing us to study them in greater detail. By characterizing the properties of the gravitational lens, we are able to estimate its two-dimensional mass distribution of dark and visible matter. We are especially intrigued in studying the origin of 10 distant lensed images of actively star-forming galaxies. Ultimately, we want to know if this particular galaxy cluster is lensing the light from a newly-forming cluster early universe, one that will evolve into a massive cluster later in the cosmic epoch.

Fulleton, Grant (Sophomore, Computer Science). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

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Garcia Perez, Arantza (Senior, Forensic Biology, Biology & Chemistry). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University. [D-6]

OVERCOMING PHYSIOLOGICAL CHALLENGES OF MICROGRAVITY IN SPACE

Space is a microgravity environment that poses many complex challenges. Among such challenges are the physiological effects of microgravity on the human body, such as bone and muscle atrophy. An exercise apparatus has been designed to combat this dilemma by addressing the physiological and psychological aspects of physical fitness. This apparatus combines different mechanics gives versatility, allowing astronauts to perform a vast range of exercises, mimicking both machine work and free weights. The interactive interface of the apparatus provides a means of motivation and social support during fitness training to parallel working out in a group or with a trainer on Earth. A fitness schedule has also been created to complement the designed exercise apparatus. The fitness schedule focuses on a balance between concentric and eccentric muscle contraction exercises, strengthening over 90% of all human muscle groups that affect the skeletal structure of the astronauts' physical health.

Gibson, Claire (Sophomore, Geology, Astronomy & Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University. [F-5]

IS THERE FINE-GRAINED MATERIAL UNDER THE SURFACE OF BENNU?

Identifying whether fine-grained material resides on the Surface of 101955 Bennu can better our understanding of porous carbonaceous asteroids in the Solar System, and the properties and processes that compose these small bodies. The purpose of the experiment undertaken is to identify whether fine-grained (<100µm) material resides subsurface of Bennu due to the "rubble pile" characteristic of the asteroid. Thermophysical modeling and visualization of the surface of Bennu at selected crater sites thought to uncover the subsurface material were analyzed to identify whether changes in temperature across the surface of a crater indicate such material. So far, analysis of craters does not indicate fine-grained material below the surface of Bennu. Future activities include analyzing more craters of different sizes to gather a more extensive data set to identify whether fine-grained material exists below the surface only in certain areas.

Gonzales, Johnelle (Senior, Physics, Astronomy, Astronomy & Planetary Science). Mentor: Christopher Doughty, School of Informatics, Computing, & Cyber Systems, Northern Arizona University. [F-6]

A SIGNAL WITHIN THE SEDIMENTS: USING BIOLOGICAL STOICHIOMETRY AS A POTENTIAL BIOSIGNATURE ON MARTIAN SEDIMENTS

Current theory suggests that Mars was once wet. If Mars once had microbial life, as the planet dried, this life would sequester in the wetter cracks of mud relative to the surface, thus making bioimportant elements more abundant versus bio-unimportant elements. These mudcracks turned to mudstone and their elemental composition were recently measured by rovers on Mars. Here we test this hypothesis on Earth and observe elemental distributions on global scales from past and current life over millions of years. This elemental distribution is measured in the field by using an X-ray Fluorescence (XRF) spectrometer on sedimentary rocks, particularly mudstones, with surface depressions. We also use the XRF on lab grown biocrusts to see if we can replicate the same pattern expected. With enough data collection we will then use algorithmic techniques to recognize patterns and compare it to data taken from Mars.

Gonzalez, Angel (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Gonzalez Lopez, Ivan (Sophomore, Associate of Science, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Grant, Alexia (Sophomore, Systems Engineering, Engineering). Mentor: Christopher Impey, Astronomy, University of Arizona. [B-9]

APPLICATIONS OF MACHINE LEARNING IN THE FIGHT AGAINST MISINFORMATION AND FAKE NEWS

The prevalence of misinformation in the scientific community presents a concern for many academic professionals in the STEM field. This project aims to combat misinformation through the development of an artificial intelligence system that can recognize an author's claim and its supporting evidence. As a result, the system's users will be able to improve their scientific writing skills regardless of their academic background. The system's development relies on machine learning, a type of artificial intelligence that allows a program to learn some sort of skill through the synthesis of various data sets. In this case, our system learned how to identify claim-evidence pairs by analyzing two pools of scientific articles with claim-evidence pairs tagged by our group of researchers. While the project is still ongoing, it is expected that the final iteration of our system will be able to identify claim-evidence pairs, and evaluate the validity of the information therein.

Guinanao, Raphaelle Therese (Junior, Computer Science, Systems & Industrial Engineering). Mentor: Hannah Budinoff, Systems & Industrial Engineering, University of Arizona. [D-12]

ENABLING PART-PROCESS DESIGN FOR METAL ADDITIVE MANUFACTURING

Powder Bed Fusion (PBF), an additive manufacturing process, allows for quick prototyping and fabricating intricate parts. However, the dimensional accuracy of each part is affected by the machine, the part's geometrical design, and process parameters (variables for printing specifications). This study aims to determine the impact of process parameters and part geometry on the magnitude of maximum part distortion. To efficiently explore the large geometry-process parameter space, we will simulate the PBF process and predict part distortions using ANSYS Additive. By running build simulations on 3D models with different geometrical features and varying the feature dimensions, the output demonstrates the sensitivity of part distortion to geometry and process part variations. These results will inform engineers, allowing for the prediction of the accuracy of parts based on chosen process parameters or predicting how process parameters can be varied to optimize parts.

Gutierrez-Coatney, Bryanna (Senior, Astrophysics, School of Earth & Space Exploration). Mentor: Sanchayeeta Borthakur, School of Earth & Space Exploration, Arizona State University. [E-2]

AUTOMATING ABSORPTION LINE IDENTIFICATION IN QUASI-STELLAR OBJECT SIGHTLINES USING PROBABILISTIC PROGRAMMING

The process of identifying elements at different redshift values in space has been done manually for hundreds of years due to the natural human ability of being able to parse spectral data by sight. Our team aims to automate this process through the use of Bayesian statistics, python software, and machine learning. This effort to streamline the cleaning, processing, and creation of our code is to create a reliable program that can work automatically for years to come and will save a great deal of time for astronomers.

Gyrulf, William (High School Student, Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Halferty, Grace (Senior, Mechanical Engineering, Biology, Aerospace & Mechanical Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. Inside, these small electronics are susceptible to the high-energy radiation present in orbit, so it is important to understand radiation intensities at different altitudes. This project is a proof-of-concept to study the radiation profile of the Earth's atmosphere, particularly exploring radiation intensity as a function of altitude. Within the bounds of a standard 1U CubeSat, the UArizona ASCEND! payload housed a digital Geiger counter and atmospheric profiling system to measure the amount of ionizing radiation present in Earth's atmosphere up to approximately 100,000 feet above MSL.

Hallstrom, Jonas (Junior, Physics). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [E-3]

EFFECTS OF PROPERTY VARIATION ON PLANETESIMAL THERMAL MODELING

We created a thermal model using implicit finite difference methods that simulates the thermal evolution of a consolidated body in the early solar system. The known thermal constraints of asteroid 25143 Itokawa's parent body were combined with the results of this model to constrain other properties of the body. Our results agree well with previous findings that require Itokawa's parent body to form between 1.9 and 2.2 Myr after CAI formation and be greater than 20 km in radius. However, we find that varying the material properties within their range of uncertainty results in significantly weaker constraints. Our accounting for the uncertainty in specific heat and thermal diffusivity would allow the body to form between 1.8 and 2.4 Myr with a minimum radius varying between 18 and 30 km. Uncertainty in initial aluminum abundance is also discussed and shown to significantly increase the range of allowed formation times.

Hampton-Ross, Darius (Junior, Aerospace Engineering, School for Engineering of Matter, Transport, & Energy). Mentor: Kenan Song, The Polytechnic School, Arizona State University. [H-1]

SYNTHESIS OF 2D TI3C2TX MXENE FLAKES FROM TI3ALC2 MAX PHASES FOR ELECTRONIC PROPERTY ANALYSIS

MXenes are a class of graphene-like two-dimensional materials synthesized by the etching of MAX phase carbides and nitrides. They are widely known for their unique properties such as layered structure, conductivity, hydrophilicity, and easy functionalization. These properties have sparked high interest in the additive manufacturing industry, for their applicability in energy storage, catalysis, electromagnetic shielding, and environmental restoration. The 〖Ti〗_3 C_2 T_x MXene plays a significant role in coating, and more specifically for protection against electromagnetic interference. Although MXene has shown promising results, it suffers downfalls when it comes to their small flake size, surface defects, and harmful use of strong acids during synthesis. The current goal of this research is to improve the synthesis method through safer alternative etchants, and to improve the flake quality through improved processing and production methods.

Hayes, Alexandria (Sophomore, Mechanical Engineering, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Heide, Robin (Senior, Ecology & Evolutionary Biology, Forestry). Mentor: Anita Antoninka, School of Forestry, Northern Arizona University. [C-11]

GERMINATION OF THE ENDANGERED BEAR POPPY

The Las Vegas Bear Poppy plant only grows in the Gypsum soils of the Mojave Desert and has a low seasonal germination success rate, causing it to be endangered. The purpose of this research is to explore the question of what can be done in order to promote the germination of Bear Poppy seeds. Several methods of scarification were used on the seeds in hopes that it will become easier for the embryo to break through and grow. Scarification was done mechanically, chemically, and biologically before planting the seeds with the same soil and watering cycles in a greenhouse. After several months of watering, no growth has been observed. The lack of successful results can lead to the conclusion that scarification may not be the right method for promoting germination for this plant and more methods will need to be explored until there is successful germination of the Bear Poppy.

Henley, Shae (Sophomore, Aerospace Engineering, Engineering). Mentor: Dathon Golish, Lunar & Planetary Laboratory, University of Arizona. [H-12]

CATSAT: INTEGRATION AND TESTING FOR A UNIVERSITY OF ARIZONA CUBESAT

As more spacecraft are launched into orbit, the need to enhance communications from satellites and to study the Earth's ionosphere is becoming increasingly important. CatSat, a University of Arizona CubeSat (small satellite), aims to improve antenna technology and complete ionospheric experiments. Before launch, we must verify the satellite can function and conduct research as expected. My work focuses on the integration and testing of CatSat, specifically with a new inflatable antenna design and a WSPR (weak signal propagation reporter) antenna. I work with spacecraft hardware to prepare payloads and spacecraft systems for testing, develop integration and test procedures, and document functional and environmental tests. These tests further our understanding of how CatSat's technology works, and how to best optimize the satellite and extend its lifespan in space. This will lead to the successful deployment of the inflatable and WSPR antennas after launch, allowing for new research in low-Earth orbit.

Henningsen, Daniel (Junior, Physics, Astrophysics, School of Earth & Space Exploration). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University. [D-2]

AWS SKYSURF PROCESSING

SKYSURF is the largest Hubble Space Telescope (HST) archive program in history. We aim at measuring the absolute sky surface brightness (with time dependence) from ~57,000 ACS and WFC3 datasets in ~1,100 fields and then use this to aid in detecting dim objects in those datasets. Here we describe the measurement of background levels in the SKYSURF database using ProFound on AWS. In order to test the best setup for AWS we set up multiple machines into which we fed a few datasets into and ran a ProFound script on. ProFound is a software written by a collaborator that measures background brightness of HST images. We then timed these machines to see the differences in computational speeds and runtime costs from AWS. This turned out to be a great solution for processing the large amount of data we had to work with, taking approximately 50 days to process.

Henry, Jacob (Senior, Chemical Engineering, Environmental Science). Mentor: Monica Ramirez-Andreotta, Environmental Science, University of Arizona. [C-15]

ANALYZING URANIUM CONTAMINATION IN RAINWATER FROM NATIONAL ATMOSPHERIC DEPOSITION PROGRAM SITES

The goal of the project was to explore and obtain a better understanding of the trends of Uranium contamination found in rainwater. The predicted results were to have an increased contamination due to ongoing mining around the National Atmospheric Deposition Program (NADP) sites. Rainwater samples collected from the years of 2019-2020 were gathered from NADP sites Chiricahua, Grand Canyon, Oliver Knoll, Organ Pipe, and Petrified Forest using mechanized rainwater catchers. These samples were digested with diluted nitric acid by Total Metals (TM) and Dissolved Metals (DM). The data was organized into an excel spreadsheet sorted by Year, Site, and Year and Site.

The values of minimum concentration, maximum concentration, average concentration, medium concentration, and standard deviation of the sample set were calculated. The p-value was found to be above 0.05 showing that there is no significant trend of Uranium in rainwater.

Herrington, Katie (Sophomore, Physics, Aerospace Engineering, School of Earth & Space Exploration). Mentor: Judd Bowman, School of Earth & Space Exploration, Arizona State University. [E-4]

ANALYSIS OF IONOSPHERIC VARIABILITY IN EDGES OBSERVATIONS

The Experiment to Detect the Global EoR Signature (EDGES) can be used to track how the ionosphere and number of charged particles in the atmosphere change with time. This is achieved by comparing data from EDGES taken at the same location in the sky on different days. Any changes observed can be attributed to changes in the ionosphere because the astronomical sky is constant. EDGES uses radio emissions from our galaxy as background and uses the variation in radio emissions from astronomical signals to determine changes in charged particles in our ionosphere.

Howe, Zachary (Senior, Aeronautical Sciences). Mentors: Douglas Isenberg and Yabin Liao, Mechanical Engineering & Aerospace Engineering, Embry-Riddle Aeronautical University. [G-5]

INVESTIGATION OF LONG-DISTANCE VIDEO AND TELEMETRY STREAMING

For satellite and UAV applications a radio link is established to receive real time telemetry. This link can be formed using a variety of frequencies and equipment, each with their own pros and cons regarding effective range, data rate, and cost. We have developed a high-altitude balloon payload that analyzes these factors by comparing data transmission over three separate frequencies: 900MHz, 1.3GHz, and 2.4GHz. Live video and telemetry will be broadcasted over the 1.3GHz and 2.4GHz frequencies using an Eagle Tree Vector and Raspberry Pi Zero W respectively. Additionally, telemetry will be sent over a 900MHz link using an RFD900+ Modem. These signals are received with high-gain antennas on a tracking ground station. An on-board SD card will also collect this same telemetry data to be compared with what is received. Overall, this experiment will characterize the quality and range of these radio links to guide future university aerospace projects.

Howe, Shane (Junior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [H-4]

EAGLESAT-2 MEMORY DEGRADATION EXPERIMENT

Onboard the EagleSat-2 satellite is one of the experimental payloads called the Memory Degradation Experiment (MDE) designed to test the degradation of 5 different kinds of computer Random Access Memory (RAM) under the conditions of space radiation. Memory types are FRAM (Ferroelectric RAM), SRAM (Static RAM), MRAM (Magnetoresistive RAM), Flash memory, and EEPROM (Electronically Erasable Programable Read Only Memory). Testing of RAM modules is done by writing a random bit string onto the memory modules then reading from those modules at numerous time intervals until a new bit string is read made after a while, and comparing the read data from the originally written information. The experiment detects and locates any bit flips, or errors, in the written bit strings after being read to determine the degradation of that memory module.

Huckabee, Isabela (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Michael Line, School of Earth & Space Exploration, Arizona State University. [E-5]

CHARACTERIZING THE ATMOSPHERES OF CLOUD-FREET-DWARFS USING GAUSSIAN PROCESSES

Exoplanet atmospheres have a multitude of challenges concerning their characterization. However, self luminous brown dwarfs are similar in temperature and surface gravity to giant exoplanets, and serve as excellent analogs to help with these challenges. We present a grid of cloud-free brown dwarfs covering atmospheres with Teff $\in$ [300K,950K], log g $\in$ [3.0,5.5], log Z $\in$ [-1.0,1.0], C/O $\in$ [0.1,0.7], and log Kzz $\in$[2,8]. We then analyze low resolution spectra of brown dwarf targets by incorporating a Bayesian inference framework for robust error propagation called Starfish. Typical model analysis ignores uncertainties that arise from model interpolation and assumes residuals that are independent of each other across wavelengths, but this can result in underestimated errors.

Starfish propagates interpolation uncertainties into model parameters and models the covariances of error across wavelengths in the spectra. By combining Starfish with our grid-fitting routine, we aim to answer questions about brown dwarf chemical abundances.

Ingebretsen, Carl (Junior, Astronomy). Mentor: Virginie Faramaz, Astronomy, University of Arizona. [E-20]

EXOZODIACAL DUST IN THE EPSILON ERIDANI SYSTEM

Epsilon Eridani is a Sun analogue surrounded by an unusually prominent exozodiacal dust cloud, micron-sized dust grains orbiting in the Habitable Zone, a thousand times more massive than the Sun's Zodiacal Cloud. It is thought to be the result of comets sublimating. Epsilon Eridani has two known debris disks that could be the source of these comets. To explore this hypothesis, we combine analytical predictions and N-body simulations, to explore mean-motion resonances (MMR) that the disks are thought to overlap, with either the detected inner planet at ~3 au, Eps Eri b, or the inferred belt shaping outer planet at ~50 au, Eps Eri c. We find that the 3:1 and 4:1 inner MMR with Eps Eri c show promise since they can elicit cometary activity orders of magnitude greater than that in the Solar System, on time scales as long as Eps Eri's age.

Inions, Jennifer (Senior, Applied Biology, Biology & Chemistry). Mentor: Stephen Waples, Biology & Chemistry, Embry-Riddle Aeronautical University. [D-6]

OVERCOMING PHYSIOLOGICAL CHALLENGES OF MICROGRAVITY IN SPACE

Space is a microgravity environment that poses many complex challenges. Among such challenges are the physiological effects of microgravity on the human body, such as bone and muscle atrophy. An exercise apparatus has been designed to combat this dilemma by addressing the physiological and psychological aspects of physical fitness. This apparatus combines different mechanics gives versatility, allowing astronauts to perform a vast range of exercises, mimicking both machine work and free weights. The interactive interface of the apparatus provides a means of motivation and social support during fitness training to parallel working out in a group or with a trainer on Earth. A fitness schedule has also been created to complement the designed exercise apparatus. The fitness schedule focuses on a balance between concentric and eccentric muscle contraction exercises, strengthening over 90% of all human muscle groups that affect the skeletal structure of the astronauts' physical health.

James, Jennifer (Senior, Space Physics, Physics & Astronomy). Mentor: Quentin Bailey, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-12]

NEW SHORT-RANGE TESTS OF GRAVITY

New Short-Range Tests of Gravity is a theory project with the goal to calculate a modification to the Newtonian gravitational force between two masses. Physicists worldwide have been searching for new physics, including new short-range forces. The theoretical work in this project makes use of a general framework for describing signals from new physics, called the Standard-Model Extension (SME), which allows for generic violations of Lorentz symmetry. The modified equations sought in this work can be used by experimental groups worldwide, in their efforts to find modifications to gravity at distances less than a millimeter.

We are using the least action principle in the SME framework to find the field equations needed and solving the field equations in the Newtonian gravity limit using Green function methods and studying the properties of the solutions.

Jones, Gabrielle (Senior, Astroinformatics, School of Informatics, Computing, & Cyber Systems). Mentor: Tyler Robinson, Astronomy & Planetary Science, Northern Arizona University. [F-7]

DETECTABILITY OF SURFACE BIOSIGNATURES FOR DIRECTLY IMAGED EXOPLANETS

In the coming years, space-based telescopes will aid in the ground-breaking detection of atmospheric biosignatures. However, it remains unclear if we could go one step further — to the surface. Prominent features indicative of life exist within surface reflectance spectra and include pigment absorption features and the Vegetation Red Edge (VRE). Iron oxide has a red edge similar to the VRE, but the similarity has not yet been quantified. Our study focuses on the detectability of the VRE against the iron oxide red edge and pigments of photosynthetic and non-photosynthetic extremophiles on an Earth-like exoplanet. We quantified the time it would take for a future LUVOIR-like telescope to detect biological pigments and the VRE from the surface of an Earth-like exoplanet. Our results are the first of their kind to determine the types of surface biosignatures that could feasibly be detected using a future LUVOIR telescope.

Jorda, Sophia Mhae (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Kemper, Skylar (Senior, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-14]

LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

In recent years, the Laser Interferometer Gravitational-Wave Observatory (LIGO) has been developing more advanced ground-based laser interferometers which utilizes complex suspension systems to detect various levels of low frequency GW's. Our experiment utilizes a torsion pendulum and a laser set up to model the LIGO suspension detector which will be utilized for understanding how to maximize the sensitivity of laser interferometer to low frequency (1-20 Hz) GW's, which are often produced by binary stars and core-collapse supernovae. The first purpose is to experimentally characterize the transfer function of the torsion pendulum with respect to ground vibrations. The second goal is to investigate ways to distinguish low frequency torsion and translations from low frequency gravitational waves. The knowledge that comes out of this experiment will help distinguish ground noise events from gravitational waves events, which will be a major step in being able to detect them in the low frequency regime.

Koga, Kendall (Senior, Physics, Astronomy, Astronomy & Planetary Science). Mentor: Will Grundy, Lowell Observatory. [F-8]

THE PORTABLE GONIOMETER

The Bidirectional reflectance distribution function (BRDF) of a material describes how much light is reflected in all directions as a function of the angle of its illumination source. Measuring BRDF using Goniometry has historically been a time consuming process that requires a large apparatus with several moving parts. Our new device concept is built around a camera contained in a light controlled environment, with a series of strategically placed light sources with known spectra that illuminate a sample, which in turn illuminates a series of reflective lines. When the sample is illuminated from a particular angle, the device can take a picture of the reflective lines and use software to analyze the image and calculate BRDF values at a range of positions for that angle of incidence. This compact and lightweight device allows researchers to rapidly gather BRDF values for a sample, either in a lab, or in the field.

Kroemer, Christian (Senior, Earth & Space Exploration, School of Earth & Space Exploration). Mentor: Meenakshi Wadhwa, Earth & Space Exploration, Arizona State University. [F-2]

TISSINTITE-II AND OTHER HIGH PRESSURE-TEMPERATURE MINERALS IN LUNAR METEORITE NWA 13967

When meteorites impact the lunar surface, massive quantities of regolith can be ejected, with some material exceeding the escape velocity of the Moon and entering interplanetary space. This material can be captured by Earth's gravity and fall to the surface as a new meteorite. This is the origin of lunar meteorites such as Northwest Africa 13967. With such meteorites, the processes of impacts on the Moon can be explored through mineralogical study of high pressure and temperature phases of certain minerals. In researching NWA 13967, the primary minerals examined were tissintite, anorthite, corundum, olivine, and silica. Tissintite, a compressed modification of plagioclase, is especially unique as it is only found in shocked meteorites.

Kubas, Alexia (Senior, Astronomy). Mentor: Christopher Hamilton, Lunar & Planetary Laboratory, University of Arizona. [F-12]

GIORDANO BRUNO: SECONDARY IMPACT CRATERING PROCESSES ON THE MOON

The age of a planetary surface can be estimated using measurements of impact crater sizes combined with models of impact cratering rates. Crater-counts on the continuous ejecta blanket surrounding an impact crater provide a standard method of deriving an absolute model age (AMA) for the parent crater. The continuous ejecta blanket records evidence of all primary impacts that have occurred after the formation of the parent crater. However, high-resolution images acquired by the Lunar Reconnaissance Orbiter Camera (LROC) reveal variations in crater number density on Giordano Bruno's continuous ejecta blanket, which result in conflicting AMAs for different parts of the crater. After counting all craters at Giordano Bruno and analyzing how crater size–frequency distributions vary across different geomorphic facies, we conclude that self-secondary cratering inflates the AMA of Giordano Bruno's continuous ejecta blanket and leads to an overestimation of the age of the primary crater.

Landon, Parker (Senior, Computer Engineering, Space Physics, Electrical, Computer, & Software Engineering; Physics & Astronomy). Mentor: John Pavlina, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [D-7]

QUANTIZING THE UNSEEN: GIG UNDERGRADUATE OPTICAL RESEARCH

Optical research has been at the forefront of today's scientific endeavors. Concepts like fiber-optic communications, laser weapon defense systems, and this project, laser interferometry, continually influence modern technologies. Interferometry is foundational to graduate-level physics research, and this project is the stepping-stone for most beginner graduate students. This project aims to characterize a diode laser and tune the current controller for it. By doing this we hope to modulate the laser output to fall within the quantum noise level. Quantum noise, appearing sometimes as shot noise, is signal uncertainty due to quantum effects. By feeding back the laser input into an optimized controller, we will be able to decrease the effects of external factors (i.e. thermal noise, vibrations, and power supply fluctuations).

Larrieu, Loren (Senior, Electrical Engineering, College of Engineering, Informatics, & Applied Science). Mentor: Christopher Edwards, Astronomy & Planetary Science, Northern Arizona University. [D-9]

MULTI-SPECTRAL THERMAL INFRARED IMAGER FOR UAV-BASED REMOTE SENSING

Thermal infrared (TIR) spectroscopy can provide important geological data for planetary science and has been used to characterize terrestrial and extra-terrestrial surfaces for decades. Planetary analog sites on Earth are particularly useful in planning for future planetary exploration. Here we present a novel design for a multi-camera, TIR imaging system to be mounted on an Unmanned Aerial Vehicle (UAV). We utilize commercially available or otherwise easily accessible materials to construct the assembly and mounting system. The system uses a pseudo-synchronous imaging technique and is powered by a Raspberry Pi 4 capable of supporting 5 FLIR Lepton 3.5 cameras. This project is a proof of concept for surface characterization of planetary analog sites for geological exploration. A successful test of this system will consist of 5 clear images of a landscape while the UAV is in flight.

Lawson, Jonathan (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Liebhart, Danika (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Limes, Hayley (Senior, Environmental Science). Mentor: Erin Posthumus, School of Natural Resources and the Environment, University of Arizona. [B-In Title Only]

PHENOLOGY BASED POLLINATOR RESTORATION IN THE SOUTH-CENTRAL REGION

Pollinator restoration management in the South-Central Region (SCR) of the United States (Texas, Oklahoma, New Mexico, and Louisiana) has a need for accurate climate-informed estimates of when pollinator friendly nectar plants flower and seed, as well as how climate change will impact future plant timing. This research aims to establish a process to analyze the data collected through the Time to Restore: Connecting People, Plants, and Pollinators project, and provide such estimates of plant flowering and fruiting. By drawing from existing data in the USA-National Phenology Network's Nature's Notebook, and iNaturalist applications, we characterized the onset, duration, and peak of flowering for 8 species in the SCR. Future research will investigate how climate variables affect the timing of these events. By providing a better understanding of plant timing, managers can make planting choices that will be adaptable to changing climates and provide continuous pollen resources for pollinators.

Lin, Yuka (Senior, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-14]

LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

In recent years, the Laser Interferometer Gravitational-Wave Observatory (LIGO) has been developing more advanced ground-based laser interferometers which utilizes complex suspension systems to detect various levels of low frequency gravitational waves (GW's). Our experiment utilizes a torsion pendulum and a laser set up to model the LIGO suspension detector which will be utilized for understanding how to maximize the sensitivity of laser interferometer to low frequency (1-20 Hz) GW's, which are often produced by binary stars and core-collapse supernovae. The primary purpose is to experimentally characterize the transfer function of the torsion pendulum with respect to ground vibrations. The second goal is to investigate ways to distinguish low frequency torsion and translations from low frequency GWs. The knowledge resulting from this experiment will help distinguish ground noise events from GWs, which will be a major step in being able to detect them in the low frequency regime.

Linden, Emily (Sophomore, Physics). Mentor: Philip Mauskopf, School of Earth & Space Exploration, Department of Physics, Arizona State University. [E-6]

ON A NOVEL SUPERCONDUCTING ON-CHIP FOURIER TRANSFORM SPECTROMETER

The novel Superconducting On-Chip Fourier Transform Spectrometer (SOFTS) provides an efficient way of obtaining spectral content for millimeter-wave astronomy and observational cosmology surveys. SOFTS is a mm-wave Mach-Zehnder interferometer made of two quadrature hybrids and superconducting transmission lines. We exploit the non-linear current dependent kinetic inductance of the thin film superconducting transmission lines (STLs) to introduce a path length difference in one of the STL to achieve interferometry. Our calculations and simulations show that we can conduct spectroscopy with SOFTS on a millimeter scale and achieve similar or better results than the conventional meter-scale spectrometers based on opto-mechanical technology.

Lopez, David (Senior, Meteorology, Climatology, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

ANALYSIS OF ATMOSPHERIC DATA AND COLLECTION METHODS THROUGH SIMULTANEOUS EXPERIMENTATION

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Lopez, Keivyn (Sophomore, Mechanical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Ly, Salma (Junior, Chemical Engineering). Mentor: Matthew Green, Chemical Engineering, Arizona State University. [D-3]

ELECTROSPUN, NON-WOVEN, NANO-FIBROUS NOVEL POLY(VINYL ALCOHOL) MEMBRANES FUNCTIONALIZED WITH L-ARGININE FOR VIRUS CAPTURE

The development of pretreatment membranes has led to multiple advancements in air filtration systems. Electrospinning a membrane can lead to improvement in reproducible samples, and accuracy in pore size. The membranes serve as an antiviral layer in a mask, rendering increased accurate results with eco-friendly materials, reusability, and increased screening of viral droplets. Enhanced electronegative properties of the mat are supported by previous experiments to attract/capture viruses and increase longevity compared to current masks. By functionalizing the mat with charged ammonium groups in the membrane which improve ionic conductivity, thermal and chemical stability. Crosslinking membranes enhances the overall tensile strength and mechanical properties. Quaternization fabricates an anion-exchange and enhances hydrophilicity. Different stoichiometric ratios of L-arginine to the PVA, and cross-linking reagents were tested with a carbon capture apparatus supporting evidence of functionalized L-arginine. This polymer will now move next into viral testing after successful samples of membrane synthesize.

Macfarlane, Jackson (Junior, Applied Meteorology, Applied Aviation Sciences). Mentor: Curtis James, Applied Aviation Sciences, Embry-Riddle Aeronautical University. [C-5]

A CLIMATOLOGICAL ANALYSIS OF CONVECTION IN THE TRENTINO REGION OF THE ITALIAN ALPS

Convection over complex terrain has always been a forecasting challenge because it is not accurately predicted by regional forecast models. Severe convection and flash flooding events are common in the European Alps as in many mountainous climates, causing property damage and loss of life. This study analyzes the initiation and propagation of convective cells over the Trentino region in the southern Italian Alps. We identify convective cells using a storm-tracking algorithm and the TAASRAD-19 radar reflectivity dataset. Cells that exceed minimum reflectivity and minimum area thresholds are tracked by the algorithm. Tracks are then compiled as frequency maps using statistical clustering tools in a GIS software package. The frequency maps allow an analysis of climatological factors involved in the initiation and propagation of convection in relation to terrain forcing. The results of this study can be used as a source of guidance for international research efforts in the area.

Mackey, Nina (Sophomore, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Alex Craig, Aerospace & Mechanical Engineering, University of Arizona. [H-13]

SHOCK TUBE METHOD FOR DYNAMIC CALIBRATION OF PRESSURE TRANSDUCERS

Pressure transducers are ubiquitous in wind tunnel experiments. Their dynamic measurement capabilities are especially important to understand unsteady flow features. Quantifying the dynamic response of these instruments helps improve their reliability. A shock tube facility was built to perform the dynamic calibration of Kulite XCE-062 pressure transducers. Shock tubes are ideal for this application because they provide a rapid change in pressure between known amplitudes. The shock tube consists of a high-pressure driver section and a low pressure driven section separated by a mylar diaphragm. When the diaphragm bursts, a shock wave is created that travels in the direction of the pressure transducer mounted at the end of the driven section. The pressure transducer experiences a step change in input, and the response can be used to characterize its frequency response function. This data can be used to calibrate the dynamic response of the sensor.

Madan, Surya (Junior, Aerospace Engineering, I.R.A. Fulton Schools of Engineering). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

ANALYSIS OF ATMOSPHERIC DATA AND COLLECTION METHODS THROUGH SIMULTANEOUS EXPERIMENTATION

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Magnusson, Magnus (Senior, Astronomy, Statistics & Data Science, Astronomy). Mentor: Eiichi Egami, Astronomy, University of Arizona. [E-21]

PhoSim: Visualizing What JWST/NIRCam Will See

The James Webb Space Telescope (JWST) was launched in December 2021 and is currently in the commissioning phase of deployment. Simulating images from the instruments on JWST is vital for testing data processing pipelines and validating measurements of telescope properties. The Photon Simulator (PhoSim) provides a unique method for simulating images by tracking the path of each photon as it travels through the optical system. Specifically, PhoSim simulates the Near Infrared Camera (NIRCam). One of NIRCam's primary science objectives is to image the most distant objects in the universe. I have improved the accuracy of PhoSim images by adjusting the positions/rotations of the detectors in the focal plane based on the ground-testing measurements. I also produced a Jupyter notebook for simulating complex galaxy morphology (a unique capability of PhoSim), and created multi-color NIRCam images of the Large Magellanic Cloud (LMC), which can be compared with the flight data soon.

Manlove, Jordan (Senior, Journalism, Strategic Communications). Mentor: Angelita Denny, Department of Energy, Legacy Management. [B-4]

Adjusting for Interns

The Department of Energy's Office of Legacy Management (LM) was established in 2003. LM's mission is to "Fulfill the Department of Energy's post closure responsibilities and ensure protection of human health and the environment". This includes lasting responsibilities towards for more than 100 sites throughout the country set during World War II and the Cold War. LM employs interns through the Mentor for Environmental Scholars Program (MES) and Florida International University Science & Technology Workforce Development Program. This project focused on creating an intern guidebook which will allow a unified transition into the program. Updates are applied every year, accounting for proceeding interns' schedules. The guidebook was a collaborative effort by interns and mentors involved with the program. Intern feedback, and intern helpful information such as a monthly pre-planned schedule, as well as an explanation of upcoming projects was relied upon. The guidebook will be finalized and used this summer.

Mata, Anyell (Junior, Electrical Engineering, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

Analysis of Atmospheric Data and Collection Methods through Simultaneous Experimentation

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Matthews, Adrianna (Senior, Astrobiology, Biogeoscience, School of Earth & Space Exploration). Mentor: Elizabeth Trembath-Reichert, School of Earth & Space Exploration, Arizona State University. [C-3]

HABITABILITY OF EXTREMOPHILES

Polyextremophiles grow in environments hosting multiple extremes, such as hot, high pressure, acidic, black smoker vents. Due to their ability to withstand a range of conditions on Earth, they may serve as analogues for potential life elsewhere. Their investigation must be tailored to their analogous environmental conditions, metabolisms, and preservation potential. To evaluate cultured polyextremophiles, a literature review of 96 extremophiles was conducted that recorded each organism's preferred metabolism(s), carbon sources, isolation environment, and growth preferences across temperature, pressure, salinity, and pH. Polygonal plots were constructed from these data, representing the range of conditions where growth was observed along each condition per extremophilic group. Further analysis of mineral stability in correspondence with habitability plots was conducted, revealing minerals with the potential to contain microfossils. By studying these organisms and the minerals of their respective environments, we can carve a path for the search of past or present extraterrestrial life.

McConville, Daniel (Senior, Materials Science & Engineering, Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. Inside, these small electronics are susceptible to the high-energy radiation present in orbit, so it is important to understand radiation intensities at different altitudes. This project is a proof-of-concept to study the radiation profile of the Earth's atmosphere, particularly exploring radiation intensity as a function of altitude. Within the bounds of a standard 1U CubeSat, the UArizona ASCEND! payload housed a digital Geiger counter and atmospheric profiling system to measure the amount of ionizing radiation present in Earth's atmosphere up to approximately 100,000 feet above MSL.

McCuistion, Nelly (Senior, Environmental & Sustainability Studies, School of Earth & Sustainability). Mentor: Jasmine Anenberg, Forestry, Northern Arizona University. [C-12]

MOSS PELLETS: EXPLORING NEW REGENERATIVE METHODS IN DEGRADED GRASSLAND ECOSYSTEMS

Plants and biocrusts (cyanobacteria, mosses and lichens) are critical for stabilizing soils, but they can be lost with climate change and land degradation. Methods that focus on recolonization of these organisms are a critical component of restoration. Moss pellets may aid in large-scale rehabilitation because of their transportation and distribution abilities. We tested combinations of Syntrichia ruralis, a common biocrust moss, and Achillea millefolium, a co-occurring forb, added to an experiment with and without pellet material. We wanted to see whether mosses and seeds perform better together vs. separately. Overall, we found that S. ruralis had a positive effect on A. millefolium, but A. millefolium may compete against S. ruralis. Both mosses and seeds germinated more successfully without pellet material. Pellets provide a gateway into testing similar methods of restoration, as they have the potential to be cheaply and quickly distributed.

Meadows, April (Sophomore, Physics & Astrophysics, Mathematics, Applied Physics, Materials Science). Mentor: John Kistler, Applied Physics & Materials Science, Northern Arizona University. [B-6]

HAVING A HEART FOR PHYSICS: EXPERIMENTS ARE FOR EVERYONE

Many without a physics background have trouble being motivated enough to learn about a subject in physics even if it would benefit them. The purpose of this project was to write a physics lab that could be performed by non-physics majors that was able to explain certain concepts of physics in a simple manner while also being engaging enough to retain students' interest. Preparation included setting up labs for students to perform, performing experiments as instructed by the given lab manual, and rewriting existing labs to be easier to understand for students. The lab was written to explain the effects of exercise on the heart using an electrocardiogram to study pulse before and after exercise. Since heart activity is relevant to everyone, the lab allows students to take interest in their own health while learning about how physics can be applied in every aspect of life.

Minke, Annalisa (Sophomore, Biosystems Engineering, Atmospheric Sciences, Hydrology & Atmospheric Sciences). Mentor: Xubin Zeng, Hydrology & Atmospheric Sciences, University of Arizona. [C-16]

INVESTIGATING THE CORRELATION BETWEEN INVERSION STRENGTH PROXIES AND CLOUD FRACTION

Low level clouds strongly effect the Earth's temperature and climate by reflecting solar radiation and trapping longwave radiation. Predicting these effects is important to understanding the future climate. Clouds have been modeled using Estimated Inversion Strength (EIS) or Lower Tropospheric Stability (LTS) to tune the coverage. The EIS and LTS relations with clouds were established using monthly data. These relationships are being retested here using dropsonde measurements from aircraft over the Northwestern Atlantic. The data was processed in Python and the correlation coefficient was calculated. EIS and LTS were originally found to have a correlation coefficient with low level clouds of 0.8. After recalculation, the correlation coefficient of EIS and LTS was around 0.02 depending on the level of binning. Therefore, these proxies are not strongly correlated to low level clouds in this area and using them to tune models adds to prediction error.

Moore, Shannon (First-Year, Space Physics, Physics & Astronomy). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-11]

SMALL ARM-LENGTH INTERFEROMETRY FOR U-CLASS SPACECRAFT

Recent developments in space-based laser interferometery have shown that considerable improvements in the sensitivity of gravitational wave observatories can be achieved while mitigating many of the drawbacks encountered in ground-based detectors. The purpose of this study is to evaluate the feasibility of implementing a short-arm length cavity interferometer as a payload for U-Class spacecraft. Placement of the payload in Low Earth Orbit would provide an environment free of any ground vibrational disturbances. However, given the space constraints of U-Class spacecraft, optical configurations, such as the Michelson Fabry-Perot interferometer, will be tested to increase the operating sensitivity of the interferometer. Further analysis will also be done to ensure the integrity and enable in-orbit operation of the experiment. In summary, this research project will analyze the viability and precision of implementing a small-scale interferometer into a U-Class Spacecraft that will be placed in Low Earth Orbit.

Moreno Huerta, Dayana (Sophomore, Chemistry, Chemistry & Biochemistry). Mentor: Jessica Barnes, Lunar & Planetary Laboratory, University of Arizona. [F-15]

COORDINATED MICROANALYSIS OF LUNAR SOILS IN PREPARATION FOR FUTURE RETURNED SAMPLES

There are still many uncertainties about the origin and evolution of the Moon. Samples retrieved from the lunar surface provide the opportunity to study the Moon's chemical composition through time. Our study investigates the geological diversity of volcanic rocks collected from the Soviet Luna 16 and Luna 24 missions which are still relatively understudied using modern analytical techniques. In order to understand the geological diversity, we are studying the range in chemical and textural types of basaltic fragments and aim to select a representative set of fragments from the soils. We used a Digital Microscope (DM) to rigorously select volcanic rock fragments in the Luna soils for further analysis by Scanning Electron Microscopy (SEM). Our study will help inform about the geological diversity of an area of the Moon different from Apollo sampling sites.

Nadkarni, Arsh (Senior, Astronomy, Applied Physics). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

PROFILING HIGH-ALTITUDE RADIATION WITH A GENERAL DATA LOGGER

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. Inside, these small electronics are susceptible to the high-energy radiation present in orbit, so it is important to understand radiation intensities at different altitudes. This project is a proof-of-concept to study the radiation profile of the Earth's atmosphere, particularly exploring radiation intensity as a function of altitude. Within the bounds of a standard 1U CubeSat, the UArizona ASCEND! payload housed a digital Geiger counter and atmospheric profiling system to measure the amount of ionizing radiation present in Earth's atmosphere up to approximately 100,000 feet above MSL.

O'Brien Sylvester, Paul (Sophomore, Systems Engineering, Engineering). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [G-7]

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Ordaz Perez, David (Junior, Aerospace Engineering, School for Engineering of Matter, Transport & Energy). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University. [A-1]

MODELING ROCKET TRAJECTORIES

Our research was focused on creating a trajectory prediction model to assist in the Tethered Payload Mission. This model aimed to predict the flight path, landing location, and touchdown velocity of a rocket. To create the model, two launch locations were chosen: Tucson, Arizona and Blacksburg, Virginia. The rocket's vertical path was determined as a function of drag and time. It was calculated by deriving kinematic equations and coding a function for numerical differentiation. Moreover, the horizontal path was determined as a function of wind speed, wind direction, and time. Wind direction and speed were interpolated at each calculated height and used to evaluate the horizontal displacement of the rocket. Lastly, a numerical root finding method was coded to record the landing location and touchdown velocity. This was repeated for numerous data sets so that a statistical analysis could be used to determine the accuracy of the model.

Pabuna, Vivien Frances (Junior, Computer Science). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Parmenter, Joshua (Senior, Computer Engineering, Electrical, Computer, & Software Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [H-5]

EAGLESAT II - SATELLITE COMMUNICATION DEVELOPMENT IN AN UNDERGRADUATE ENVIRONMENT

EagleSat II is a student-led organization designing a 3U CubeSat to host a dual-payload scientific research mission. Of primary importance to the mission is a reliable communication infrastructure. Mission requirements specify lower data throughput than modern satellites, meaning EagleSat II can design a simpler satellite that will fit our needs. The most important aspect of the satellite is the communication infrastructure, or the means in which the satellite and the ground station share telemetry information. This telecommunication is a software-intensive, complex task that requires a group of motivated engineers to complete; and thus, different management strategies, including Agile framework, were employed to help busy students maximally contribute to the team. This included group coding sessions, fast-paced and focused meeting times, and asynchronous accountability reporting. This resulted in realized maximum throughput of undergraduate technical capability, proving that an undergraduate university has the capability to produce reliable software for the space sector.

Patel, Yamini (Junior, Geological Sciences, School of Earth & Space Exploration). Mentor: Amanda Clarke, School of Earth & Space Exploration, Arizona State University. [C-4]

POST-CALDERA EXPLOSIVE ERUPTIONS AT THE VALLES CALDERA, NM

The magmatic systems of calderas after giant caldera-forming eruptions can remain ‘restless’ for long periods of time producing relatively smaller eruptions. The Valles Caldera, NM most recently experienced an eruption about 50 ka, which produced the El Cajete pyroclastic deposits. These deposits are petrographically and compositionally different from previous eruptions and may represent a new batch of magma beneath the caldera. Density characterization of the El Cajete pumice clasts can shed light on this new batch of magma beneath the caldera and how vesiculated the magma was during the most recent eruption, a key indicator of the amount of volcanic gas driving the eruption. We present new pumice clast density measurements from El Cajete, which range from (250-2500 kg/m^3) with a peak around 750 kg/m^3. These values indicate high gas content that probably drove rapid magma ascent. Future data will help quantify ascent rate.

Patena Ortiz, Isai (Sophomore, Associate of Science, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team’s hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Payton, Davis (Senior, Mechanical Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [A-3]

WING SWEEP, STRUCTURAL MOTION AND THEIR EFFECT ON BOUNDARY-LAYER SEPARATION AND TRANSITION

Boundary-layer separation and transition are important topics in the development of flight vehicles. Laminar Separation Bubbles (LSBs) can have a major influence on aerodynamic performance and efficiency due to the separation of a laminar boundary layer and its eventual turbulent reattachment downstream. This research characterizes LSBs formed on an airfoil by analyzing the effect of wing sweep and structural motion as encountered in flight. A wing fitted with pressure taps is mounted inside the Arizona Low Speed Wind Tunnel and subjected to different flow conditions and sweep angles. Pressure measurements and Infrared Thermography allow for observation of the LSB while the wing is static and also during plunging motion. The experiments characterize the location and extent of the LSBs when subjected to various parameters. This study helps efforts to continue the optimization of laminar flow airfoils and their control.

Peeler, Grayson (Senior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [H-6]

EagleSat II- ADCS

The EagleSat II Attitude Determination and Control System (ADCS) is one of the main bus systems onboard the planned EagleSat II CubeSat. The goal of EagleSat II mission is to study the origins of high energy particles and their effects on solid state storage. This information will be useful for the future of space travel. The ADCS will be responsible for determining and controlling the orientation of the satellite in orbit. Satellite orientation will be determined using a variety of sensors including sun and nadir cameras and a magnetometer. A combination of magnetorquers and reaction wheels will be used to control the satellite's angular velocity and orientation. It will also be used to enter and hold local orientations such as a Y-Thompson spin. The ADCS unit will acquire and maintain multiple orientations during the mission's lifespan for the purpose of data collection, power generation, and ground communication.

Petersen, Scott (Junior, Geosciences). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona. [A-4]

Arizona Flyers: Development of a Persistent High-Altitude Earth and Climate Observation Platform

The impetus to develop a climate-monitoring system is becoming more urgent as anthropogenic climate change continues to destabilize Earth's climate system. We have worked on developing a system to monitor Earth's climate from the stratosphere: a glider that can remain aloft in the stratosphere indefinitely by utilizing dynamic soaring. We have been conducting low-altitude tests of the glider and its systems in hopes to launch the glider on a high-altitude weather balloon. The low altitude tests consisted of hand-launching the glider, testing its autopilot, and testing the glider's connectivity to our ground station. These tests have been mostly successful, and we have corrected problems related to the glider's communication with the ground. The largest obstacle we have encountered has been the regulations around conducting a flight with the glider attached to a high altitude balloon. We have and will continue to work with the FAA to conduct our operations.

Petersen, Mikela (Senior, Mechanical Engineering). Mentor: Constantin Ciocanel, Mechanical Engineering, Northern Arizona University. [D-10]

Magnetic Shape Memory Alloy Composite Research

Magnetic shape memory alloys (MSMA), specifically Ni-Mn-Ga, are smart materials that can experience strains of up to 10% with frequencies up to 1 kHz when introduced to a magnetic field or mechanical stress. This project aims to develop a magnetically activated composite (MAC) consisting of MSMA, silicon polymer, and iron particles with a volume fraction of 60% for technologies where highly compliant actuators, sensors, or dampers, or where nano and micro precision positioning are required. The MAC was to exhibit lower strain levels than the MSMA while preserving the operating frequencies and adding a damping functionality. The adopted MAC formulation exhibited up to 2.61% axial strain and required lower magnetic field for actuation, because the addition of the iron particles increased the magnetic induction of the composite by 28 to 32%. Furthermore, the MAC showed high compliance and electrical resistance despite the presence of iron particles in the polymer matrix.

Phaklides, Nicodemus (Senior, Electrical Engineering, Electrical, Computer, & Software Engineering). Mentors: Douglas Isenberg and Yabin Liao, Mechanical Engineering & Aerospace Engineering, Embry-Riddle Aeronautical University. [G-5]

Investigation of Long-Distance Video and Telemetry Streaming

For satellite and UAV applications a radio link is established to receive real time telemetry. This link can be formed using a variety of frequencies and equipment, each with their own pros and cons regarding effective range, data rate, and cost. We have developed a high-altitude balloon payload that analyzes these factors by comparing data transmission over three separate frequencies: 900MHz, 1.3GHz, and 2.4GHz. Live video and telemetry will be broadcasted over the 1.3GHz and 2.4GHz frequencies using an Eagle Tree Vector and Raspberry Pi Zero W respectively. Additionally, telemetry will be sent over a 900MHz link using an RFD900+ Modem. These signals are received with high-gain antennas on a tracking ground station. An on-board SD card will also collect this same telemetry data to be compared with what is received. Overall, this experiment will characterize the quality and range of these radio links to guide future university aerospace projects.

Phelps, Erin (Senior, Environmental Science). Mentor: Jason Williams, United States Department of Agriculture. [C-17]

LEGACY EFFECTS OF ECOLOGICAL STRUCTURE AND HYDROLOGIC FUNCTION IN PINYON AND JUNIPER WOODLANDS

Managers of Pecos National Historical Park (PECO) are challenged with clearing woodlands to maintain historical viewsheds, restore grasslands, and limit runoff and erosion. However, knowledge on site ecohydrological responses to woodland clearing remains limited. This study applies soil cover, water repellency, and hydraulic conductivity measurements to quantify the ecological structure and hydrologic function of an intact woodland as compared to nearby grasslands cleared of trees over a decade earlier. Within cleared woodlands, intercanopies had higher basal cover and saturated hydraulic conductivity relative to intact woodlands, while tree microsites also had higher basal cover but slight decrease in saturated hydraulic conductivity. Increased basal cover and infiltration help conserve soil and limit erosion. Our findings suggest PECO's management practice of clearing woodlands are meeting most of their management objectives. These results will provide PECO managers with an improved ecological understanding of the park and guidance in predicting ecological responses of management decisions.

Pledger, Jaacob (Senior, Human Factors Psychology, Behavioral & Social Sciences). Mentor: Heather Lum, Behavioral & Social Sciences, Embry-Riddle Aeronautical University. [B-3]

STUDYING ASPECTS OF TEAMWORK AND COMMUNICATION IN A VIRTUAL REALITY ENVIRONMENT

The gaming experience is critical to the development and evolution of games as well as an avenue for studying aspects of human behavior. This study aims to look at levels of immersion in a virtual reality gaming system. Researchers hope to establish an experimental plan that will accurately and reliably measure user engagement in the gaming experience as well as emotional and physiological feedback. All of these factors will give support for a variety of applications beyond this study including, but not limited to, consumer, military, and computer-based training simulations.

Plummer, Michael (Sophomore, Mechanical Robotics, Aerospace Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Prince, Beau (Senior, Physics, Mathematics, Applied Physics & Materials Science). Mentor: Mark Loeffler, Astronomy & Planetary Science, Northern Arizona University. [F-9]

SPACE WEATHERING OF CARBONACEOUS ASTEROIDS

On many asteroid surfaces, space weathering is thought to cause an asteroid's reflectance spectrum to become darker and more positively sloped (redder) over time in the UV-visible spectral region. Interestingly, carbonaceous asteroids, while likely weathered, may exhibit red or blue spectral slopes. One such blue carbonaceous asteroid is Bennu. To investigate the origins of Bennu's blue spectral slope, we studied the contributions of dark material to the reflectance spectrum of a predominantly silicate mixture. To this end, we created binary mixtures containing various amounts of graphite, magnetite, and troilite with a base of synthetic forsterite. We found that the introduction of any of these three minerals causes the spectrum of forsterite to become blue, and this effect is only weakly dependent on grain size. Future work will extend this investigation to the spectral contributions of polyaromatic carbons via more complicated mixtures and pulsed laser irradiation experiments.

Ramirez, Elijah (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Ravikumar, Shradhanjli (Junior, Astrobiology, Biogeosciences, School of Earth & Space Exploration). Mentor: Sang-Heon (Dan) Shim, School of Earth & Space Exploration, Arizona State University. [F-3]

NITROGEN STORAGE IN THE DEEP INTERIORS OF ROCKY PLANETS

Large reservoirs of nitrogen may exist in the deep interiors of rocky planets, including Earth. One possible mechanism of nitrogen storage involves ringwoodite (Mg2SiO4), a high-pressure polymorph of olivine with a cubic spinel structure that is found in the Earth's mantle transition zone. At high temperatures and pressures, the mineral silicon nitride (Si3N4) has also been found to take on a spinel structure, suggesting that a solid solution between ringwoodite and silicon nitride may be possible. Using density-functional theory (DFT) calculations, this project aims to assess hypothetical models of mineral structures within this solid solution for their stability at high pressure. Since nitrogen is a major part of Earth’s atmosphere, understanding nitrogen storage in the lower mantle and transition zone could provide insight into the atmospheric conditions of the early Earth, and may have implications on the past conditions of the terrestrial planets and rocky exoplanets as well.

Razo, Elias (High School Student, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Redford, Thomas (Senior, Physics, Mathematics, English). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [E-7]

IDENTIFICATION OF THIOL FUNCTION GROUP IN CARBONACEOUS CHONDRITES WHICH ARE METEORITE ANALOGS OF BENNU

We have detected the presence of thiols, an organic sulfur function group, and elemental sulfur in two carbon-rich meteorites, Graves Nunataks 95229 (GRA 95229) and Murchison. These two meteorites are very pristine samples with relatively low alteration and likely meteorite analogs of asteroid Bennu. Thiols can have implications for the meteoric contribution towards the origin of life on Earth. We used x-ray spectroscopy techniques such as X-Ray Absorption Near Edge Spectroscopy (XANES) and micro X-Ray Fluorescence (μXRF). We have detected these thiols and elemental sulfurs mixed in with the fine-grained matrix. In addition to thiols and elemental sulfur, we have located iron sulfide and sulfate minerals in situ and produced maps showing the sulfur species at exact locations on the meteorite sample.

Redshaw, Caleb (Senior, Mechanical Engineering, School for Engineering of Matter, Transport & Energy). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University. [E-8]

SEEING-SORTED U-BAND IMAGING OF THE EXTENDED GROTH STRIP

We present the results of deep ground-based U-band imaging of the Extended Groth Strip (EGS) field and the creation of best-resolution and best-depth mosaics following a seeing-sorted stacking method. The analysis uses 324 images taken from 2012 March to 2021 June using the Large Binocular Camera on the Large Binocular Telescope. We sorted each image based on the full width at half maximum (FWHM) of unsaturated stars into best resolution (FWHM ≤ 0.″9) and best depth (FWHM ≤ 1.″6) categories. The zeropoint in each image was matched to Sloan Digital Sky Survey data, to account for sky transparency variations. We omitted images with stellar ellipticity (1-b/a) ≥ 0.08 from the final stacks. We find that the galaxy counts turn over at ∼25.75 mag in the best resolution mosaic and at ∼26 mag in the best depth mosaic. These mosaics and source catalogs complement HST and future JWST observations.

Reynoso, Lucas (Junior, Mechanical Engineering, School for Engineering of Matter, Transport, and Energy). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [F-4]

CHARACTERIZATION OF ORGANIC MATERIALS IN TABLE SALT

Ceres is a differentiated dwarf planet that is the most water-rich object (~25 wt%) in the inner solar system after Earth. Ceres shows localized areas of hydrated sodium carbonates and ammonium-bearing phyllosilicates, which demonstrate ongoing geological activity and the possible presence of a water-rich mud layer below an ice-rich crust. This study explores how organics accumulate as 'fossils' in salt crystals forming from brine solutions. Terrestrial analog work is done by incorporating 13C-rich glycine into chloride crystal structures and analyzing the amount of carbon that is traceable. Sodium chloride crystals are grown from a supersaturated solution in a laminar flow hood and in a wet chemistry space without any cover to vary evaporation rates. Performing terrestrial and laboratory analog work provides a comparison for future missions to Ceres and a better understanding of the chemistry of brines and organic matter.

Rodriguez, David (Junior, Electrical Engineering, School of Earth & Space Exploration). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

ANALYSIS OF ATMOSPHERIC DATA AND COLLECTION METHODS THROUGH SIMULTANEOUS EXPERIMENTATION

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Roehling, Kristen (Sophomore, Chemistry, Applied Math, Chemistry & Biochemistry). Mentor: Stephen Kukolich, Chemistry & Biochemistry, University of Arizona. [D-1]

STUDYING THE STRUCTURE AND DYNAMICS OF AMMONIUM FORMATE WITH MICROWAVE SPECTROSCOPY

Ammonium formate, a helpful model for DNA interactions, is being characterized through microwave spectroscopy. Microwave transitions have been recorded of ammonium formate for the normal and fully deuterated samples, which were fit to rotational constants, yielding details of its dynamic structure. Several measures have proven helpful in resolving difficulties with this novel project. These initiatives include writing a new program with MATLAB, measuring transitions for a fully deuterated isotopic sample, measuring multiple states of the molecule, and extensive high-level quantum calculations. Studying ammonium formate with microwave spectroscopy reveals unique insight into the hydrogen bonding dynamics in the DNA base pair of adenine and thymine that is difficult to obtain through other methods. Proton tunneling may be involved in genetic mutations, so understanding this dynamic may help scientists combat health issues.

Roig, Gabriela (Junior, Exploration Systems Design, School of Earth & Space Exploration). Mentor: Danny Jacobs, School of Earth & Space Exploration, Arizona State University. [B-1]

VACUUM CHAMBER TESTING

LightCube is an education outreach CubeSat set to launch in low earth orbit. Vacuum chamber testing is necessary to ensure all of LightCube's systems will be operational for the duration of the mission's lifetime. During the testing of the payload, arcing occurred across the charging circuit. Initially a new circuit was designed to prevent this, but during testing arcing occurred again. Additional steps were taken to mitigate this event, yet the charging circuit arced again. It was then determined that the cause was due to Paschen's Law. Using the Townsend Breakdown Equation, the necessary pressure to ensure no arcing was calculated to be e-3 Torr. The O-rings on the chamber door were replaced and an alternative clamping method was utilized in order to achieve the necessary pressure. Further testing will be conducted with other subsystems with additional data collection through feedthroughs that will require further analysis using Paschen's Law.

Roszell, Hayden (Junior, Software Engineering, Electrical, Computer, & Software Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [H-5]

EAGLESAT II - SATELLITE COMMUNICATION DEVELOPMENT IN AN UNDERGRADUATE ENVIRONMENT

EagleSat II is a student-led organization designing a 3U CubeSat to host a dual-payload scientific research mission. Of primary importance to the mission is a reliable communication infrastructure. Mission requirements specify lower data throughput than modern satellites, meaning EagleSat II can design a simpler satellite that will fit our needs. The most important aspect of the satellite is the communication infrastructure, or the means in which the satellite and the ground station share telemetry information. This telecommunication is a software-intensive, complex task that requires a group of motivated engineers to complete; and thus, different management strategies, including Agile framework, were employed to help busy students maximally contribute to the team. This included group coding sessions, fast-paced and focused meeting times, and asynchronous accountability reporting. This resulted in realized maximum throughput of undergraduate technical capability, proving that an undergraduate university has the capability to produce reliable software for the space sector.

Ryder, Denise (Post-Baccalaureate, Mathematics, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Ryder, Joshua (Post-Baccalaureate, Computer Science, Science & Engineering). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [G-3]

ATMOSPHERIC CONDITIONS AFFECTING SURFACE TEMPERATURE

Our team's hypothesis is that atmospheric conditions in Arizona are similar to other desert locations. To test this hypothesis, we built a payload capable of collecting data on various atmospheric factors including Ozone, CO_2, water vapor, and UV levels. These measurements were then compared to these same atmospheric factors in similar desert locations (Los Angeles, Las Vegas, Saudi Arabia, Australia). Dissimilar locations (e.g., Hawaii) were also compared. In addition, our team collaborated with Diné College on the payload to carry biological experiments.

Saban, Kristen (Junior, Ecology & Evolutionary Biology). Mentor: Matt Goode, School of Natural Resources and the Environment, University of Arizona. [C-18]

DIET OF THE TIGER RATTLESNAKE, CROTALUS TIGRIS, IN SOUTHERN ARIZONA

Diet is a fundamental aspect of an animal's biology. Yet, much remains unknown about the factors influencing diet choices in tiger rattlesnakes (Crotalus tigris). This study synthesizes C. tigris fecal sample data to elucidate connections between prey type (mammal or reptile) and morphological, temporal, and climatic variables. Data were collected on rattlesnakes between 2002 and 2013 captured at the Stone Canyon Club site in Tucson, Arizona. Data on body size, sex, and age were recorded, and fecal samples were analyzed for the presence of scales or hair to determine prey type. Mammals have remained the dominant prey type across all years and snakes with a mammal diet tend to have larger body size. Future investigations will include analyses of individual snake diet variation and diet evolution related to climate and urban development. Overall, this study may help inform conservation policy relating to development and climate change for southwestern rattlesnake species.

Schairer, Aidan (High School Student, Engineering, CTE Engineering). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [G-2]

HIGH ALTITUDE PAYLOAD

ASCEND is a program that allows STEM students to gain data from the atmospheric levels of our planet. The main objective of the project is finding placements of the ozone layer, oxygen molecules, and UV lighting within the atmosphere. Research into these areas is done by having a team build a payload that is set to survive harsh conditions and collect data. Spring semester 2022, students from Casa Grande Union High School engineered a payload to collect data and launch it on April 2nd, 2022. Included in the payload were various sensors, a camera, and two Ardiuno Unos. The project included aspects of high level problem solving, project managing, teamwork, and engineering. Collecting this data will be used for various reasons including global problems similar to the thinning of the ozone layer.

Sherant, Andrew (Sophomore, Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Shoemaker, Ethan (Senior, Mechanical Engineering). Mentor: Amirhossein Arzani, Mechanical Engineering, Northern Arizona University. [H-10]

TOWARDS IMPROVED PHYSICS-INFORMED MACHINE LEARNING

Physics-Informed Machine Learning is a very promising new technology at the forefront of numerical methods for solving partial differential equations (PDEs). The objective of this research was to improve upon the current standard in this field in a fluid mechanics context. An iterative approach was taken throughout the project to improve the accuracy and capabilities of these networks. All of the results from our neural network were compared to ground truth data from a computational fluid dynamics (CFD) simulation. In semester one, the time to network convergence was successfully halved. In semester two, the more significant portion of the research, we were able to generate accurate velocity field solutions using only sparse pressure data measurements from the CFD simulations. This is an incredibly impactful and significant success, as these results were achieved without the application of boundary conditions.

Simon, Amber (Senior, Astrobiology & Biogeosciences, School of Earth & Space Exploration). Mentor: Cassie Bowman, School of Arts and Liberal Sciences, Arizona State University. [B-2]

CAUSE - EFFECT MATRIX AND ANALYSIS FOR PUBLIC OPPORTUNITIES RELATING TO SPACE MISSIONS

NASA's Psyche Mission is a unique space mission targeting the metal-rich asteroid (16) Psyche. To inform the public about the mission, providing public engagement opportunities is essential. It is crucial to space missions for promoting, educating, and inspiring next generations of future engineers and scientists as well as helping everyone feel included in exploration. Engaging the public in the most effective ways possible leading up to launch will benefit the Psyche mission by raising awareness, educating, and including the widest and most diverse audience possible in the excitement and science of the mission. This project will test and implement a weighted matrix developed by Psyche capstone students to evaluate a range of public engagement opportunities against a large set of criteria. This matrix could also be used by other space missions to evaluate public events and opportunities in the future.

Slone, Janessa (Junior, Space Physics, Physics & Astronomy). Mentor: Quentin Bailey, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-12]

NEW SHORT-RANGE TESTS OF GRAVITY

New Short-Range Tests of Gravity is a theory project with the goal to calculate a modification to the Newtonian gravitational force between two masses. Physicists worldwide have been searching for new physics, including new short-range forces. The theoretical work in this project makes use of a general framework for describing signals from new physics, called the Standard-Model Extension (SME), which allows for generic violations of Lorentz symmetry. The modified equations sought in this work can be used by experimental groups worldwide, in their efforts to find modifications to gravity at distances less than a millimeter.

We are using the least action principle in the SME framework to find the field equations needed and solving the field equations in the Newtonian gravity limit using Green function methods and studying the properties of the solutions.

Solomon, Santana (Senior, Medical Studies, College of Health Solutions). Mentor: Sara Walker, School of Earth & Space Exploration, Arizona State University. [D-4]

MARS IN-SITU RESOURCE UTILIZATION FOR HEALTH APPLICATIONS

The investigation of the Mars In-Situ Resource Utilization for Health Applications project seeks to explore the viability of using chemicals present on Mars for human health applications. A computational approach was used to test which essential nutrients can be produced from Mars resources by using biochemical network expansion to evaluate the resource potential on Mars to aid long-term space missions. The results of the network expansion suggested that the amount and variety of producible compounds differ greatly by the choice of sites from which resources will be extracted. The resource abundant sites (e.g. Gale Crater) are more promising than other locations such as Gusev Crater, Meridiani Planum, and Ares Vallis. Additionally, atmospheric compounds alone were not sufficient to support human health, and the extraction of some terrestrial compounds is necessary. Site selection is a critical factor for the future ISRU applications, especially for the production of more complex chemicals.

Spejcher, Becca (Sophomore, Astronomy, Physics & Astronomy). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-13]

WHAT DRIVES THE VARIABILITY IN LUMINOUS BLUE VARIABLE STARS?

Luminous blue variable stars (LBVs) are evolved massive stars with strong winds and large variability. The variability of these stars is not yet well understood. We are using photometric data from NASA's Transiting Exoplanet Survey Satellite (TESS) to study 30 LBV candidates in the Large and Small Magellanic Clouds. The light curves extracted from TESS will be compared to the All-Sky Automated Survey for SuperNovae (ASAS-SN) light curves of the same stars. This is to rule out any instrumental errors with TESS. We can then perform Fourier Transforms on the corrected TESS data which allows us to find the time scales of variability. Using the results from the Fourier analysis we can begin to understand the driving mechanisms of our candidates by comparing them to known LBVs such as P Cygni.

Squillace, Reynier (Junior, Astronomy). Mentor: Yancy Shirley, Astronomy, University of Arizona. [E-10]

NITROGEN ISOTOPIC FRACTIONATION IN PRESTELLAR CORE L43-E

Prestellar cores are nitrogen-rich, gravitationally bound dense regions within molecular clouds which will eventually lead to star formation. Throughout the ISM, the two stable isotopes of nitrogen, 14N and 15N, are generally found in a ratio of around 330 (Hily-Blant et al 2020). The nitrogen isotopic fractionation ratio has been observed in fewer than 10 prestellar sources, but no chemodynamical core models have successfully predicted the observed ratio of 14N to 15N, which differs from the global value. We observed the 14N and 15N isotopes of o-NH2D in prestellar core L43-E using the Kitt Peak ARO 12m radio telescope, and are currently working to constrain the column density of each isotope as a function of possible excitation temperatures.

Stamer, Sarah (Sophomore, Astronomy, Physics). Mentor: Christopher Impey, Astronomy, University of Arizona. [B-9]

ADDRESSING THE PANDEMIC OF SCIENCE MISINFORMATION ON THE INTERNET

As more people turn to online sources to obtain information, science misinformation is a critical issue. The goal of the project is to develop and test an artificial intelligence (AI) system to detect misinformation within online science articles and student science writing. Articles on ten diverse pseudoscience topics were evaluated as legitimate science or science misinformation using general science knowledge. Within the legitimate science articles and student writing, claims and evidence were extracted using an online tool to help train the AI. From a set of pseudoscience articles, 260 articles were classified as legitimate science or misinformation. Claims and evidence were tagged within 110 of the legitimate science articles. After compiling 450 student assignments, claims and evidence were tagged in 162 assignments. This project could be scaled for usage by professors in general education science courses to evaluate student writing or by the general public when online.

Sudkamp, Lillian (Junior, Aerospace Engineering). Mentor: Ahmed Sulyman, Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University. [H-7]

THE EAGLESAT 2: FABRICATION TEAM FINALIZATIONS

The EagleSat 2 is a 3U CubeSat with a dual payload, that will study Cosmic Ray Particles and Memory Degradation. As the EagleSat 2's launch date nears (Spring 2023), the Fabrications team, in charge of structural and printed circuit board design, has reached its final stages of development. As all Structure pieces have been designed, ordered, and hard anodized, the Fabrications team is focused on the testing and the assembly of the satellite. Using vibration, heat, and force simulations as well as a careful assembly plan, the Fabrications team will ensure a secure satellite body that will protect the EagleSat 2 throughout its deployment.

Swirbul, Andi (Junior, Astrophysics, School of Earth & Space Exploration). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University. [E-9]

ANALYZING STAR-GALAXY SEPARATION METHODS FOR SKYSURF

Although the night sky may appear dark to our eyes, our view of it is dominated by foreground light from dust within our Solar System and galaxy. In the case of the Hubble Space Telescope, less than 5% of the light received comes from the extragalactic sources that it targets – the other 95% comes from varying types of foreground light. The SKYSURF project aims to measure the absolute all-sky surface brightness in 57,302 ACS and WFC3 datasets in order to better understand foreground and background light. To improve SKYSURF's object classification, objects within the SKYSURF dataset were cross-referenced to objects identified previously in the Gaia stellar survey. In addition to establishing a valuable stellar catalog for the project, objects were categorized based on features including their magnitude and distribution of light. These results can be extrapolated across the remaining datasets to improve understanding of foreground and background light.

Tan, Nicolas (Senior, Aerospace Engineering, Aerospace & Mechanical Engineering). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [A-2]

ADJUSTABLE SUPERSONIC WIND TUNNEL DIFFUSER

Supersonic and hypersonic technology are vital for future development of air travel in both military and commercial applications. Wind tunnels are an important aspect of high-speed aerodynamic testing and research. Most supersonic and hypersonic tunnels do not operate continuously but use compressed air or a vacuum for short duration bursts. It is advantageous to increase wind tunnel run time in most cases. A diffuser placed downstream of the test section of a high-speed wind tunnel creates a train of weak shocks that permits longer duration testing. The improvement on run time (approx. 2x) ultimately allows for a greater amount of data to be collected. A diffuser assembly was designed to be integrated on the University of Arizona's Indraft Supersonic Wind Tunnel (ISWT). The automatic adjustment of the diffuser allows for long duration runs and consistent performance across a wide range of Mach numbers (Mach 2 – 5).

Torres, Joshua (Sophomore, Electrical Engineering). Mentor: Ernest Villicaña, Engineering, Phoenix College. [G-4]

OPTIMIZATION OF PAYLOAD DESIGN AND SYSTEMS

Phoenix College's main objective is obtaining atmospheric data and video transmission from the payload's camera. This conglomerate effort is executed by the following: an array of sensors for the analysis of the troposphere and stratosphere and the usage of APRS signals sent to a ground station via a joint Ubiquiti Rocket and Raspberry Pi assembly. To provide a stabilized video footage viewing, the camera is implemented with the assistance of an intertwined orientation sensor, known as the Arduino Nano-servo motor system. These components are powered with a printed-circuit board, boost converters, and parallel battery placement for enhanced longevity and increased current. In addition, optimization in payload structural design and material is achieved through the application of carbon fiber, 3D printed dissolvable PVA filament, and detachable subsystem housing inserts.

Treat, Julian (Senior, Aerospace Engineering). Mentor: Davide Conte, College of Engineering, Embry-Riddle Aeronautical University. [H-8]

ASSESSING THE VIABILITY OF ASTEROID REFUELLING ON THE WAY TO MARS

There is significant interest in large-scale mission to Mars. Earth-Mars Trajectories present a significant mass cost in propellant. For a reference mission using Methane and Oxygen propellant, the transfer consumes approximately 3.9 tons of propellant for every ton of material delivered to Martian orbit. It may be possible to refine rocket propellant from Near Earth Asteroids. Minor decreases in propellant required in earth orbit could translate to significant cost savings. Earth-Asteroid-Mars mission profiles can be computed and compared to a reference Mars Mission to determine viability. A list of potentially viable candidates has been refined and several candidates have already been identified which require less propellant to access than mars. Once all candidates have been fully evaluated, mission design parameters including travel time and propellant costs will be used to determine the optimal candidates for such missions.

Urias, Mairely (Junior, Electrical Engineering, School of Electrical, Computer & Energy Engineering). Mentor: Hugh Barnaby, School of Electrical, Computer & Energy Engineering, Arizona State University. [D-5]

Space Environment Radiation Testing on Electrical Components

Radiation is known to damage electrical components. The charges that are generated when particles pass through them are responsible for disrupting their normal operation or destroying components entirely. Developing electronics that withstand this is crucial to their function in space. In this study, we will simulate the radiation from a space environment with a Hitachi ProBeat IV synchrotron-based pencil beam scanning system. We will be testing with 100 MeV protons, with a 5-mm diameter beam at 90% uniformity, testing up to 1013 cm-2 fluence with intermediary measurement points at 1011, 2x1011, 5x1011, 1012, 2x1012, 5x1012, 1013 cm-2. For short term exposures (<1e9 cm-2), we anticipate results supporting analysis of single event effect susceptibilities in selected transistors and circuits. For long term exposures (>1e10 cm-2), we anticipate results supporting analysis of combined TID and displacement damage susceptibilities. The results are important for determining radiation tolerance of technologies for space missions.

Valenzuela, Melissa (Senior, History, Astronomy & Planetary Science). Mentor: Lauren Amundson, Lowell Observatory. [E-18]

The Story of Pluto

The discovery of Pluto marks an important event in the field of planetary science and has had a unique impact on both popular culture and American history. "The Story of Pluto" is a digital exhibit that highlights key events in Pluto's history, including the initial search started by Percival Lowell, public response to the discovery, and NASA's New Horizons mission that launched in 2006. Using archival materials from Lowell Observatory, this project seeks not only to preserve Pluto's story, but also to engage the public in planetary science while making the archives more accessible to a broader audience. One intern from Northern Arizona University was selected to conduct research and construct an interactive, digital exhibit using historic photos, documents, and 3D objects from Lowell's Pluto Collection. She utilized fundamental museum theory and archival practices to inform her research, and consulted astronomers to develop a comprehensive overview of Pluto's legacy.

van der Leeuw, Jacob (Senior, Mathematics, Computer Science). Mentor: Lon Hood, Planetary Sciences, University of Arizona. [F-14]

Mapping Lunar Crustal Magnetic Fields in the Polar Regions

Lunar crustal magnetic fields have been proposed to originate from the deposition of iron-rich ejecta from impacts on the moon's surface which were later cooled and magnetized by an ambient magnetic field. This work aims to identify the distribution and implications of crustal magnetic fields in lunar polar regions. Magnetometer data from the Lunar Prospector and Kaguya orbital missions were selected, and an equivalent source dipole technique was applied in order to normalize the measurements to constant altitudes of 20 km and 30 km. Magnetic anomalies were found in both polar regions. Some of the anomalies identified in the south polar region sit over permanently shadowed craters containing ice deposits. Anomalies in the south pole may have been caused by iron-rich ejecta from the impact that formed the Schrodinger basin which were later magnetized. These craters will be further studied by future manned and unmanned missions.

Weber, Ben (Sophomore, Aerospace Engineering, Interplantery Initiative). Mentor: Thomas Sharp, School of Earth & Space Exploration, Arizona State University. [G-1]

ANALYSIS OF ATMOSPHERIC DATA AND COLLECTION METHODS THROUGH SIMULTANEOUS EXPERIMENTATION

The overall objective of the two payloads is to profile the atmosphere. In profiling it, an experiment was conducted in each. Payload one's goal was to increase payload stabilization mid-flight. Included in payload one is a 1-dimensional Attitude Determination and Control System. The ADCS consists of two cameras, an accelerometer, a motor, wheel, and functions per the laws of conservation of angular momentum. To operate, a program utilizes accelerometer data and feeds it to the motor which is programmed to spin the wheel accordingly to orient the payload into an equilibrium position. Experimental success is determined by current camera footage being compared with that of prior flights, with instability being the primary criterion of comparison. Payload two's goal is to collect atmospheric data. To achieve this, an accelerometer, internal and external temperature, pressure, humidity, a VOC (Volatile Organic Compounds), geiger counter (radiation sensor), and GPS sensors are utilized.

Weigand, Rebekah (Junior, Mechanical Engineering, Propulsion). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-9]

DESIGN AND CHARACTERIZATION OF LIQUID FUEL SPRAY INJECTOR

The focus of this work is on the fluid behavior of the injection and mixing zone of a gas turbine engine afterburner. Afterburners increase thrust on demand by adding thermal energy to the nozzle exhaust stream. Turbine exhaust gas is diffused into the afterburner, fuel is injected, and the temperature of the flow is increased by combustion. The goal of this research is to characterize the atomization and spray distribution of the injected fuel droplets. A 3D printed fuel spray injector prototype will be tested using pressurized water and qualitative data about the atomization and spray distribution of the fluid will be collected using a high-speed camera. Computational Fluid Dynamics analysis will examine the recirculation of the fuel in the mixing zone downstream of the injector. This work can be used in the design afterburner fuel spray bars or rings and in the design of injectors of liquid rocket engine.

Weiss, Maxwell (Senior, Electrical Engineering, School of Informatics, Computing, & Cybersecurity). Mentor: Ying-Chen Chen, School of Informatics, Computing, & Cybersecurity, Northern Arizona University. [D-11]

EMERGING NON-VOLATILE MEMORY: RESISTIVE SWITCHING BEHAVIORS IN AMORPHOUS TUNGSTEN OXIDE DIELECTRIC

Reliability issues in charge-based non-volatile memory and power consumption issues have been attracting attention. Among the emerging memories, Resistive Random Access Memory (RRAM) is a promising candidate to bridge the memory wall between CPU and memory. In addition, RRAM has superior scalability, low power consumption, and CMOS compatibility which make it a high-density storage class memory. The purpose of this work is to explore the resistive switching behaviors of Tungsten Oxide. The memory devices were fabricated using electron beam physical vapor deposition and a lift-off process with a shadow mask. The Tungsten Oxide deposition occurred at varying thicknesses, followed by Indium Tin Oxide (ITO) electrodes as the transparent conductive electrodes. The experimental results include the typical RRAM electrical characteristics, e.g a distribution of forming, set, and reset voltages as well as a distribution of resistance states i.e 1 and 0 states in memory. Novel crystallinity was observed during memory operation.

Wetzstein, Hope (Senior, Physics, Astronomy). Mentor: Mark Salvatore, Astronomy & Planetary Science, Northern Arizona University. [F-10]

LAB ANALYSES OF OLIVINE-CARBONATE MIXTURES AS OBSERVED ON MARS

The Mars Exploration Rover Spirit explored the geology of Gusev crater and investigated rocks composed of coarse olivine grains set within a carbonate-bearing matrix. These same geologic units are hypothesized to be in Jezero crater as well, which is currently being explored by the Perseverance rover. Characterizing these units is difficult due to the heterogeneity in particle sizes, cementation, and spectral signature of each phase. For this research we created synthetic mixtures of olivine and carbonate grains, cemented and uncemented, and measured these mixtures under a variety of different sample and environmental conditions. These measurements were made using visible/near-infrared reflectance spectroscopy, mid-infrared emission spectroscopy, and thermal camera observations. Preliminary research found mid-infrared emission data were more capable of differentiating between the uncemented mixtures than the visible/near-infrared reflectance data. Cementing the mixtures, and adding salt, has allowed our results to be closer to the surface components on Mars.

Willis-Reddick, Maia (Sophomore, Geology, Geosciences). Mentor: Stefano Nerozzi, Lunar & Planetary Laboratory, University of Arizona. [F-13]

MAPPING AND CHARACTERIZATION OF SUBSURFACE DEPOSITS IN PLANUM BOREUM, MARS, USING RADAR SOUNDING

The outskirts of Planum Boreum on Mars are characterized by enigmatic subsurface reflectors detected by the Shallow Radar (SHARAD) on the Mars Reconnaissance Orbiter. We hypothesize that these reflectors are remnants of ancient ice caps, with implications for the evolution of the north polar cap and its links with global climate. Utilizing radar sounding, we identified 35,000 km2 of deposits in our area of investigation. Additionally, by examining power loss between the surface and the subsurface, we calculated low loss tangents, indicating that these deposits show dielectric properties similar to that of water ice. This is conclusive evidence that our reflectors are ice-rich deposits reaching depths of up to ~150m, with possible lithic inclusions and/or pore spaces. Additional investigations will assist us in determining if surface properties play a role for the location and distribution of these reflectors in this region.

Woods, Tyler (Sophomore, Astronomy, Planetary Science). Mentor: Joshua Emery, Astronomy & Planetary Science, Northern Arizona University. [B-7]

SOCIAL MEDIA GROWTH IN ASTRONOMY

Spreading awareness about current astronomy advancements is incredibly important, and appealing to a younger age group is vital. How do you create a successful social media account and website for science information and news, and captivate the public? My goal is to answer this question by testing different posting schedules and alternating the types of media for a target audience of 15-30 year old active followers. An active follower is someone who is subscribed to an account that consistently views and interacts with the account's postings. Preliminary results show that a Monday/Friday schedule, alternating captivating info-graphics and videos, utilizing hashtags, and posting at optimal times increases chances of quick growth and can maximize traction on the platform's algorithm. But our first video within the span of this experiment blew up to 6,600 views, a surprising result that we attribute to chance.

2021-2022 Arizona NASA Space Grant
Program Mentors

Organized by mentor's last name

Amundson, Lauren (Lowell Observatory) See: Valenzuela, Melissa [E-18].

Anenberg, Jasmine (School of Forestry, Northern Arizona University) See:
Cooke, Brianne [C-9]
McCuistion, Nelly [C-12].

Antoninka, Anita (School of Forestry, Northern Arizona University) See:
Baca, Justine [C-7]
Heide, Robin [C-11].

Arzani, Amirhossein (Mechanical Engineering, Northern Arizona University) See: Shoemaker, Ethan [H-10].

Bailey, Quentin (Physics & Astronomy, Embry-Riddle Aeronautical University) See:
James, Jennifer [E-12]
Slone, Janessa [E-12].

Barnaby, Hugh (School of Electrical, Computer & Energy Engineering, Arizona State University) See: Urias, Mairely [D-5].

Barnes, Jessica (Lunar & Planetary Laboratory, University of Arizona) See: Moreno Huerta, Dayana [F-15].

Borthakur, Sanchayeeta (School of Earth & Space Exploration, Arizona State University) See: Gutierrez-Coatney, Bryanna [E-2].

Bose, Maitrayee (School of Earth & Space Exploration, Arizona State University) See:
Hallstrom, Jonas [E-3]
Redford, Thomas [E-7]
Reynoso, Lucas [F-4].

Bowman, Judd (School of Earth & Space Exploration, Arizona State University) See:
Herrington, Katie [E-4].

Bowman, Cassie (School of Arts and Liberal Sciences, Arizona State University) See: Simon, Amber [B-2].

Bray, Veronica (Lunar & Planetary Laboratory, University of Arizona) See: DeFour-Remy, Shea [F-11].

Bryner, Elliott (Mechanical Engineering, Embry-Riddle Aeronautical University) See:
Black, Benjamin [H-2]
Brand, Zoe [H-3]
Weigand, Rebekah [H-9].

Budinoff, Hannah (Systems & Industrial Engineering, University of Arizona) See: Guinanao, Raphaelle Therese [D-12].

Chen, Ying-Chen (School of Informatics, Computing, & Cybersecurity, Northern Arizona University) See: Weiss, Maxwell [D-11].

Ciocanel, Constantin (Mechanical Engineering, Northern Arizona University) See: Petersen, Mikela [D-10].

Clarke, Amanda (School of Earth & Space Exploration, Arizona State University) See: Patel, Yamini [C-4].

Coe, Michelle (Lunar & Planetary Laboratory, University of Arizona) See:
Blanchard, Sarina [G-7]
Blanchard, Nicolas [G-7]
Burruel, Isela [G-7]
Halferty, Grace [G-7]
McConville, Daniel [G-7]
Nadkarni, Arsh [G-7]
O'Brien Sylvester, Paul [G-7].

Condes, AnnMarie (Chemistry, Pima Community College) See: Dyer, Brody [G-6].

Conte, Davide (College of Engineering, Embry-Riddle Aeronautical University) See: Treat, Julian [H-8].

Craig, Alex (Aerospace & Mechanical Engineering, University of Arizona) See: Mackey, Nina [H-13].

Denny, Angelita (Department of Energy, Legacy Management) See:
Brown, Kayla [C-6]
Manlove, Jordan [B-4].

Doughty, Christopher (School of Informatics, Computing, & Cyber Systems, Northern Arizona University) See: Gonzales, Johnelle [F-6].

Edwards, Christopher (Astronomy & Planetary Science, Northern Arizona University) See: Larrieu, Loren [D-9].

Egami, Eiichi (Astronomy, University of Arizona) See: Magnusson, Magnus [E-21].

Jarvis, Sara (Biological Sciences, Northern Arizona University) See: Berkland, Liam [D-8].

Kacar, Betül (Bacteriology, The University of Wisconsin - Madison) See: Carruthers, Brooke [C-14].

Kistler, John (Applied Physics & Materials Science, Northern Arizona University) See: Meadows, April [B-6].

Kukolich, Stephen (Chemistry & Biochemistry, University of Arizona) See: Roehling, Kristen [D-1].

Lara, Mary (Astronomy & Planetary Science, Northern Arizona University) See: Begaye, Tracey [E-16].

Liao, Yabin (Aerospace Engineering, Embry-Riddle Aeronautical University) See:
Howe, Zachary [G-5]
Phaklides, Nicodemus [G-5].

Line, Michael (School of Earth & Space Exploration, Arizona State University) See: Huckabee, Isabela [E-5].

Little, Jesse (Aerospace & Mechanical Engineering, University of Arizona) See:
Anthis, Roman [A-2]
Payton, Davis [A-3]
Tan, Nicolas [A-2].

Llama, Joe and Hall, Jeff (Lowell Observatory) See: AshLind, Isaac [E-15].

Loeffler, Mark (Astronomy & Planetary Science, Northern Arizona University) See: Prince, Beau [F-9].

Lum, Heather (Behavioral & Social Sciences, Embry-Riddle Aeronautical University) See:
Davis, Remington Cole [B-3]
Pledger, Jaacob [B-3].

Mauskopf, Philip (School of Earth & Space Exploration, Department of Physics, Arizona State University) See: Linden, Emily [E-6].

Morris, John (Career & Technical Education, Casa Grande Union High School) See:
Allado, Neal Ryan [G-2]
Carlisi, Merick [G-2]
Gonzalez, Angel [G-2]
Jorda, Sophia Mhae [G-2]
Lawson, Jonathan [G-2]
Liebhart, Danika [G-2]
Ramirez, Elijah [G-2]

Razo, Elias [G-2]
Schairer, Aidan [G-2].

Nerozzi, Stefano (Lunar & Planetary Laboratory, University of Arizona) See: Willis-Reddick, Maia [F-13].

Noravian, Armineh (Science & Engineering, Central Arizona College) See:
Aguilar, Alex [G-3]
Brewington, Robert [G-3]
Gyrulf, William [G-3]
Hayes, Alexandria [G-3]
Plummer, Michael [G-3]
Ryder, Denise [G-3]
Ryder, Joshua [G-3]
Patena Ortiz, Isai [G-3].

O'Rourke, Joseph (School of Earth & Space Exploration, Arizona State University) See:
Blaske, Claire [F-1].

Pavlina, John (Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University) See: Landon, Parker [D-7].

Pierce, Nathan (School of Natural Resources and the Environment, University of Arizona) See:
Blais, Jacob [C-8].

Posthumus, Erin (School of Natural Resources and the Environment, University of Arizona) See: Limes, Hayley [B-In Title Only].

Ramirez-Andreotta, Monica (Environmental Science, University of Arizona) See: Henry, Jacob [C-15].

Richardson, Noel (Physics & Astronomy, Embry-Riddle Aeronautical University) See:
Beltran, Marina [E-13]
Spejcher, Becca [E-13].

Robinson, Tyler (Astronomy & Planetary Science, Northern Arizona University) See: Jones, Gabrielle [F-7].

Salvatore, Mark (Astronomy & Planetary Science, Northern Arizona University) See:
Wetzstein, Hope [F-10].

Schmidt, Rachael (Biology and Chemistry, Embry-Riddle Aeronautical University) See: Dillon, Caitlin [D-In Title Only].

Sharp, Thomas (School of Earth & Space Exploration, Arizona State University) See:
Cooper, Genevieve [G-1]

Lopez, David [G-1]
Mata, Anyell [G-1]
Rodriguez, David [G-1]

Weber, Ben [G-1]
Madan, Surya [G-1].

Shim, Sang-Heon (Dan) (School of Earth & Space Exploration, Arizona State University) See: Ravikumar, Shradhanjli [F-3].

Shirley, Yancy (Astronomy, University of Arizona) See: Squillace, Reynier [E-10].

Shkarayev, Sergey (Aerospace & Mechanical Engineering, University of Arizona) See: Petersen, Scott [A-4].

Shock, Everett (School of Earth & Space Exploration, Arizona State University) See: Baez, Justin [C-1].

Sierra-Alvarez, Reyes (Chemical & Environmental Engineering, University of Arizona) See: Baker, Eliot [C-13].

Song, Kenan (The Polytechnic School, Arizona State University) See: Hampton-Ross, Darius [H-1].

Stolte, Daniel (Marketing & Communications, University of Arizona) See: Benavidez, Koda [B-8].

Sulyman, Ahmed (Electrical, Computer, & Software Engineering, Embry-Riddle Aeronautical University) See:
Howe, Shane [H-4]
Parmenter, Joshua [H-5]
Peeler, Grayson [H-6]
Roszell, Hayden [H-5]
Sudkamp, Lillian [H-7].

Takahashi, Timothy (School for Engineering of Matter, Transport & Energy, Arizona State University) See:
Ordaz Perez, David [A-1]
Eilers, Dustin [A-In Title Only].

Throop, Heather (School of Earth & Space Exploration, Arizona State University) See: Benites, Eliana [C-2].

Trembath-Reichert, Elizabeth (School of Earth & Space Exploration, Arizona State University) See: Matthews, Adrianna [C-3].