Arizona/NASA Space Grant

Undergraduate Research Internship Program

Twenty-Ninth Annual Statewide Symposium

ARIZONA SPACE GRANT CONSORTIUM

Presentations by Space Grant Interns from:

University of Arizona
Arizona State University
Northern Arizona University
Embry-Riddle Aeronautical University
Central Arizona College
Glendale Community College
Phoenix College
Pima Community College

April 18, 2020
Zoom Virtual Teleconference Meeting

2019-2020 Statewide Arizona/NASA Space Grant Undergraduate Research Internship Symposium
April 18, 2020

Welcome to the 29th annual Statewide Arizona/NASA Space Grant Undergraduate Research Internship Symposium! The Symposium will feature talks from 84 Arizona undergraduate students, with an additional 55 students represented "In Title Only". Talks will last ten minutes each, roughly divided as 7-8 minutes for presentations and 2-3 minutes for questions. Four parallel topical sessions will run throughout the day.

This year, all in-person symposium events are canceled as our nation responds to COVID-19. The Arizona Space Grant Consortium has adjusted its symposium to ensure the safety and well-being of our participants. For the first time, the symposium will be held entirely online as a Zoom Virtual Teleconference Meeting. View the symposium schedule for Zoom links and passwords to join and listen to each symposium session.

This symposium is made possible through NASA support of the Arizona Space Grant Consortium. The efforts of steering committee members and Space Grant representatives at Arizona State University, Northern Arizona University, Embry-Riddle Aeronautical University, Central Arizona College, Glendale Community College, Phoenix College, Pima Community College, and The University of Arizona are acknowledged. Interns with a variety of academic backgrounds have come together to make the program a success; this symposium is a tribute to their dedication and spirit of inquiry.

This year marks the 30th 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/index.php?page=space-grant-30th to view short videos featuring past and present Space Grant students.

One such former Arizona Space Grant intern, Dr. Moriba Jah, is our keynote speaker for the symposium. Dr. Jah will virtually present a talk titled "Toward Space Safety, Security, and Sustainability: The Trajectory of an Astrodynamicist". The talk will focus on salient challenges regarding the achievement of space safety, security, and sustainability. Dr. Jah will discuss his research toward possible solutions whilst also describing his career path leading him to this point.

The Arizona NASA Space Grant internship program would not be possible without the efforts of many university faculty, private sector, and other federal research faculty 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 scholars. We thank them all for their past, present and future support.

Timothy Swindle, Director
Arizona Space Grant Consortium, UA

Michelle Coe, Manager
Arizona Space Grant Consortium, UA

Saturday, April 18, 2020, Zoom Virtual Teleconference Meeting

8:30-9:30 a.m. WELCOME & KEYNOTE SPEAKER:

Zoom Link: https://arizona.zoom.us/j/95016907140
Password: **Removed for website use**
Dr. Timothy D. Swindle, Director, Arizona Space Grant Consortium
Dr. Moriba Jah, Associate Professor, Aerospace Engineering and Engineering Mechanics, University of Texas at Austin

Zoom Link	https://arizona.zoom.us/j/96465892418	https://arizona.zoom.us/j/93484492494	https://asu.zoom.us/j/9665026855?pwd=QVBhTHY2OVkrTzlPZy83ekdvY2NmUT09	https://arizona.zoom.us/j/96535903606
Password	**This information has been removed for publication on the AZSGC Symposium 2020 website. Contact your local Space Grant office for password information.			
TIME **(MST)**	**Moderators:** Elliott Bryner, ERAU; Paloma Davidson, NAU; Timothy Swindle, UA **Session A** **TOPICS IN MATH, PHYSICS & CHEMISTRY** (9:40 AM – 10:30 AM) --- **Session E** **EDUCATION & PUBLIC OUTREACH** (10:30 AM – 11:30 AM) --- **Session H** **AEROSPACE TECHNOLOGY: SPACEFLIGHT/ENGINEERING PROGRAMS** (11:30AM – 1:00 PM)	**Moderators:** Nadine Barlow, NAU; Desiree Crawl, ASU; Yancy Shirley, UA **Session B** **ASCEND** (9:40 AM – 10:30 AM) --- **Session F** **ASTRONOMY & SPACE PHYSICS** (10:30 AM-1:00 PM)	**Moderators:** Alexa Drew, ASU; Chandra Holifield Collins, USDA; Tom Sharp, ASU **Session C** **EARTH & ENVIRONMENTAL SCIENCE/ENGINEERING** (9:40 AM-12:50 PM)	**Moderators:** Amanda Clarke, ASU; Michelle Coe, UA; Ron Madler, ERAU **Session D** **PLANETARY SCIENCE** (9:40 AM-10:40 AM) --- **Session G** **EXPLORATION SYSTEMS ENGINEERING: BIOLOGICAL, MATERIALS, OPTICAL, AND ELECTRICAL** (10:50 AM-1:00 PM)

9:40-9:50	[A-1] *Hannah Dromiack* Controlling Cellular Automata	[B-1] *Quynn Bell* *Estevan Cleveland* *Zach Moir* PCC ASCEND Project HEXi	[C-1] *Kathryn Chamberlin* Arctic Ice Management	[D-1] *Justin Baez* Mapping Solute Concentrations In Outflow Channels
9:50-10:00	[A-2] *Madison Grayson* Proton Patient Log File Analysis for Machine Performance Evaluation	[B-2] *Meghann Boland* *Misgana Gebremariam* *Constantino Meza* *Maxx Mudd* *Javier Perez Torres* *Samuel Queen* Phoenix College ASCEND 2019-2020: Technology and Achievements	[C-2] *Dylan Chandler* Using eDNA to Assess Invertebrate Biodiversity Across a Temperature Gradient	[D-2] *Zeke Bandelier* Hydrated Salts on Mars
10:00-10:10	[A-3] *Brad Ratto* Gravitational Wave Calibration Error for Supernovae Core Collapse	[B-3] *Christopher Korges* CAC ASCEND Launch Results from Fall 2019 and Spring 2020	[C-3] *Cedric Gammon* Does Forest Management alter the Effects of Soil Fauna on Fungal Communities and Nitrogen Availability?	[D-3] *Cara Courtney* Modelling the Effects of the Flow Conditions and Rheology on Lava Flows with Polyethylene Glycol
10:10-10:20	[A-4] *Kimberly Velarde* Herpes Simplex Virus 1 Amplicon Vectors	[B-4] *Genevieve Cooper* *Maxwell Fell* *Feras Jayyusi* *Anyell Mata* *Kyle McCormick* *David Rodriguez* Glendale Community College Fall 2019 Payload	[C-4] *Brielle Januszewski* Dose-Toxicity Characterization of Silver Nanoparticles	[D-4] *Megan Gialluca* Investigating the Capabilities of the JWST to Categorize Earth-Like Planets Orbiting Cool Main Sequence Stars
10:20-10:30	[A-5] *Lily Wayne* Using Calcium Isotope Fractionation to Measure Bone Mineral Density	[B-5] *Ivan Martinez Morales* *Christopher Yurgel* Arizona Space Grant ASCEND! Analysis of Sonoran Desert Biomass Health Through Normalized Difference Vegetation Index Data at Altitude	[C-5] *Emily Kunkle* A Fossilized Rootless Hydrothermal System in the Cottonwood Subbasin of the Verde Valley, AZ	[D-5] *Zachary Kirch* Large Binocular Telescope Interferometer (LBTI) Software Documentation Project
10:30-10:40	[E-1] *Rachel Abraham* Science Communication: Out of the Silos and into the Media	[F-1] *Michaela Cullipher* Perchlorate in Tortoises and on Mars	[C-6] *Mila Lubeck* Forward Model of Glacial Isostatic Adjustment in Greenland and Future Projection of Greenland Ice Mass Loss	[D-6] *Hannah Zigo* Investigating Potential Ancient Inverted Valley Networks on Mars
10:40-10:50	**BREAK**			

10:50-11:00	[E-2] *Reman Almusawi* Airborne Lead and Arsenic in Hayden, AZ	[F-2] *Danielle Dickinson* Spectroscopy of the Superluminous Supernova ASASSN 15ua	[C-7] *Ruby O'Brien-Metzger* Danger of Dust Storms in Picacho Peak	[G-1] *Edwin Beraud Calderon* Correlating Wall Shear Stress to Heat Distribution in a Pipe Under Unsteady Fluid Flow
11:00-11:10	[E-3] *Kaitlin Murphy* Monitoring and Analyzing Particulate Matter in Regard to Air Quality within an Indigenous Community	[F-3] *Ethan Duncan* Presolar Grain Isolation: A Novel Development Using Focused Ion Beam (FIB)	[C-8] *Brianna Orrill* Chemical Gradients, Fluid Mixing and the Influence on Biological Diversity in Yellowstone National Park	[G-2] *Gerardo Figueroa* Rapid Bonding Multi-Sensor Development for Bone Monitoring in Space
11:10-11:20	[E-4] *Savannah Perez* Redefine NAU Astronomy Courses with Innovative Teaching Styles	[F-4] *Ruby Fulford* The Search for Volatile Carbon Transport in Protoplanetary Disks	[C-9] *Richard Pepel* Photodegradation of Onium Photoacid Generators under UV Irradiation: Identification and Environmental, Safety, and Health, (ESH) Evaluation of Photoproducts	[G-3] *Christopher Galus* Nanoscale Analysis of Silicon Nitride Ceramics using Molecular Dynamics
11:20-11:30	[E-5] *Christianna Reinhardt* NASA Space Grant for Science Writing	[F-5] *Maria Galloway-Sprietsma* Study of o-NH2D in Cepheus Star Forming Region L1251	[C-10] *Diana Ramirez* Exploring the Effect of Growth Conditions on the Volatile Metabolome of Chromobacterium spp. using GC×GC-TOF-MS.	[G-4] *Collin Ganser* Investigating Geopolymer-Mediated Adsorption of MRSA Cells and Secreted Proteins
11:30-11:40	[H-1] *Felicity Aldava* Design and Mobility Evolution for the Exploration of Asteroids Using a Spacecraft on Stilts	[F-6] *Madelyn Hart* Cataloging and Observing Active Galactic Nuclei	[C-11] *Alyssa Renteria* MES 2020 Project: Next Top Interpolation Method	[G-5] *Kyle Ghaby* Surviving Space Travel: Solvent-Mediated Preservation of Diabetes Medicine
11:40-11:50	[H-2] *Alyssa Baller* Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO)	[F-7] *James Lilly* Characterizing Physical Properties Associated with Hierarchical Structure in Star-Forming Regions	[C-12] *Elinor Sauer* Evaluating the Accuracy of Tempe Town Lake dataSONDE	[G-6] *Alexis Hocken* Photocurable Poly(ethylene glycol) Diacrylate Resins with Variable Loadings of Functionalized Silica Nanoparticles
11:50-12:00	**BREAK**			
12:00-12:10	[H-3] *Janet Duarte Nevarez* Exploration through Innovation	[F-8] *Caroline McCormick* The Evolution of the Mass-Chemical Abundance-Star Formation Relation over Seven Billion Years	[C-13] *Allison Segapeli* A Method Validation Study: Comparing Field Portable X-Ray Fluorescence to Laboratory Inductive Coupled-Mass Spectrometry for Five Metal(loid)s in Arizona Soils	[G-7] *Ava Karanjia* Investigating the Role of the Las and Rhl Quorum Sensing Systems in the Pathogenesis of Pseudomonas aeruginosa

12:10-12:20	[H-4] *Collin Greene* Flow Characterization for Jet Transition Piece in TFCL	[F-9] *Liam Nolan* What Powers the Faint (μJy) Radio Source Population?	[C-14] *Lauren Thompson* The Influence of Water Control Structures on Rangeland Vegetation Patterns	[G-8] *Brianna Lopez* The Impact of Staphylococcus aureus Volatiles on Pseudomonas aeruginosa Phenotypes
12:20-12:30	[H-5] *Parker Landon* Julia Language 1.2 Ephemeris Reader and Gravitational Modeling Program for Solar System Bodies	[F-10] *Jack Schulte* The Supernova Origins of Stardust Enriched with 13C and 15N	[C-15] *Nicole Van Overmeiren* Community Monitoring of Arsenic and Lead in Residential Properties Neighboring Mining Operations	[G-9] *Julian Mena* SPHEREx: Scanning the Skies
12:30-12:40	[H-6] *Becca Laub* EagleSat Project Management	[F-11] *Ryan Webster* Analysis of Physical Correlation between Ultra Diffuse Galaxies and Conventional Galaxies	[C-16] *Taylor Walton* Geochemistry and Microbiology of the Photosynthetic Fringe	[G-10] *Tiphanie Pfefferle* 3-D Printed Micro Cilia for the Removal of Biofilm in Space Crafts
12:40-12:50	[H-7] *Katherine Rocha* EagleSat 2: On-Board Computer Subsystem	[F-12] *Lily Whitler* Validating the Analysis Pipeline for the Hydrogen Epoch of Reionization Array: Radio Frequency Interference and the Power Spectrum	[C-17] *Carlos Weiler* Degradation of Trace Organic Compounds via Advanced Oxidation Processes	[G-11] *Joshua Smith* Predicting Satellite-to-Ground Propagation Effects Induced by the Ionosphere for a Low Orbit Satellite
12:50-1:00	[H-8] *Ryan Stephenson* Development of Digital Readout for Microwave Kinetic Inductance Detectors	[F-13] *Kadin Worthen* Investigating Four Newly Resolved Debris Disks in Scorpius-Centaurus		[G-12] *Rodney Staggers Jr* The Autonomous Underwater Exploration Drone Project

Program Schedule

Session A:
Topics in Math, Physics, and Chemistry

Moderators:
Elliott Bryner, ERAU, Department of Mechanical Engineering
Paloma Davidson, NAU, Department of Astronomy and Planetary Science
Timothy Swindle, UA, Lunar and Planetary Laboratory

[A-1] **Controlling Cellular Automata**, Hannah Dromiack, (Senior, Physics, Arizona State University), Sara Walker, School of Earth and Space Exploration, Arizona State University.

[A-2] **Proton Patient Log File Analysis for Machine Performance Evaluation**, Madison Grayson, (Senior, Physics, Arizona State University), Ricardo Alarcon, Physics, Arizona State University.

[A-3] **Gravitational Wave Calibration Error for Supernovae Core Collapse**, Brad Ratto, (Junior, Aerospace Engineering Astronautics, Embry-Riddle Aeronautical University), Michele Zanolin, Physics Department, Embry-Riddle Aeronautical University.

[A-4] **Herpes Simplex Virus 1 Amplicon Vectors**, Kimberly Velarde, (Senior, Microbiology, Arizona State University), Ian Hogue, Immunotherapy, Vaccines and Virotherapy, Arizona State University.

[A-5] **Using Calcium Isotope Fractionation to Measure Bone Mineral Density**, Lily Wayne, (Senior, Biochemistry, Arizona State University), Ariel Anbar, School of Molecular Science, Arizona State University.

[A-In Title Only] **Nanofabrication Using Self-Assembled Monolayers**, Madison Driskill, (Senior, Chemical Engineering, University of Arizona), Anthony Muscat, Chemical and Environmental Engineering, University of Arizona.

[A-In Title Only] **Using Atomic Force Microscopy to Study Diamond Surfaces**, Eric Gutierrez, (Sophomore, Physics, Arizona State University), Anna Zaniewski, Physics, Arizona State University.

[A-In Title Only] **Electronic Properties of Van Der Waals Magnets: Bulk to Monolayer**, Chase Hanson, (Junior, Physics and Math, Arizona State University), Antia Botana, Physics, Arizona State University.

[A-In Title Only] **Low Defect Self-assembled Monolayers for Molecular Devices**, Sofia Jacobson, (Sophomore, Molecular and Cellular Biology, University of Arizona), Anthony Muscat, Chemical and Environmental Engineering, University of Arizona.

[A-In Title Only] **Using Microgravity at the International Space Station to Lead to New Therapeutics for Taspase1: A Novel Cancer Target**, Rebecca Jernigan, (Senior, Microbiology and Biochemistry, Arizona State University), Jose Martin-Garcia, Center for Applied Structural Discovery, Arizona State University.

[A-In Title Only] **Analyzation of the Titanium-diamond Interface via X-Ray Photoelectron spectroscopy**, Holly Johnson, (Senior, Physics, Arizona State University), Anna Zaniewski, Physics, Arizona State University.

[A-In Title Only] **Thermodynamics of Ultramafic Deep Sea Hydrothermal Vent Systems: Exploring Overabundance of CO2**, Crystal Kubby, (Junior, Biophysics and Astrobiology, Arizona State University), Everett Shock, School of Earth and Space Exploration, Arizona State University.

[A-In Title Only] **Electronic Circuits and Computer Programs for Microwave Spectrometer**, Riva Villaran, (Junior, Chemistry, University of Arizona), Stephen Kukolich, Department of Chemistry, University of Arizona.

Program Schedule

Session B:
ASCEND

Moderators:
Nadine Barlow, NAU, Department of Astronomy and Planetary Science
Desiree Crawl, ASU, School of Earth and Space Exploration
Yancy Shirley, UA, Astronomy and Steward Observatory

[B-1] **PCC ASCEND Project HEXi**, Quynn Bell, (Sophomore, General Studies, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-1] **PCC ASCEND Project HEXi**, Estevan Cleveland, (Junior, Biochemistry, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-1] **PCC ASCEND Project Hexi**, Zach Moir, (Sophomore, Computer Engineering, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-2] **Phoenix College ASCEND: Video Stabilization**, Meghann Boland, (Sophomore, Mechanical Engineering, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-2] **Phoenix College ASCEND 2019-2020: Technology and Achievement**s, Misgana Gebremariam, (Junior, Computer Science, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-2] **Phoenix College ASCEND 2019-2020: Technology and Achievements**, Constantino Meza, (Sophomore, Mechanical Engineering, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-2] **Phoenix College ASCEND 2019-2020: Technology and Achievements**, Maxx Mudd, (Sophomore, Computer Science, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-2] **Phoenix College ASCEND 2019-2020: Technology and Achievements**, Javier Perez Torres, (Junior, Electrical Engineering, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-2] **Phoenix College ASCEND: Automated Antenna Aiming**, Samuel Queen, (Sophomore, Computer Science, Phoenix College), Ernest Villicaña, Engineering, Phoenix College.

[B-3] **CAC ASCEND launch results from Fall 2019 and Spring 2020**, Christopher Korges, (Sophomore, Business Administration, Central Arizona College), Wayne Pryor, Astronomy, Central Arizona College.

[B-4] **Glendale Community College Fall 2019 Payload**, Genevieve Cooper, (Sophomore, Computer Science, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-4] **Glendale Community College Fall 2019 Payload**, Maxwell Fell, (Junior, Mechanical Engineering, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-4] **Glendale Community College Fall 2019 Payload**, Feras Jayyusi, (Senior, Computer Science, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-4] **Glendale Community College Fall 2019 Payload**, Anyell Mata, (Sophomore, Electrical Engineering, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-4] **Glendale Community College Fall 2019 Payload**, Kyle McCormick, (Junior, Electrical Engineering, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-4] **Glendale Community College Fall 2019 Payload**, David Rodriguez, (Junior, Biomedical Engineering, Glendale Community College), Timothy Frank, Engineering, Glendale Community College.

[B-5] **Arizona Space Grant ASCEND! Analysis of Sonoran Desert Biomass Health Through Normalized Difference Vegetation Index Data at Altitude**, Ivan Martinez Morales, (Junior, Computer Science, Arizona State University), Thomas Sharp, School of Earth and Space Exploration, Arizona State University.

[B-5] **Arizona Space Grant ASCEND! Analysis of Sonoran Desert Biomass Health Through Normalized Difference Vegetation Index Data at Altitude**, Christopher Yurgel, (Junior, Aerospace, Arizona State University), Thomas Sharp, School of Earth and Space Exploration, Arizona State University.

[B-In Title Only] **CAC ASCEND launch results from Fall 2019 and Spring 2020**, Michaela Anderson, (Sophomore, Strategic Communication, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **CAC ASCEND launch results from Fall 2019 and Spring 2020**, Daniel Barkley, (Senior, Electrical and Electronics Engineering, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Nick Blanchard, (Sophomore, Electrical and Computer Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **CAC ASCEND launch results from Fall 2019 and Spring 2020**, Gerard Dsouza, (Sophomore, Computer Systems Engineering, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Ahmad Eladawy, (Sophomore, Aerospace Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **PCC ASCEND Project HEXi**, Maximo Esquivel, (Sophomore, Engineering, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-In Title Only] **ERAU ASCEND: Project Overview and Software**, Thomas Fike, (Sophomore, Electrical Engineering, Embry-Riddle Aeronautical University), Douglas Isenberg, Mechanical Engineering, Embry-Riddle Aeronautical University.

[B-In Title Only] **CAC ASCEND launch results from Fall 2019 and Spring 2020**, Aerin Fulton, (Sophomore, Business, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **CAC ASCEND Launch Results from Fall 2019 and Spring 2020**, Eduardo Garcia, (Sophomore, Electrical Engineering, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **CAC ASCEND Launch Results from Fall 2019 and Spring 2020**, Federico Lopez, (Sophomore, Aerospace Engineering, Central Arizona College), Wayne Pryor, Science, Central Arizona College.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Kevin May, (Sophomore, Aerospace Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Daniel McConville, (Sophomore, Materials Science and Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **Analyzing the Viability of a Lunar-Regolith Simulant Shielded 1U CubeSat Payload and Diagnosing the In-flight Near-Space Environment Using a General Data Logger**, Arsh Nadkarni, (Junior, Astronomy and Applied Physics, University of Arizona), Michelle Coe, Department of Planetary Sciences, University of Arizona.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Scott Petersen, (Sophomore, Aerospace Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **ERAU ASCEND: Project Overview and Software**, Nicodemus Phaklides, (Sophomore, Electrical Engineering, Embry-Riddle Aeronautical University), Douglas Isenberg, Mechanical Engineering, Embry-Riddle Aeronautical University.

[B-In Title Only] **PCC ASCEND Project HEXi**, Briana Pomales, (Sophomore, Chemistry, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Reed Spurling, (Sophomore, Electrical and Computer Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **PCC ASCEND Project HEXi**, Nathan Vandivort, (Sophomore, Pre-Engineering, Pima Community College), AnnMarie Condes, Chemistry, Pima Community College.

[B-In Title Only] **Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger**, Kenneth Werrell, (Sophomore, Aerospace Engineering, University of Arizona), Michelle Coe, Lunar and Planetary Laboratory, University of Arizona.

[B-In Title Only] **PCC ASCEND Project HEXi**, Andres Leonardo Zavala Quijada, (Sophomore, Astronomy, Computer Sciences, Mathematics, and Physics, Pima Community College), Ann Condes, Chemistry, Pima Community College.

Program Schedule

Session C:
Earth and Environmental Science/Engineering

Moderators:
Alexa Drew, ASU, School of Earth and Space Exploration
Chandra Holifield Collins, USDA, Southwest Watershed Research Center
Tom Sharp, ASU, School of Earth and Space Exploration

[C-1] **Arctic Ice Management**, Kathryn Chamberlin, (Senior, Electrical Engineering, Arizona State University), Steven Desch, School of Earth and Space Exploration, Arizona State University.

[C-2] **Using eDNA to Assess Invertebrate Biodiversity Across a Temperature Gradient**, Dylan Chandler, (Junior, Environmental Science, Northern Arizona University), Rebecca Best, School of Earth and Space Exploration, Northern Arizona University.

[C-3] **Does Forest Management alter the Effects of Soil Fauna on Fungal Communities and Nitrogen Availability?** Cedric Gammon, (Sophomore, Environmental Science, Northern Arizona University), Nancy Johnson, School of Earth and Sustainability, Northern Arizona University.

[C-4] **Dose-Toxicity Characterization of Silver Nanoparticles**, Brielle Januszewski, (Senior, Civil Environmental Engineering, Arizona State University), François Perreault, School of Sustainable Engineering and the Built Environment, Arizona State University.

[C-5] **A Fossilized Rootless Hydrothermal System in the Cottonwood Subbasin of the Verde Valley, AZ**, Emily Kunkle, (Senior, Geology, Northern Arizona University), Lisa Thompson, Geology, Northern Arizona University.

[C-6] **Forward Model of Glacial Isostatic Adjustment in Greenland and Future Projection of Greenland Ice Mass Loss**, Mila Lubeck, (Junior, Geophysics, University of Arizona), Christopher Harig, Geosciences, University of Arizona.

[C-7] **Danger of Dust Storms in Picacho Peak**, Ruby O'Brien-Metzger, (Junior, Mechanical Engineering, University of Arizona), Eric Betterton, Hydrology and Atmospheric Sciences, University of Arizona.

[C-8] **Chemical Gradients, Fluid Mixing and the Influence on Biological Diversity in Yellowstone National Park**, Brianna Orrill, (Junior, Astrobiology, Arizona State University), Everett Shock, School of Earth and Space Exploration, Arizona State University.

[C-9] **Photodegradation of Onium Photoacid Generators under UV irradiation: Identification and Environmental, Safety, and Health, (ESH) Evaluation of Photoproducts**, Richard Pepel, (Junior, Chemical Engineering, University of Arizona), Reyes Sierra, Chemical and Environmental Engineering, University of Arizona.

[C-10] **Exploring the Effect of Growth Conditions on the Volatile Metabolome of Chromobacterium spp. using GC×GC-TOF-MS.**, Diana Ramirez, (Senior, Microbiology, Arizona State University), Heather Bean, School of Life Sciences, Arizona State University.

[C-11] **MES 2020 Project: Next Top Interpolation Method**, Alyssa Renteria, (Sophomore, Global Environmental Science, University of Hawaii at Manoa), Angelita Denny, Legacy Management, Department of Energy.

[C-12] **Evaluating the Accuracy of Tempe Town Lake dataSONDE**, Elinor Sauer, (Senior, Environmental Chemistry and Biological Sciences, Arizona State University), Hilairy Hartnett, School of Earth and Space Exploration, Arizona State University.

[C-13] **A Method Validation Study: Comparing Field Portable X-Ray Fluorescence to Laboratory Inductive Coupled-Mass Spectrometry for Five Metal(loid)s in Arizona Soils**, Allison Segapeli, (Sophomore, Chemical Engineering, University of Arizona), Monica Ramirez-Andreotta, Environmental Science, University of Arizona.

[C-14] **The Influence of Water Control Structures on Rangeland Vegetation Patterns**, Lauren Thompson, (Junior, Ecology and Evolutionary Biology, University of Arizona), Mary Nichols, Southwest Watershed Research Center, U.S. Department Of Agriculture - Agricultural Research Service.

[C-15] **Community Monitoring of Arsenic and Lead in Residential Properties Neighboring Mining Operations**, Nicole Van Overmeiren, (Junior, Chemical Engineering, University of Arizona), Monica Ramirez-Andreotta, Environmental Science, University of Arizona.

[C-16] **Geochemistry and Microbiology of the Photosynthetic Fringe**, Taylor Walton, (Senior, Biochemistry, Arizona State University), Everett Shock, School of Earth and Space Exploration, Arizona State University.

[C-17] **Degradation of Trace Organic Compounds via Advanced Oxidation Processes**, Carlos Weiler, (Senior, Chemical Engineering, University of Arizona), Eduardo Saez, Chemical Engineering, University of Arizona.

[C-In Title Only] **Metabarcoding Across the Desert Southwest: Using Environmental DNA to Track Fish and Wildlife Use of Aquatic Ecosystems**, Bethany Davis, (Senior, Forensic Biology, Embry-Riddle Aeronautical University), Hillary Eaton, Department of Biology and Chemistry, Embry-Riddle Aeronautical University.

[C-In Title Only] **Determining Gravel Provenance in Altiplano, Chile**, Bailey Estes, (Senior, Geology, Northern Arizona University), Nancy Riggs, Geology, Northern Arizona University.

[C-In Title Only] **Using Machine Learning Models to Predict Pollen Release**, Sydney Filler, (Junior, Mathematics and Economics, University of Arizona), Kathy Gerst, National Phenology Network, University of Arizona.

[C-In Title Only] **Soil Texture Alters Drought Response in Pinus edulis**, Maria Hernandez, (Senior, Biology, Northern Arizona University), Amy Whipple, Biology, Northern Arizona University.

[C-In Title Only] **Detecting Invasive Species**, Christian Jimenez, (Sophomore, Computer Science, Northern Arizona University), Katharyn Duffy, EcoInformatics, Northern Arizona University.

[C-In Title Only] **Statistical Analysis of the Northern Arizona Tornado Outbreak**, Paige Swenson, (Senior, Applied Meteorology, Embry-Riddle Aeronautical University), Curtis James, Applied Aviation Sciences, Embry-Riddle Aeronautical University.

Program Schedule

Session D:
Planetary Science

Moderators:
Amanda Clarke, ASU, School of Earth and Space Exploration
Michelle Coe, UA, Lunar and Planetary Laboratory
Ron Madler, ERAU, Aerospace and Mechanical Engineering

[D-1] **Mapping Solute Concentrations In Outflow Channels**, Justin Baez, (Sophomore, Geological Sciences, Arizona State University), Everett Shock, School of Earth and Space Exploration, Arizona State University.

[D-2] **Hydrated Salts on Mars**, Zeke Bandelier, (Senior, Chemistry, Northern Arizona University), Jennifer Hanley, Astronomy, Lowell Observatory.

[D-3] **Modelling the Effects of the Flow Conditions and Rheology on Lava Flows with Polyethylene Glycol**, Cara Courtney, (Senior, Mechanical Engineering, Arizona State University), Amanda Clarke, School of Earth and Space Exploration, Arizona State University.

[D-4] **Investigating the Capabilities of the JWST to Categorize Earth-Like Planets Orbiting Cool Main Sequence Stars**, Megan Gialluca, (Junior, Astronomy and Physics, Northern Arizona University), Tyler Robinson, Astronomy and Planetary Science, Northern Arizona University.

[D-5] **Large Binocular Telescope Interferometer (LBTI) Software Documentation Project**, Zachary Kirch, (Senior, Electrical and Computer Engineering, University of Arizona), Steve Ertel, Astronomy, University of Arizona.

[D-6] **Investigating Potential Ancient Inverted Valley Networks on Mars**, Hannah Zigo, (Senior, Astronomy, Northern Arizona University), Christopher Edwards, Astronomy and Planetary Sciences, Northern Arizona University.

[D-In Title Only] **Mapping of Crustal Magnetic Fields on the Moon**, Cecilyn Bustamante Torres, (Junior, Astronomy, University of Arizona), Lon Hood, Lunar and Planetary Laboratory, University of Arizona.

[D-In Title Only] **Ancient Meteorites and Impacts: Windows to the Evolution of the Solar System**, Madeline Marquardt, (Senior, Astrobiology, Arizona State University), Thomas Sharp, School of Earth and Space Exploration, Arizona State University.

Program Schedule

Session E:
Education and Public Outreach

Moderators:
Elliott Bryner, ERAU, Department of Mechanical Engineering
Paloma Davidson, NAU, Department of Astronomy and Planetary Science
Timothy Swindle, UA, Lunar and Planetary Laboratory

[E-1] **Science Communication: Out of the Silos and into the Media**, Rachel Abraham, (Senior, Neuroscience, University of Arizona), Daniel Stolte, University Communications, University of Arizona.

[E-2] **Airborne Lead and Arsenic in Hayden, AZ**, Reman Almusawi, (Senior, Civil Engineering, University of Arizona), Eric Betterton, Hydrology and Atmospheric Sciences, University of Arizona.

[E-3] **Monitoring and Analyzing Particulate Matter in Regard to Air Quality within an Indigenous Community**, Kaitlin Murphy, (Junior, Environmental Studies and Sustainability, Northern Arizona University), Mansel Nelson, Institute for Tribal Professionals, Northern Arizona University.

[E-4] **Redefine NAU Astronomy Courses with Innovative Teaching Styles**, Savannah Perez, (Senior, Physics and Astronomy, Northern Arizona University), Lisa Chien, Astronomy and Planetary Sciences, Northern Arizona University.

[E-5] **NASA Space Grant for Science Writing**, Christianna Reinhardt, (Post-Baccalaureate, BioMedical Sciences, Northern Arizona University), Chris Etling, Arizona Daily Sun, Arizona Daily Sun.

Program Schedule

Session F:
Astronomy and Space Physics

Moderators:
Nadine Barlow, NAU, Department of Astronomy and Planetary Science
Desiree Crawl, ASU, School of Earth and Space Exploration
Yancy Shirley, UA, Astronomy and Steward Observatory

[F-1] **Perchlorate in Tortoises and on Mars**, Michaela Cullipher, (Senior, Biology, Northern Arizona University), Catherine Propper, Biology, Northern Arizona University.

[F-2] **Spectroscopy of the Superluminous Supernova ASASSN 15ua**, Danielle Dickinson, (Junior, Astronomy and Physics, University of Arizona), Nathan Smith, Astronomy, University of Arizona.

[F-3] **Presolar Grain Isolation: A Novel Development Using Focused Ion Beam (FIB)**, Ethan Duncan, (Junior, Astrophysics and Physics, Arizona State University), Maitrayee Bose, School of Earth and Space Exploration, Arizona State University.

[F-4] **The Search for Volatile Carbon Transport in Protoplanetary Disks**, Ruby Fulford, (Sophomore, Astronomy, University of Arizona), Kamber Schwarz, Lunar and Planetary Laboratory, University of Arizona.

[F-5] **Study of o-NH2D in Cepheus Star Forming Region L1251**, Maria Galloway-Sprietsma, (Junior, Physics and Astronomy, University of Arizona), Yancy Shirley, Astronomy, University of Arizona.

[F-6] **Cataloging and Observing Active Galactic Nuclei**, Madelyn Hart, (Junior, Physics, Astronomy, and Mathematics, Northern Arizona University), Scott Barrows, Astronomy, Lowell Observatory, CU Boulder.

[F-7] **Characterizing Physical Properties Associated with Hierarchical Structure in Star-Forming Regions**, James Lilly, (Senior, Astronomy and Physics, University of Arizona), Yancy Shirley, Astronomy, University of Arizona.

[F-8] **The Evolution of the Mass-Chemical Abundance-Star Formation Relation over Seven Billion Years**, Caroline McCormick, (Junior, Astronomy, University of Arizona), Chun Ly, Steward Observatory, University Libraries, University of Arizona.

[F-9] **What Powers the Faint (μJy) Radio Source Population?**, Liam Nolan, (Sophomore, Earth and Space Exploration, Astrophysics, Arizona State University), Rolf Jansen, School of Earth and Space Exploration, Arizona State University.

[F-10] **The Supernova Origins of Stardust Enriched with 13C and 15N**, Jack Schulte, (Junior, Physics, Arizona State University), Maitrayee Bose, School of Earth and Space Exploration, Arizona State University.

[F-11] **Analysis of Physical Correlation between Ultra Diffuse Galaxies and Conventional Galaxies**, Ryan Webster, (Senior, Astronomy, University of Arizona), Dennis Zaritsky, Department of Astronomy, University of Arizona.

[F-12] **Validating the Analysis Pipeline for the Hydrogen Epoch of Reionization Array: Radio Frequency Interference and the Power Spectrum**, Lily Whitler, (Senior, Physics and Mathematics, Arizona State University), Steven Murray, School of Earth and Space Exploration, Arizona State University.

[F-13] **Investigating Four Newly Resolved Debris Disks in Scorpius-Centaurus**, Kadin Worthen, (Junior, Physics, Arizona State University), Jennifer Patience, School of Earth and Space Exploration, Arizona State University.

[F-In Title Only] **Understanding the Circumgalactic Medium in Dwarf Galaxies**, Martin Flores, (Senior, Physics, Arizona State University), Sanchayeeta Borthakur, School of Earth and Space Exploration, Arizona State University.

[F-In Title Only] **Modeling Quasi-Thermal Noise in the Solar Wind**, Savannah Gramze, (Junior, Astronomy, University of Arizona), Mihailo Martinovic, Lunar and Planetary Laboratory, University of Arizona.

[F-In Title Only] **Navy Precision Optical Interferometer Data Pipeline and Reduction**, Peter Kurtz, (Senior, Computer Science, Northern Arizona University), Stephen Williams, Astronomy, United States Naval Observatory.

Program Schedule

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

Moderators:
Amanda Clarke, ASU, School of Earth and Space Exploration
Michelle Coe, UA, Lunar and Planetary Laboratory
Ron Madler, ERAU, Aerospace and Mechanical Engineering

[G-1] **Correlating Wall Shear Stress to Heat Distribution in a Pipe Under Unsteady Fluid Flow**, Edwin Beraud Calderon, (Senior, Mechanical Engineering, Northern Arizona University), Amirhossein Arzani, Mechanical Engineering, Northern Arizona University.

[G-2] **Rapid Bonding Multi-sensor Development for Bone Monitoring in Space**, Gerardo Figueroa, (Junior, Biomedical Engineering, University of Arizona), John Szivek, Orthopaedic Surgery, University of Arizona.

[G-3] **Nanoscale Analysis of Silicon Nitride Ceramics using Molecular Dynamics**, Christopher Galus, (Senior, Mechanical Engineering, Northern Arizona University), Mark Hawthorne, Material Science, ATC Materials.

[G-4] **Investigating Geopolymer-mediated Adsorption of MRSA Cells and Secreted Proteins**, Collin Ganser, (Senior, Astrobiology and Biogeosciences, Arizona State University), Shelley Haydel, School of Life Sciences, Arizona State University.

[G-5] **Surviving Space Travel: Solvent-Mediated Preservation of Diabetes Medicine**, Kyle Ghaby, (Senior, Chemistry and Biomedical Science, Northern Arizona University), Gerrick Lindberg, Chemistry and Biochemistry, Northern Arizona University.

[G-6] **Photocurable Poly(ethylene glycol) Diacrylate Resins with Variable Loadings of Functionalized Silica Nanoparticles**, Alexis Hocken, (Junior, Chemical Engineering, Arizona State University), Matthew Green, School for Engineering of Matter, Transport, and Energy, Arizona State University.

[G-7] **Investigating the Role of the Las and Rhl Quorum Sensing Systems in the Pathogenesis of Pseudomonas aeruginosa**, Ava Karanjia, (Senior, Chemical Engineering and Microbiology, Arizona State University), Heather Bean, School of Life Sciences, Arizona State University.

[G-8] **The Impact of Staphylococcus aureus Volatiles on Pseudomonas aeruginosa Phenotypes**, Brianna Lopez, (Senior, Biological Sciences, Genetics, Cellular and Developmental Biology, Arizona State University), Heather Bean, School of Life Sciences, Arizona State University.

[G-9] **SPHEREx: Scanning the Skies**, Julian Mena, (Sophomore, Astrophysics, Arizona State University), Philip Mauskopf, School of Earth and Space Exploration, Arizona State University.

[G-10] **3-D Printed micro cilia for the removal of Biofilm in Space Crafts**, Tiphanie Pfefferle, (Senior, Chemistry, Northern Arizona University), Stephanie Hurst, Department of Chemistry and Biochemistry, Northern Arizona University.

[G-11] **Predicting Satellite-to-Ground Propagation Effects Induced by the Ionosphere for a Low Orbit Satellite**, Joshua Smith, (Senior, Aerospace Engineering, University of Arizona), Mike Parker, Rincon Research Corp, University of Arizona.

[G-12] **The Autonomous Underwater Exploration Drone Project**, Rodney Staggers Jr, (Junior, Mechanical Engineering, Arizona State University), Jnaneshwar Das, School of Earth and Space Exploration, Arizona State University.

[G-In Title Only] **Serotonin-Mediated Liver Regeneration**, Andrea Borsenik, (Sophomore, Biological Sciences, Arizona State University), Xiaojun Tian, School of Biological and Health Systems Engineering, Arizona State University.

[G-In Title Only] **Micro-penetrometer for Measuring Forces on Low-Gravity Environments**, Francisco Garcia, (Junior, Mechanical Engineering, University of Arizona), Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona.

[G-In Title Only] **Experimental Study on Compression and Shear Strength of CFRP After Impact**, Joseph Gentile, (Sophomore, Aeronautical Engineering, Embry-Riddle Aeronautical University), Wahyu Lestari, Aerospace Engineering, Embry-Riddle Aeronautical University.

[G-In Title Only] **Soft Robotics for Use in Space and Extreme Environments**, Matthew Johnson, (Senior, Aerospace Engineering, University of Arizona), Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona.

[G-In Title Only] **Total Ionizing Dose Effects on ESD Diodes**, Brendan Scobie, (Senior, Electrical Engineering, Arizona State University), Jennifer Kitchen, School of Electrical, Computer and Energy Engineering, Arizona State University.

[G-In Title Only] **Habituation of Alarm Signalling in Harvester Ants**, Ciara Sypherd, (Senior, Aerospace Engineering and Astrobiology, Arizona State University), Jennifer Fewell, School of Life Sciences, Arizona State University.

Program Schedule

Session H:
Aerospace Technology: Spaceflight and Engineering Programs

Moderators:
Elliott Bryner, ERAU, Department of Mechanical Engineering
Paloma Davidson, NAU, Department of Astronomy and Planetary Science
Timothy Swindle, UA, Lunar and Planetary Laboratory

[H-1] **Design and Mobility Evolution for the Exploration of Asteroids Using a Spacecraft on Stilts**, Felicity Aldava, (Junior, Computer Science, University of Arizona), Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona.

[H-2] **Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO)**, Alyssa Baller, (Junior, Optical Sciences and Engineering, University of Arizona), Tisha Saltzman, Steward Observatory, University of Arizona.

[H-3] **Exploration through Innovation**, Janet Duarte Nevarez, (Junior, Aerospace Engineering, Arizona State University), Paul Scowen, School of Earth and Space Exploration, Arizona State University.

[H-4] **Flow Characterization for Jet Transition Piece in TFCL**, Collin Greene, (Senior, Mechanical Engineering, University of Arizona), Jesse Little, Aerospace and Mechanical Engineering, University of Arizona.

[H-5] **Julia Language 1.2 Ephemeris Reader and Gravitational Modeling Program for Solar System Bodies**, Parker Landon, (Sophomore, Computer Engineering and Space Physics, Embry-Riddle Aeronautical University), Keala Martin, Aerospace Engineering, Embry-Riddle Aeronautical University.

[H-6] **EagleSat Project Management**, Becca Laub, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University), Daniel White, Engineering, Embry-Riddle Aeronautical University.

[H-7] **EagleSat 2: On-Board Computer Subsystem**, Katherine Rocha, (Sophomore, Computer Engineering, Embry-Riddle Aeronautical University), Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-8] **Development of Digital Readout for Microwave Kinetic Inductance Detectors**, Ryan Stephenson, (Sophomore, Electrical Engineering, Arizona State University), Philip Mauskopf, College of Liberal Arts and Sciences, Arizona State University.

[H-In Title Only] **Development of an Improved Motion Mechanism to Investigate Laminar Separation Bubbles Subjected to Unsteady Plunging Motion**, Kailie Szewczyk, (Junior, Aerospace Engineering, University of Arizona), Jesse Little, Aerospace and Mechanical Engineering, University of Arizona.

[H-In Title Only] **Film Cooling Effectiveness**, Tara Trail, (Junior, Mechanical Engineering, Embry-Riddle Aeronautical University), Elliott Bryner, College of Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **Computational Flow Control: Minimum Amplitude for Effective Flow Control**, Thorne Wolfenbarger, (Junior, Aerospace Engineering, Embry-Riddle Aeronautical University), Wallace Morris, Aerospace Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **Crew Member Vital Signs as Indicators of Environmental Changes Aboard Space Habitats**, Shaun Brown, (Junior, Biomedical Engineering, Electrical and Computer Engineering, University of Arizona), Wolfgang Fink, Biomedical Engineering, and Electrical and Computer Engineering, University of Arizona.

[H-In Title Only] **ERAU EagleSat 2, Cosmic Ray Payload**, Trevor Butcher, (Junior, Electrical Engineering, Embry-Riddle Aeronautical University), Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **EagleSat 2: Memory Bit-Flip Experiment Overview and Development**, Brennan Gray, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University), Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **Preliminary Design of a Cube Satellite Compliant Hall Thruster**, Alexis Hepburn, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University), Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **Reducing the Cost of Uncertainty Quantification at Hypersonic Speeds**, Forrest Mobley, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University), Shigeo Hayashibara, College of Engineering, Embry-Riddle Aeronautical University.

[H-In Title Only] **Dynamic Calibration in a Shock Tube: Boundary Layer Stability and Transition (BLST) Laboratory**, Dashiel Pudwill, (Junior, Aerospace Engineering, University of Arizona), Stuart Craig, Aerospace and Mechanical Engineering, University of Arizona.

[H-In Title Only] **Development of an Improved Motion Mechanism to Investigate Laminar Separation Bubbles Subjected to Unsteady Plunging Motion**, Paxton Tomooka, (Junior, Aerospace Engineering, University of Arizona), Jesse Little, Aerospace and Mechanical Engineering, University of Arizona.

2019-20 Arizona/NASA Space Grant
Undergraduate Research Intern & ASCEND Team Abstracts

Abraham, Rachel (Senior, Neuroscience), Mentor: Daniel Stolte, University Communications, University of Arizona. [E-1]

SCIENCE COMMUNICATION: OUT OF THE SILOS AND INTO THE MEDIA

Science communication is a vital, yet often overlooked aspect of the scientific process. When science is properly communicated, the spread of misinformation can be fought, researchers can gain future collaborators and funding, and everyday people can develop a better understanding of the world around them. Now, more than ever, scientists seem to work in silos separated from both the general population and other areas of science. The challenge we now face is bridging the gaps between these very different groups, with greatly varied backgrounds. One way this happens is through the production of news releases by universities geared towards larger news media. This project focused on the exploration of science communication through these news releases. They covered a variety of science-related topics and their production involved research, interviews, writing, and editing. Some pieces successfully garnered media attention, resulting in various features from prominent outlets.

Aldava, Felicity (Junior, Computer Science), Mentor: Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona. [H-1]

DESIGN AND MOBILITY EVOLUTION FOR THE EXPLORATION OF ASTEROIDS USING A SPACECRAFT ON STILTS

There are 2 million asteroids in the solar system that vary in shape, size, composition, and origin. These small bodies can provide critical insight into the origins of the solar system. Sampling the surface and subsurface of these bodies is one of the best ways possible to attain this insight. Current missions can only perform touch and go and have only been able to collect a few samples from a small body. The SPIKE (Spacecraft Penetrator for Increasing Knowledge of NEOs) craft is a unique spacecraft that is a hybrid lander and flyby spacecraft with one or more booms to hop to places on an asteroid. This study aims to use Evolutionary Algorithms to optimize the number of booms to facilitate 'walking' over the asteroid surface. The resulting designs can consist of multiple booms to help understand mobility in low-gravity conditions and provide new pathways for exploration beyond touch and go.

Almusawi, Reman (Senior, Civil Engineering), Mentor: Eric Betterton, Hydrology and Atmospheric Sciences, University of Arizona. [E-2]

AIRBORNE LEAD AND ARSENIC IN HAYDEN, AZ

Activities associated with mining operations including smelting, ore handling, and mine tailings management have been identified as sources of dust and aerosols which may be contaminated with lead and arsenic. The purpose of this study is to: a) quantify the concentration of lead in settled dust using inverted disk samplers in outdoor and indoor environments; b) evaluate the air handler exchange rate of an indoor environment using a CO2 monitor, and c) identify the potential health risk of airborne particles from mining operations. Previous work at the Hayden-Winkelman smelter site has shown relatively high levels of lead. Sampling was conducted at the Hayden High School, which is located two kilometers east of the mine tailings impoundment and one-kilometer south-east of the active copper smelter. The results will highlight the need to consider the concentration of lead in dust settlement for human exposure and potential health effects.

Anderson, Michaela (Sophomore, Strategic Communication), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look

at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

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

MAPPING SOLUTE CONCENTRATIONS IN OUTFLOW CHANNELS

Yellowstone National Park is home to some of the most extreme geochemical conditions exhibited at the surface of the Earth. A multitude of processes occurring beneath the surface contributes to the overall states of hot springs, which become enriched with chemically active solutes. In some hot spring systems, the fluid can escape the source, creating outflow channels. Water flowing out of hot springs cools, reacts with the air, and can mix with existing surface water. Geochemical data from outflow channels are used in this study to understand the effects that water evaporation has on the concentrations of solutes. Targeting conservative solutes, those that are unaffected by chemical reactions such as chloride, allows the effects of evaporation to be quantified from increasing concentrations with decreasing temperatures. Less conservative solute species are then identified because they exhibit different behavior. In some cases, like sulfide, large concentration changes suggest biological activity.

Baller, Alyssa (Junior, Optical Sciences and Engineering), Mentor: Tisha Saltzman, Steward Observatory, University of Arizona. [H-2]

GALACTIC/EXTRAGALACTIC ULDB SPECTROSCOPIC TERAHERTZ OBSERVATORY (GUSTO)

Specialized cleanrooms are used to protect and ensure the safety of flight hardware such as telescope optics, cryostats, and lasers. Inside the cleanroom, the GUSTO team will integrate flight electronics, optics and mechanical support elements into a 150-liter liquid helium cryostat. My area of responsibility focused on setting up and monitoring components of the cleanroom such as air particle counts, humidity, temperature, and safety of electrostatic discharge (ESD) while handling hardware. To ensure that personal contaminates are not introduced to the instruments, precautions are taken. All personnel working in the cleanroom must adhere to requirements of gowning procedures that include the wearing of smocks, hairnets, face masks, ESD shoes, and ESD wrist straps. With the required procedures, proper set-up of the cleanroom, and continuous monitoring of the lab environment, there is greater assurance of mission success due to the reduction of risks associated with payload integration.

Bandelier, Zeke (Senior, Chemistry), Mentor: Jennifer Hanley, Astronomy, Lowell Observatory. [D-2]

HYDRATED SALTS ON MARS

Hydrated chlorine salts play an important role in the stability of water on Mars. Hydrated chlorine salts can depress the freezing point of water to possible Martian temperatures allowing liquid water to exist on Mars. Hydrated minerals have already been detected but distinguishing chlorine salts from other minerals such as sulfates is necessary due to the large change in water stability. The purpose of this work was to detect chlorine salts on the surface of Mars and to test detection capabilities around lander sites. The main instrument used was CRISM, a near infrared spectrometer orbiting Mars. The data analyzed were IR-reflectance spectra from 1.0-2.5 μm. Two new parameters, BD2130 and BD2220, were used in detection of chlorine salts. Chlorine salts were not detected at the Phoenix lander site and surrounding areas. However, water was unexpectedly detected during summer months when water ice is absent from the surface.

Barkley, Daniel (Senior, Electrical and Electronics Engineering), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Bell, Quynn (Sophomore, General Studies), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-1]

PCC ASCEND Project HEXi

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, pressure, light, and radiation. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae.

Beraud Calderon, Edwin (Senior, Mechanical Engineering), Mentor: Amirhossein Arzani, Mechanical Engineering, Northern Arizona University. [G-1]

Correlating Wall Shear Stress to Heat Distribution in a Pipe Under Unsteady Fluid Flow

Heat transfer using fluids has a wide range of applications in industry. The present study is based on the hypothesis that wall shear stress (WSS) computed on a wall surface could be used to predict surface temperature distribution in complex geometries. We performed computational fluid dynamics simulations using the ANSYS Fluent software to simulate pulsatile water flow in uniformly heated helical tubes. Furthermore, ANSYS computed velocity, temperature, and WSS in space and time. Subsequently, the open-source ParaView software was used for advanced visualization and processing of the results. The surface line integral convolution technique was used to visualize WSS streamlines. We demonstrated that regions of high surface temperature coincided with converging WSS vectors. This study shows that WSS vector fields could be used to predict surface temperature distribution in laminar internal flows.

Blanchard, Nick (Sophomore, Electrical and Computer Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

Boland, Meghann (Sophomore, Mechanical Engineering), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

PHOENIX COLLEGE ASCEND: VIDEO STABILIZATION

Video from the payload in previous projects have been difficult to view due to the camera spinning with the payload. In an attempt to improve the video quality, video stabilization was implemented using an Arduino Nano and an MPU6050, a sensor that includes a 3-axis Accelerometer and a 3-axis Gyroscope. Using the readings from the Z-Axis, the Nano stores the data collected. The data is then used to calculate the speed of rotation needed to be implemented by the Servo to counteract the spin of the payload. This allows for a smoother video to be recorded on the ascent of the payload. In the future other sensors and programs will be tested to find the best video quality possible.

Borsenik, Andrea (Sophomore, Biological Sciences), Mentor: Xiaojun Tian, School of Biological and Health Systems Engineering, Arizona State University. [G-In Title Only]

SEROTONIN-MEDIATED LIVER REGENERATION

Current treatment for liver cirrhosis is restricted to treating the symptoms of the disease. However, there is a large body of research pertaining to serotonin-mediated liver regeneration as a treatment for the root cause of liver cancer and cirrhosis. A meta-analysis of the literature on the current research was conducted to build a model of the biological mechanisms behind serotonin-mediated liver regeneration. A schematic model was made highlighting the key factors, including serotonin, that play a role in liver regeneration. The goal of this research is to create a mathematical model of how serotonin plays into liver regeneration and cancer to demonstrate the therapeutic threshold of serotonin. Ultimately, the hope is the model can be verified in a laboratory setting and then generalized for clinical use.

Brown, Shaun (Junior, Biomedical Engineering, Electrical and Computer Engineering), Mentor: Wolfgang Fink, Biomedical Engineering, and Electrical and Computer Engineering, University of Arizona. [H-In Title Only]

CREW MEMBER VITAL SIGNS AS INDICATORS OF ENVIRONMENTAL CHANGES ABOARD SPACE HABITATS

Changes in crew member vital signs can be assessed via noninvasive techniques, such as electrocardiogram (ECG) readings, blood oxygenation measurements, ocular structure observation, and visual performance assessment. The crewmembers act as biosensors that, when integrated into other subsystems, help monitor space habitat health as a function of their own. The availability and compactness of ECG, blood oxygenation, ocular structure, and vision performance monitoring equipment lend themselves to be ideal in environments where self-diagnostics and payload considerations are vital to mission success. We have compiled a list of findings describing how different environmental conditions aboard space habitats quantify the health of the habitat environment. The findings of our study may lay the foundation for subsequent deep learning-based, anomaly detection frameworks that may help determine more accurately cross-correlations between different environmental factors aboard space habitats and corresponding vital sign changes of crew members.

Bustamante Torres, Cecilyn (Junior, Astronomy), Mentor: Lon Hood, Lunar and Planetary Laboratory, University of Arizona. [D-In Title Only]

MAPPING OF CRUSTAL MAGNETIC FIELDS ON THE MOON

Mapping of Crustal Magnetic Fields on the MoonCecilyn Bustamante Torres, Dr. Lon Hood Orbital magnetometer data from two missions (the NASA Lunar Prospector mission and the Japanese Kaguya mission) were used to map magnetic anomalies on the Moon. These magnetic field anomalies are produced by magnetized material in the lunar crust. It is known that the Moon had a dynamo magnetic field, but it is not certain what the magnetized material consists of. The orbital magnetometer data were used to create maps, which will allow better modeling and interpretation of the magnetic anomalies. Correlations with surface geology will help to distinguish between sources such as impact ejecta containing iron from the impactors that created large craters on the Moon. Modeling can determine directions of magnetization, which indicate the orientation of the dynamo magnetic field when the

magnetized material was first formed. The location of the magnetic pole at the time it was formed can be estimated if the magnetizing field was generated in the Moon's iron core.

Butcher, Trevor (Junior, Electrical Engineering), Mentor: Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

ERAU EAGLESAT 2, COSMIC RAY PAYLOAD

The Cosmic Ray Payload (CRP) is one of the scientific experiments flying on the EagleSat 2 3-Unit CubeSat. The CRP shall measure incident direction and energy magnitude of high-energy cosmic ray particles and atomic nuclei during the end of the 2020 solar minimum. It can also detect high-energy gamma and X-ray particle events. These characteristics are measured using an array of off-the-shelf CMOS imaging detectors, with a platinum energy absorber between array layers. The goal of this experiment is to create a celestial map of extrasolar cosmic ray sources, along with the approximate energy of particles coming from those sources. This payload is nearing completion, with ground-based alpha and beta particle testing being done on the sensors and detection algorithm. Full system integration testing and bus system integration still needs to be completed, along with circuit board manufacturing.

Chamberlin, Kathryn (Senior, Electrical Engineering), Mentor: Steven Desch, School of Earth and Space Exploration, Arizona State University. [C-1]

ARCTIC ICE MANAGEMENT

Arctic ice is melting faster in the summer months than it can replenish during the winter months, leading to an annual decrease in the amount of Arctic sea ice. The decrease in Arctic ice is contributing to global climate change in the forms of: increase in sea levels, decreasing sea water salinity, increase of carbon dioxide release in the atmosphere, and decreasing the Earth's albedo. Arctic Ice Management (AIM) is proposing a way to counter the reduction in Arctic ice by pumping sea water from below the ice onto the surface of the ice. The theory is that pumping nearly freezing sea water onto the ice will promote the growth of ice during the winter months. AIM is testing this theory with an experiment in a walk-in freezer and fridge and pumping salt water onto a base layer of ice to determine the optimal parameters that encourage ice growth.

Chandler, Dylan (Junior, Environmental Science), Mentor: Rebecca Best, School of Earth and Space Exploration, Northern Arizona University. [C-2]

USING EDNA TO ASSESS INVERTEBRATE BIODIVERSITY ACROSS A TEMPERATURE GRADIENT

A potential way to monitor biodiversity in aquatic ecosystems is through the analysis of environmental DNA (eDNA). Because DNA degradation is known to increase with temperature, this study aims to assess how temperature affects the accuracy of this method by looking at invertebrate taxonomic richness of stock ponds in northern Arizona across an elevation gradient as a proxy for temperature. Samples from eight ponds were collected and eDNA sequenced using the mitochondrial COI marker to identify the invertebrates in each community. This data will be compared to taxonomic richness data collected from the same ponds but through a traditional surveying method in which invertebrates were collected and identified in the lab. The patterns of taxonomic richness between the two methods will be compared in order to determine if eDNA analysis can be used as a tool for monitoring biodiversity across a temperature gradient as climates change continues to alter environments.

Cleveland, Estevan (Junior, Biochemistry), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-1]

PCC ASCEND PROJECT HEXI

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the

effects of altitude, pressure, light, and radiation. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae.

Cooper, Genevieve (Sophomore, Computer Science), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

GLENDALE COMMUNITY COLLEGE FALL 2019 PAYLOAD

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

Courtney, Cara (Senior, Mechanical Engineering), Mentor: Amanda Clarke, School of Earth and Space Exploration, Arizona State University. [D-3]

MODELLING THE EFFECTS OF THE FLOW CONDITIONS AND RHEOLOGY ON LAVA FLOWS WITH POLYETHYLENE GLYCOL

This project consists of pumping polyethylene glycol into cold water to simulate lava flows. We will compare these flows to physics-based models where the Newtonian Viscosity, Yield Strength of the Core (YSC), or Yield Strength of the Crust (YS) of the flow are the primary retarding factor of flow propagation. We can predict which model best captures the movement of the flow based on the flow's known Ψ value; the ratio of the characteristic timescale of thermal flux from the vent and of crust formation due to surface cooling. We hypothesize that high Ψ flows (high flux, little crust formation) will correlate best with Newtonian models, and low Ψ flows (low flux, extensive crust formation) will correlate best with YSC models. Comparisons between experiments and models support our original hypotheses regarding low Ψ flows. However, propagation of high Ψ flows is not perfectly captured by Newtonian models.

Cullipher, Michaela (Senior, Biology), Mentor: Catherine Propper, Biology, Northern Arizona University. [F-1]

PERCHLORATE IN TORTOISES AND ON MARS

Perchlorate is a toxic chemical compound found in explosions and rocket fuel. Perchlorate is also known to inhibit thyroid growth by deterring iodine uptake. The soil on Mars contains high levels of perchlorate, making it a hazard for life on Mars. Desert tortoises living on military bases are thought to be exposed to perchlorate through explosions. This experiment looks at the thyroid levels of tortoises through comparisons of carapace length and weight, fecal hormone levels and perchlorate found in soil near habitats. By studying thyroid levels in desert tortoises on military bases, we hope to make connections between the environment on Mars and the conditions on military bases.

Davis, Bethany (Senior, Forensic Biology), Mentor: Hillary Eaton, Department of Biology and Chemistry, Embry-Riddle Aeronautical University. [C-In Title Only]

METABARCODING ACROSS THE DESERT SOUTHWEST: USING ENVIRONMENTAL DNA TO TRACK FISH AND WILDLIFE USE OF AQUATIC ECOSYSTEMS

Environmental DNA (eDNA) analysis is growing rapidly in the field of wildlife and fisheries biology. Over the past year we have developed a 16S rRNA vertebrate metabarcoding protocol to detect species in a variety of aquatic systems across Northern Arizona. Water samples are collected, vacuum filtered, and transported to the laboratory where the eDNA is extracted, the target gene amplified and sequenced using an Illumina MiSeq FGx Forensic

Genomics System. To date, we have detected a total of 93 vertebrates across all systems studied including both aquatic species and facultative users of riparian areas. A number of factors can influence the feasibility of this method including the water quality and movement, and invertebrate populations that may compete with the 16S primers used, but these studies demonstrate the utility of eDNA metabarcoding as a tool for ecological monitoring in aquatic ecosystems.

Dickinson, Danielle (Junior, Astronomy and Physics), Mentor: Nathan Smith, Astronomy, University of Arizona. [F-2]

SPECTROSCOPY OF THE SUPERLUMINOUS SUPERNOVA ASASSN 15UA

We present a series of ground-based spectroscopy of the superluminous Type IIn supernova (SN) ASASSN 15ua, which shows evidence for strong interaction between a blast wave and pre-existing circumstellar material (CSM). This supernova radiated 4.3 x 1050 erg for 540 days after eruption. These observations constrain the velocity and mass-loss rate of the progenitor wind as well as the evolution of the SN shock velocity with time through the dense CSM; in the 13 years before explosion, the mass loss rate was 1 Solar Mass per year. As in several previous SNe IIn, the intermediate-width H-alpha emission became strongly blueshifted, suggesting an asymmetric CSM, an asymmetric explosion, or extinction from dust within the CSM shell. We use these observations to constrain the immediate pre-SN evolution of the progenitor and place ASASSN 15ua in context with the observed diversity of SNe IIn and superluminous SNe IIn.

Driskill, Madison (Senior, Chemical Engineering), Mentor: Anthony Muscat, Chemical and Environmental Engineering, University of Arizona. [A-In Title Only]

NANOFABRICATION USING SELF-ASSEMBLED MONOLAYERS

Organosilane monolayers are part of process flows in nanoelectronics and biotechnology because of their versatility. Monolayers that inhibit reactions on silicon/silicon oxide surfaces are needed to create patterns that direct the deposition of molecules. On silicon oxide, they are typically deposited from the liquid phase by deposition and cleaning cycles. Adding a short immersion in an aqueous oxidizing base such as Standard Clean 1, which is a particle removal method in semiconductor manufacturing, reduced the time from 48 to 2 h to deposit an inhibiting monolayer. A line pattern in the organosilane monolayer made by conductive atomic force microscopy was used to direct titanium tetrachloride and water to deposit titanium dioxide by atomic layer deposition with a selectivity greater than 0.999. The titanium dioxide lines were about 170 nm wide, 9 nm high, and 20 μm long. The monolayer deposition could be used to make versatile structures for nanodevice fabrication.

Dromiack, Hannah (Senior, Physics), Mentor: Sara Walker, School of Earth and Space Exploration, Arizona State University. [A-1]

CONTROLLING CELLULAR AUTOMATA

Cellular Automata (CA) are abstract models of discrete state systems with nearest-neighbor interactions. Patterns producible by CA have been observed in nature, and some CA rules are computationally universal making them useful conceptual vehicles for studying pattern formation and complexity. CA combined with the use of chemical computers have opened up greater avenues into studying complex systems and pattern formation. The goal of this project is to develop a program to take in an initial CA state and determine the path to end state for it. In future work this program will be implemented with the Belousov-Zhanotinsky chemical computer at the University of Glasgow. The program developed is designed to be incorporated with an existing python package NEET developed by Sara Walker's E-Life Group. This increased amount of control over these computational machines opens new avenues into understanding complex systems and pattern formation occurring in nature.

Dsouza, Gerard (Sophomore, Computer Systems Engineering), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Duarte Nevarez, Janet (Junior, Aerospace Engineering), Mentor: Paul Scowen, School of Earth and Space Exploration, Arizona State University. [H-3]

EXPLORATION THROUGH INNOVATION

CUTLASS is an underwater platform with the intent to support long duration site survey missions. As the lead mechanical engineer for CUTLASS, I have been working on creating the subsystems for structures, propulsion, power management and distribution. I have also been working on creating different platform designs, which will then be used in a fluid simulation to try and figure out drag profiles. Another project I have been working on is SWARMS. SWARMS is a self-assembling group of CubeSats that will form a space-based THz observatory to do Earth-observing science to map the structure and content of the Earth's atmosphere. I have created a design for SWARMS that will allow us to place a compact millimeter-wave instrument on top of the 6U CubeSat within its allowable dimensions.

Duncan, Ethan (Junior, Astrophysics and Physics), Mentor: Maitrayee Bose, School of Earth and Space Exploration, Arizona State University. [F-3]

PRESOLAR GRAIN ISOLATION: A NOVEL DEVELOPMENT USING FOCUSED ION BEAM (FIB)

Presolar grains are small particles that condense in the vicinity of dying stars and, after a journey through the interstellar medium, are incorporated into meteorite parent bodies at the formation of our Solar System. Through isotopic analysis, presolar grains can tell us a great deal about the astrophysical processes contributing to formation of our Solar System. We want to develop a technique to isolate presolar grains in meteorites using focused ion beam (FIB) milling so that the petrographic context of the grains are preserved and future NanoSIMS measurements become easy. Here, we present results from FIB investigations of meteoritic grains found in the Acfer 094 meteorite, as analogs for stardust presolar grains. We proved that this technique cannot be applied for small presolar grains (~90-300 nm) using the current FIB instrument at the LeRoy Center.

Eladawy, Ahmad (Sophomore, Aerospace Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

ANALYZING THE VIABILITY REGOLITH RADIATION SHIELDING AND ASSESSING A NEAR-SPACE ENVIRONMENT WITH A GENERAL DATA LOGGER

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

Esquivel, Maximo (Sophomore, Engineering), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-In Title Only]

PCC ASCEND Project HEXI

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, pressure, light, and radiation. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae.

Estes, Bailey (Senior, Geology), Mentor: Nancy Riggs, Geology, Northern Arizona University. [C-In Title Only]

Determining Gravel Provenance in Altiplano, Chile

The Altiplano region in Chile has experienced tectonic uplift on a scale unparalleled in comparison with other convergent margins. This tectonic uplift and erosion have produced gravel beds that are interbedded with ash-flow tuffs from the modern Andean arc to the east. The gravels were deposited in low-lying areas between this arc and an older, Cretaceous arc to the west. Clasts in gravels were examined to determine erosional patterns of the Andean arc and uplift of the Altiplano region. Clasts are divided into two categories, igneous and sedimentary. The igneous clasts are more common than the sedimentary clasts.The presence of andesite in the common clast suggest that the gravels originated from the Cretaceous arc and not the modern arc. Within the modern arc samples, andesite is very rare. One possible explanation for the absence of the ash-flow tuff is that the Altiplano region was flat and uplift had not started at the time of erosion.

Fell, Maxwell (Junior, Mechanical Engineering), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

Glendale Community College Fall 2019 Payload

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

Figueroa, Gerardo (Junior, Biomedical Engineering), Mentor: John Szivek, Orthopaedic Surgery, University of Arizona. [G-2]

Rapid bonding multi-sensor development for bone monitoring in space

Bone strain is a key regulator of maintaining bone mass and bone healing. In particular, gravity changes bone strains and results in altered bone metabolism and remodeling. In order to better understand the relationship between bone strain and microgravity we need a better method to obtain direct in vivo measurements. Previous studies show that calcium phosphate ceramic (CPC) coatings can be used to obtain biologic bone bonding to implanted strain gauges, which can take 3 weeks in a rat. This study used cyanoacrylate adhesive and CPC coatings to determine whether the adhesive interfered with bone bonding to the CPC coating in a rat. Results show that the glued gauge measured peak femoral strains of 404 microstrain for the cyanoacrylate bonded gauge and 302 microstrain for the CPC gauge after implantation. We are currently continuing in vivo measurement collection and ex vivo analysis to evaluate bone bonding to the CPC particles.

Fike, Thomas (Sophomore, Electrical Engineering), Mentor: Douglas Isenberg, Mechanical Engineering, Embry-Riddle Aeronautical University. [B-In Title Only]

ERAU ASCEND: Project Overview and Software

Our payload was designed to study heat transfer into and out of a high altitude balloon gondola. This was accomplished using 32 calibrated thermistors distributed across the interior and exterior of the gondola. Data from the thermistors was used to build a complete model of heat transfer for future experiments. The payload also included a heating element to keep the electronics warm at high altitudes as well as a 3rd-party latex cutting experiment. Development of this payload included the design of printed circuit boards (PCBs), development of flight software, and study of systems engineering. The primary functions of the payload were handled via a BeagleBone Green microcontroller paired with a custom PCB cape to handle power management and sensor input. Flight software was developed using Python. The software was designed to be robust against the possibility of losing data due to unexpected reboots of the microcontroller during the flight.

Filler, Sydney (Junior, Mathematics and Economics), Mentor: Kathy Gerst, National Phenology Network, University of Arizona. [C-In Title Only]

Using Machine Learning Models to Predict Pollen Release

Forecasting pollen release from allergenic plant species is a critical societal and scientific need, with implications for public health and ecology. Data on pollen phenology has historically been extremely limited, but the National Phenology Network (USA-NPN) has collected millions of observations that track seasonal activity across the country on hundreds of plant species for over a decade. For this project, I evaluate the feasibility of generating predictions using plant reproductive phenology data from the National Phenology Database. I developed a machine learning model to predict the onset and peak pollen release of red maple as a case study that could be expanded to additional species to generate continental scale models of pollen production. These results will allow us to better understand the climate drivers behind pollen release and provide a framework for developing future predictive models.

Flores, Martin (Senior, Physics), Mentor: Sanchayeeta Borthakur, School of Earth and Space Exploration, Arizona State University. [F-In Title Only]

Understanding the Circumgalactic Medium in Dwarf Galaxies

As intergalactic gas undergoes accretion, it flows through the circumgalactic medium (CGM) and into the interstellar medium (ISM). The influence that the CGM has on galaxy evolution is still not fully understood. Previous studies on L* galaxies provide evidence that CGM gas accretion leads to the creation of HI disks. A similar study has not yet been conducted to show if these results hold for lower mass galaxies, which are more abundant. Using 21 cm HI data from the Green Bank Telescope, we explore the relationship between the ISM and the CGM in dwarf galaxies by comparing it to Lyman-alpha (Lyα) measurements from the Hubble Space Telescope program, COS-Dwarfs. We find that galaxies show a very good Lyα covering fraction in the inner CGM. We didn't find a correlation between the Lyα strength in the CGM and HI content in the ISM of galaxies, which was seen for larger galaxies.

Fulford, Ruby (Sophomore, Astronomy), Mentor: Kamber Schwarz, Lunar and Planetary Laboratory, University of Arizona. [F-4]

The Search for Volatile Carbon Transport in Protoplanetary Disks

Understanding protoplanetary disk composition is essential to understanding planetary composition and formation. Many protoplanetary disks are depleted in CO compared to the interstellar medium from which they form. A possible explanation of this phenomena is that CO gas condenses onto grains as CO2 ice in the cold outer disk, and as these grains move into the hotter inner disk via radial drift, the CO2 ice sublimates into gas. In order to test this theory, this project attempted to identify whether there exists an inverse trend between CO2 and CO abundances in several disks. Using Atacama Large Millimeter/Submillimeter Array observations, we created 13CO and C18O

images of several disks and plotted their CO fluxes against infrared CO2 fluxes from pre-existing literature. Preliminary results do not display a significant trend, but a trend (or a more decisive lack thereof) may emerge with further imaging and analysis.

Fulton, Aerin (Sophomore, Business), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Galloway-Sprietsma, Maria (Junior, Physics and Astronomy), Mentor: Yancy Shirley, Astronomy, University of Arizona. [F-5]

STUDY OF O-NH2D IN CEPHEUS STAR FORMING REGION L1251

Understanding the chemical processes during starless core and prestellar core evolution is an important step in understanding the initial stages of star and disk formation. This project is a study of deuterated ammonia, o-NH2D, in the nearby (300 pc) star-forming region Cepheus L1251. Twenty-two dense cores identified by the Herschel Space Observatory were observed with the 12m ARO telescope on Kitt Peak. Mapping of a part of the region was also recently done with the 12m Telescope. Comparisons of physical parameters such as mass, radii, average volume density, peak H2 column density, and virial parameter show evidence of separation between sources with o-NH2D detection and those without o-NH2D detection. Our results also demonstrate differences between the physical properties of optically thin and optically thick sources. These results indicate that the deuteration of ammonia provides an additional evolutionary indicator during the starless and prestellar core phases.

Galus, Christopher (Senior, Mechanical Engineering), Mentor: Mark Hawthorne, Material Science, ATC Materials. [G-3]

NANOSCALE ANALYSIS OF SILICON NITRIDE CERAMICS USING MOLECULAR DYNAMICS

Silicon Nitride is a versatile ceramic material with desirable thermal, mechanical, and dielectric properties that are currently being exploited in several space and in hypersonic applications. Molecular Dynamic (MD) simulations offer a cost effective and accurate way to predict how this material will react in different extreme environments. To further understand and be able to implement this material, the aim of this project was to build a MD simulation that accurately models the phase change process of Silicon Nitride between alpha and beta solid phases. This study of Silicon Nitride ceramics was done at ATC materials on a linux computer cluster utilizing the MD software LAMMPS developed by Sandia Laboratories. Applying the findings from these MD simulations could result in beta phase with additional resistance to thermal and mechanical shock. Using MD, the cost and risk of testing Silicon Nitride for space exploration and vehicle performance is greatly reduced.

Gammon, Cedric (Sophomore, Environmental Science), Mentor: Nancy Johnson, School of Earth and Sustainability, Northern Arizona University. [C-3]

DOES FOREST MANAGEMENT ALTER THE EFFECTS OF SOIL FAUNA ON FUNGAL COMMUNITIES AND NITROGEN AVAILABILITY?

With the increase in severe fire events as a result of climate change, land managers have employed prescribed thinning and burning in forest ecosystems. How these management activities affect soil health is virtually unknown.

Burning reduces soil organic matter and alters soil nutrient availability. Consequently, thinned and burned sites potentially have lower abundance of soil animals compared to untreated forest sites. I asked whether thinning and burning alter the influence of soil fauna on nitrogen availability and decomposition rates. We manipulated the soil faunal complexity in thinned and burned sites at Valles Caldera National Preserve in New Mexico to answer this question. Data indicated that the thinned and burned sites experienced significantly less decomposition and lower levels of nitrogen compared to control sites. As climate change increases in its severity, soils must be further studied in order to truly understand what damages are taking place.

Ganser, Collin (Senior, Astrobiology and Biogeosciences), Mentor: Shelley Haydel, School of Life Sciences, Arizona State University. [G-4]

INVESTIGATING GEOPOLYMER-MEDIATED ADSORPTION OF MRSA CELLS AND SECRETED PROTEINS

The rise in community-associated methicillin-resistant Staphylococcus aureus (MRSA) infections and the ability of MRSA to develop resistance to antibiotics necessitate new treatment methods. In this study, porous materials with adsorptive capabilities, geopolymers (GPs) were investigated for their ability to adsorb MRSA cells and secreted proteins [culture filtrate proteins (CFPs)] as a complementary method of MRSA treatment. Four GPs (SA-macroGP, macroGP, SA-mesoGP, and mesoGP) were incubated with cells and with CFPs to quantify GP adsorption capabilities. Following MRSA incubation with GPs, unbound cells were filtered and plated to determine cell counts. Following CFP incubation with GPs, unbound CFPs were separated via SDS-PAGE, stained, and analyzed using densitometry. Results indicate that macroGP was the most effective at adsorbing MRSA cells. Densitometry quantitation indicated that SA-mesoGP was the most effective at adsorbing CFP. Ultimately, GP-based products may be further developed as nonselective or selective adsorbents and integrated into fibrous materials for topical applications.

Garcia, Eduardo (Sophomore, Electrical Engineering), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Garcia, Francisco (Junior, Mechanical Engineering), Mentor: Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona. [G-In Title Only]

MICRO-PENETROMETER FOR MEASURING FORCES ON LOW-GRAVITY ENVIRONMENTS

Long term planetary and asteroid surface exploration would benefit from instruments capable of determining surface hardness and cohesion. The next step in long term planetary and asteroid surface exploration requires new instrumentation capable of measuring forces. Presently, penetrometers are not capable of measuring forces obtainable on asteroids. A penetrometer capable of measuring low forces could provide insight into subsoil strata. This experiment provides insight as to the best method for measuring small forces. Various deformable materials are subjected to forces in order to determine the greatest deformation. Currently, compression tests are in progress to determine which deformable material yields the best force response. Further experiments would yield a time-varying force response. Analysis of this response could determine the hardness and cohesion of the surface.

Gebremariam, Misgana (Junior, Computer Science), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

The Phoenix College payload's external housing was made from a strong lightweight carbon fiber material. This material was made of a bondo cardboard molding process rather than a vacuum seal model because it was more cost-efficient. During this process, we noticed that the result was just as good as a vacuum model. Our supplies came from a local business called "Sticky and Stuff", and according to the recommendation from the staff, we use a 2:1 ratio of epoxy and harder, allowing a 24hr cure time. For the internal housing of the structure, we decided to go with a more cubical approach allowing enough room in the center for wire space and the video stabilizing system, with a basal wood coated in epoxy as our mounting board. However, we updated this internal system to a shelving system that we 3D printed with ABS which allowed us to reduce our payload weight and empty space that we don't need.

Gentile, Joseph (Sophomore, Aeronautical Engineering), Mentor: Wahyu Lestari, Aerospace Engineering, Embry-Riddle Aeronautical University. [G-In Title Only]

EXPERIMENTAL STUDY ON COMPRESSION AND SHEAR STRENGTH OF CFRP AFTER IMPACT

The increasing use of carbon fiber-reinforced polymer (CFRP) in the aerospace industry requires a better understanding of its damage properties. Many modern aircraft are utilizing this material for their primary structures due to its high strength to weight ratio. However, CFRPs are sensitive to out-of-plane loading such as low-velocity impact and indentation. These damages can reduce the compressive strength significantly without leaving a visible mark on the surface, which is known as Barely Visible Impact Damage (BVID). The behavior and residual strength of CFRPs after impact damage under compressive loading are still not fully understood. The purpose of this research is to use Digital Image Correlation (DIC) to study the failure mechanism and better understand the shear properties of CFRP after impact. The strain values from the DIC method will be validated by conventional measurement using strain gauges. The DIC will capture damage propagation and local behavior of the material under compressive and shear loading. Based on the test results, damage sequence and damage mechanism of CFRPs will be analyzed.

Ghaby, Kyle (Senior, Chemistry and Biomedical Science), Mentor: Gerrick Lindberg, Chemistry and Biochemistry, Northern Arizona University. [G-5]

SURVIVING SPACE TRAVEL: SOLVENT-MEDIATED PRESERVATION OF DIABETES MEDICINE

Insulin is the biomolecule predominantly responsible for treating diabetes mellitus. Yet, current insulin formulae cannot sufficiently withstand temperatures outside of a refrigerator. Developing temperature-resistant storage would therefore dramatically improve the lives of people who face boundaries to refrigeration. The century-long challenge of developing universal insulin storage is crippled by an innate tendency to aggregate. In our attempt to prevent aggregation, we applied a class of salts that remain liquid at room temperature in which insulin was dissolved. Since aggregation is coupled with structural deviations, secondary structure and intramolecular distances of insulin were predicted in variable solvent and temperature with atomistic physics-based simulations. Solvents were chosen based on structural influence and environmental resistance. Temperatures were chosen to reflect likely situations of an applied formula that also span the relevant temperature scale. This work, while medicinally applicative to those on Earth, also has implications for molecular storage during long-term space travel.

Gialluca, Megan (Junior, Astronomy and Physics), Mentor: Tyler Robinson, Astronomy and Planetary Science, Northern Arizona University. [D-4]

INVESTIGATING THE CAPABILITIES OF THE JWST TO CATEGORIZE EARTH-LIKE PLANETS ORBITING COOL MAIN SEQUENCE STARS

With the NASA James Webb Space Telescope (JWST) set to launch soon, we aim to assess the capabilities of the JWST in detecting atmospheric features from Earth-like exoplanets transiting cool stellar hosts. We first modeled spectra of planets in the habitable zones of seven catalogued red dwarf stars, including the ultracool dwarf TRAPPIST-1, using the Spectral Mapping Atmospheric Radiative Transfer (SMART) model. These spectra served as input to two JWST observation simulation models: the preexisting Pandexo transiting exoplanet observation

simulation tool, and a new JWST observation simulation tool created by the researchers. By passing the spectra to these models, we simulated realistic JWST observations. The comparison of Pandexo's results to those from our model will help to assess the importance of assumptions made by both tools. Finally, we use our results to discuss JWST's predicted performance, emphasizing the number of observed transits needed to characterize Earth-like planets orbiting cool stars.

Gramze, Savannah (Junior, Astronomy), Mentor: Mihailo Martinovic, Lunar and Planetary Laboratory, University of Arizona. [F-In Title Only]

MODELING QUASI-THERMAL NOISE IN THE SOLAR WIND

Coronal Mass Ejections are clouds of highly magnetized energetic matter released after a Solar Flare and are accompanied by Interplanetary Shocks. The WIND spacecraft measures quasi-thermal noise (QTN) spectra around the electron plasma frequency in the solar wind, but there are difficulties in using radio measurements to produce plasma parameters. The purpose is to fit the spectra of these measurements to determine the properties of the electron plasma. The measured QTN spectra are fit with a combination of two Maxwellian distributions for the core and halo components. The results were that the majority of the spectra were fit correctly, and reliable plasma parameters were found, but there were certain features in the spectra which surpassed the QTN signal. We will proceed by looking for the physical mechanisms which would explain these features in the data.

Gray, Brennan (Senior, Aerospace Engineering), Mentor: Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

EAGLESAT 2: MEMORY BIT-FLIP EXPERIMENT OVERVIEW AND DEVELOPMENT

EagleSat 2 is a 3-U CubeSat that will launch as part of NASA's CubeSat Launch Initiative. EagleSat 2 will carry two scientific payloads, one of which is a memory bit-flip experiment. This experiment seeks to quantify the relative error rates of five different types of commercial memory when exposed to the LEO radiation environment. Major changes to the control architecture of EagleSat 2 and thus the experiment have occurred since the last presentation on this experiment. In the past year, the experiment has moved from using a microcontroller independent of the On-Board Computer (OBC) to a FPGA implemented on the same component as the OBC. While this change results in significant extra labor for the team, the risk associated with the new architecture is significantly lower. Major implementation work remains for the experiment, as well as testing of final flight hardware.

Grayson, Madison (Senior, Physics), Mentor: Ricardo Alarcon, Physics, Arizona State University. [A-2]

PROTON PATIENT LOG FILE ANALYSIS FOR MACHINE PERFORMANCE EVALUATION

Proton beam therapy is a type of radiation therapy that utilizes protons to treat certain kinds of cancer. Mayo Clinic Arizona uses pencil beam scanning (PBS), in which a small beam of protons is guided using magnets. The nature of this therapy requires it to be very precise in order to protect healthy tissue from radiation and ensure that all parts of the tumor are treated. Treatment log files provide a record of delivery accuracy for individual patients, but they also contain diagnostic information for machine performance. A collection of patient log files can identify machine performance trends over time. This facilitates the identification of machine issues before they cause downtime or degrade treatment quality. These log files contain information including the gantry, beam position, monitor units (MUs), and gantry angle. This data was analyzed to identify trends, which were then correlated with quality assurance measurements and maintenance records.

Greene, Collin (Senior, Mechanical Engineering), Mentor: Jesse Little, Aerospace and Mechanical Engineering, University of Arizona. [H-4]

FLOW CHARACTERIZATION FOR JET TRANSITION PIECE IN TFCL

The Turbulence and Flow Control Laboratory (TFCL) at UArizona executes numerous projects funded by the DoD and its contractors. Compressible subsonic air flows are of interest for many of these efforts. The TFCL currently operates a circular high-speed jet but this must be converted to a square cross section for an upcoming project. This

requires a circle-to-square transition which reduces exit area creating higher speed flows. Isentropic calculations show that the transition piece raises exit Mach numbers from [0.10 0.30] to [0.2 0.94]. To evaluate these preliminary estimates, the mean flow at the exit is characterized using a total pressure rake at various locations. The exit Mach numbers of interest range from [0.3 0.9]. The experimental data will be used to evaluate the exit flow profile and determine if any distortions are caused by the transition piece. This will be followed by measurements of turbulence using a hot wire anemometer.

Gutierrez, Eric (Sophomore, Physics), Mentor: Anna Zaniewski, Physics, Arizona State University. [A-In Title Only]

USING ATOMIC FORCE MICROSCOPY TO STUDY DIAMOND SURFACES

We will use two forms of Atomic Force Microscopy (AFM): Conductive Atomic Force Microscopy (C-AFM) and Kelvin Probe Force Microscopy (KPFM) to study the surfaces of diamond and their electrical properties. An AFM is a type of microscope that scans a sharp tip across a surface to measure its topography or electrical properties. Diamond is attracting great interest due to its unique qualities, like its wide band gap (5.45 eV), its ability to operate under high temperatures and in radioactive environments among others. We have taken a n-type nanocrystalline diamond film on molybdenum and scanned its topographical surface. Our next steps would be to carry out electrical measurements with the KPFM to determine the sample's electric potential in various areas of the surface to study its anisotropicities as well as its electrical-topographical correlation. We will also use C-AFM to study how its resistance varies over various areas of the sample.

Hanson, Chase (Junior, Physics and Math), Mentor: Antia Botana, Physics, Arizona State University. [A-In Title Only]

ELECTRONIC PROPERTIES OF VAN DER WAALS MAGNETS: BULK TO MONOLAYER

Intrinsic magnetic order in a single two-dimensional space has been highly desired for low-power, ultra-compact spintronics. Based on first-principles calculations, the evolution of the electronic structure of transition metal Janus dihalides MXY (M= V, Mn, Fe, Co, Ni; X, Y = Cl, Br, I) is analyzed from the experimental bulk to the monolayer limit. A variety of magnetic ground states is obtained as a result of the competition between direct exchange and superexchange. We show how structural symmetry-breaking plays a crucial role in the magnetic and electronic properties of 2D magnetic materials and offer a library of two-dimensional magnets that can be useful for technological applications.

Hart, Madelyn (Junior, Physics, Astronomy, and Mathematics), Mentor: Scott Barrows, Astronomy, Lowell Observatory, CU Boulder. [F-6]

CATALOGING AND OBSERVING ACTIVE GALACTIC NUCLEI

The project studies the observational properties of active galactic nuclei (AGN) through a specific focus on galaxy mergers. Escaped energy from the accretion disks of supermassive black holes (SMBH) located in the center of these galaxies generate electromagnetic radiation, which results in brighter galaxy nuclei and allows flux observations in several wavelengths to be gathered. Integrated with archival data and additional known properties, the compiled spectral energy distributions form a comprehensive catalog of AGN to be accessed for public use. Interacting AGN galaxies are determined through Wide-field Infrared Survey Explorer (WISE) imaging, noting roughly 2% of the observed galaxies as potential mergers. Increased light emitted throughout the process peak as the SMBHs merge, indicating rapidly increasing growth rate. Observed light emissions using optical and infrared radiation surveys produce data for comparisons to theoretical predictions.

Hepburn, Alexis (Senior, Aerospace Engineering), Mentor: Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

PRELIMINARY DESIGN OF A CUBE SATELLITE COMPLIANT HALL THRUSTER

The purpose of this research is to conduct the preliminary design, manufacturing, and testing of a cube satellite compliant single-stage Stationary Plasma Thruster type Hall thruster. Dimensionally, the thruster should be consistent with the requirements put forth in the most current CubeSat Design Specification document. Considerate deliberation will be provided to the thermal specifications to be compliant with future integration into CubeSat module applications. The target input power for this engine will be approximately 100 W. The thruster will take advantage of a solid LaB6 cathode as its electron source. The magnetic circuit will be powered independently via a stand-alone power supply. The exploratory design will focus exclusively on synthesizing a procurable and realizable plasma accelerator stage. Testing will be completed to demonstrate that the erosion rates observed on the thruster metallic structures, ceramic channel walls, and cathode are broadly consistent with these mission requirements.

Hernandez, Maria (Senior, Biology), Mentor: Amy Whipple, Biology, Northern Arizona University. [C-In Title Only]

SOIL TEXTURE ALTERS DROUGHT RESPONSE IN PINUS EDULIS

Climate change is intensifying drought conditions across the American Southwest. Pinyon pines (Pinus edulis), an important indicator of drought impacts in pinyon-juniper woodlands, have undergone widespread dieback. We studied the response of P. edulis seedlings and trees to prolonged drought when grown in coarse and fine textured soils. We tested the hypothesis that trees grown in coarse soils have greater rates of survival than those grown in fine textured soils. We found coarse soils yielded higher mortality, shorter seedlings, a larger root crown diameter, and fewer longer shoots. This suggests that when moisture is limiting, soil texture has contrasting effects on survival and growth that depend on age, with seedlings being more susceptible to drought in coarse soils The long-term goal of this work is to develop recommendations for where to conduct restoration trials using these results coupled with soil maps showing trends of pinyon dieback across the American Southwest.

Hocken, Alexis (Junior, Chemical Engineering), Mentor: Matthew Green, School for Engineering of Matter, Transport, and Energy, Arizona State University. [G-6]

PHOTOCURABLE POLY(ETHYLENE GLYCOL) DIACRYLATE RESINS WITH VARIABLE LOADINGS OF FUNCTIONALIZED SILICA NANOPARTICLES

The properties and characteristics of photocurable nanocomposites can be tailored to mimic those of various tissues and/or cartilage, allowing the bio-inspired synthetic materials to replace them. This project investigates the effect of methacrylate-functionalized (MA-SiO2) and vinyl-functionalized (V-SiO2) silica nanoparticle loading content on the thermal, mechanical, physical, and morphological characteristics of PEG nanocomposites. It was discovered that both V-SiO2 and MA-SiO2 did not considerably impact the glass-transition temperature or hydrophilicity of the material. The gel fraction of composites containing V-SiO2 decreases with the initial addition of 3.8 wt%, but then displays an increase with further addition. Whereas, the MA-SiO2 induced no significant changes in gel fraction with increased loading. An increase in mechanical properties was also observed with increasing concentration for both sets of series. However, due to the higher crosslink density, MA-SiO2 reached its ultimate mechanical stress threshold at a lower concentration compared to V-SiO2.

Jacobson, Sofia (Sophomore, Molecular and Cellular Biology), Mentor: Anthony Muscat, Chemical and Environmental Engineering, University of Arizona. [A-In Title Only]

LOW DEFECT SELF-ASSEMBLED MONOLAYERS FOR MOLECULAR DEVICES

Molecular devices will open up new opportunities for computation, energy conversion and storage, and sensing. Processes are needed to build these devices that can be scaled up to high volume manufacturing and make efficient use of water, energy, and materials. Self-assembly processes broadly satisfy these conditions because they make use of chemical bonding and physical forces to form ordered molecular aggregates on solid surfaces, which is additive. We deposited octadecyltrichlorosilane (ODTS) self-assembled monolayers (SAMs) onto silicon dioxide (SiO2) to deactivate the surface chemistry. The process reduced the defect density below about 3 x 1013 per cm2, which is in the range needed to use the SAM layer as a device element. We measured the thickness of the SAM at different times to learn how the layer nucleates and grows on the surface. Future work includes building and testing a transistor made using the SAM.

Januszewski, Brielle (Senior, Civil Environmental Engineering), Mentor: François Perreault, School of Sustainable Engineering and the Built Environment, Arizona State University. [C-4]

DOSE-TOXICITY CHARACTERIZATION OF SILVER NANOPARTICLES

Nanoparticles are important because of their applicability in many different fields, especially due to their anti-microbial properties. Mixtures of nanomaterials present unique possibilities in their antimicrobial functions because of the ability of the toxins to have synergistic, antagonistic, or additive relationships. The purpose of this project is to develop dose-toxicity curves of nanomaterial mixtures, specifically silver-doped graphene oxide, for bacterial communities. This work will aid environmental engineers in creating in-depth risk assessments.

Jayyusi, Feras (Senior, Computer Science), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

GLENDALE COMMUNITY COLLEGE FALL 2019 PAYLOAD

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

Jernigan, Rebecca (Senior, Microbiology and Biochemistry), Mentor: Jose Martin-Garcia, Center for Applied Structural Discovery, Arizona State University. [A-In Title Only]

USING MICROGRAVITY AT THE INTERNATIONAL SPACE STATION TO LEAD TO NEW THERAPEUTICS FOR TASPASE1: A NOVEL CANCER TARGET

Taspase1 is a novel anti-cancer therapeutic target that is overexpressed in many primary human cancers and functions as a non-oncogene addiction protease for cancer cell proliferation and apoptosis. Loss of taspase1 activity disrupts proliferation of human cancer cells in vitro and in mouse tumor xenograft models of glioblastoma. A high-resolution structure of the enzymatically active, full-length Taspase1 would greatly enable optimization of pharmacologically for Taspase1 inhibitors. Poor crystal quality leading to anisotropic diffraction currently limits the structure resolution. Crystal growth in microgravity has been previously demonstrated to improve crystal quality by reducing the kinetics in forming the crystalline lattics and preventing crystals from settling in solution. The investigation held in microgravity at the International Space Station will focus on obtaining high-quality crystals for the determination the a high-resolution structure of the Taspase1. These structures would benefit the structure-guided medicinal chemistry of Taspase1 inhibitors as an anti-cancer therapeutics.

Jimenez, Christian (Sophomore, Computer Science), Mentor: Katharyn Duffy, EcoInformatics, Northern Arizona University. [C-In Title Only]

DETECTING INVASIVE SPECIES

Some plant species, like cheatgrass, are very invasive and also very flammable, making it a threat to everything around it. Cheatgrass grows very healthy in the spring and browns down just in time for summer making it susceptible to catching fire. Every time it catches fire it only comes back more dominant and spreads its range further. To more easily track down this invasive species and better prepare for the threat that they pose in those areas, we found that cheatgrass has a unique phenological signal that can be seen on the ground (in situ), in near-surface remote sensing (PhenoCam), and in remotely sensed data (MODIS/LandSat). Through pulling in the ground

data, we can validate PhenoCam and remotely sensed data, allowing us to isolate/recognize cheatgrass signals across the Western U.S. This will allow us to better keep up with the spread of this threatening plant species.

Johnson, Holly (Senior, Physics), Mentor: Anna Zaniewski, Physics, Arizona State University. [A-In Title Only]

ANALYZATION OF THE TITANIUM-DIAMOND INTERFACE VIA X-RAY PHOTOELECTRON SPECTROSCOPY

PIN (p-doped, intrinsic, n-doped) diamond-based semiconductors with metal contacts (Ti/Pt/Au) have been shown to be capable of detecting particles such as neutrons, protons, and alpha particles. Diamond is a wide bandgap semiconductor with a bandgap of 5.45 eV, and PIN diamond has a built-in electric field, allowing it to detect particles without an external bias. Compared to its other semiconductor counterparts, namely silicon, diamond is less susceptible to thermal noise and is more robust to radiation damage, making it advantageous in energetic, high temperature environments. However, sufficiently high temperatures can cause the generation of titanium-carbide at the diamond-titanium interface. This project explores the diamond-titanium interface through annealing samples at increasing temperatures and analyzing their molecular contents through x-ray photoelectron spectroscopy.

Johnson, Matthew (Senior, Aerospace Engineering), Mentor: Jekan Thangavelautham, Aerospace and Mechanical Engineering, University of Arizona. [G-In Title Only]

SOFT ROBOTICS FOR USE IN SPACE AND EXTREME ENVIRONMENTS

Today, most robots are made with rigid materials and cannot adapt their shape to surroundings. The goal of this project is to create soft robots made from flexible materials that conform themselves to adapt to different situations. In addition, the robots should be able to use their elasticity advantageously when working together. Movement of the robot is achieved by controlling the stresses and strains of the soft material with actuators. This project will adapt soft robotic principles into space robotics. The soft materials are 3D printed according to designs from 3D modeling systems. Subsequently, experiments are performed on the soft materials to test the endurance, strength, adaptability, and movement of the material. Based on these results, a soft robot model with the adaptable materials is created. Soft robotics have a great deal of potential for exploring and navigating space and extreme environments.

Karanjia, Ava (Senior, Chemical Engineering and Microbiology), Mentor: Heather Bean, School of Life Sciences, Arizona State University. [G-7]

INVESTIGATING THE ROLE OF THE LAS AND RHL QUORUM SENSING SYSTEMS IN THE PATHOGENESIS OF PSEUDOMONAS AERUGINOSA

Pseudomonas aeruginosa is an opportunistic bacterial pathogen commonly associated with increased morbidity and mortality in cystic fibrosis (CF) patients. To adapt to the CF lung environment, P. aeruginosa undergoes multiple genetic changes as it moves from an acute to a chronic infection. This study examines the link between the accumulation of QS genetic mutations and phenotypic expression in P. aeruginosa laboratory strains and clinical isolates. We utilized several plate-based and colorimetric assays to quantify the production of exoproducts from paired clinical early- and late-stage chronic infection isolates across 16 patients. Exoproduct production of each isolate was compared to the mean production of pooled isolates to classify QS-sufficient and QS-deficient isolates. We found that over time P. aeruginosa isolates exhibits reduction in QS-related phenotypes during chronic infections. Future research of the QS regulatory networks will identify whether reversion of genotype will result in corresponding phenotypic changes in QS-deficient chronic infection isolates.

Kirch, Zachary (Senior, Electrical and Computer Engineering), Mentor: Steve Ertel, Astronomy, University of Arizona. [D-5]

LARGE BINOCULAR TELESCOPE INTERFEROMETER (LBTI) SOFTWARE DOCUMENTATION PROJECT

The Large Binocular Telescope Interferometer (LBTI) has its roots tied in detecting Exo-Planets. This project, Hunt for Observable Signatures of Terrestrial planetary Systems (HOSTS) was funded by NASA to analyze nearby planetary systems. Its purpose was to analyze if there is a high concentration of dust surrounding potential Exo-Planets in their habitable zones to determine the level at which the zodi dust obscures the detection of the habitable

planets with a future space telescope. As part of this research, it is quite important to have a remote interface that allows a user to operate on this extremely complex instrument, consisting of three interacting, high-performance optical control loops, two sensitive vacuum and cryogenic systems, and a whole suite of scientific cameras. My job as part of the LBTI team was to make this system more operable and maintainable by the team members through documentation of these protocols.

Korges, Christopher (Sophomore, Business Administration), Mentor: Wayne Pryor, Astronomy, Central Arizona College. [B-3]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Kubby, Crystal (Junior, Biophysics and Astrobiology), Mentor: Everett Shock, School of Earth and Space Exploration, Arizona State University. [A-In Title Only]

THERMODYNAMICS OF ULTRAMAFIC DEEP SEA HYDROTHERMAL VENT SYSTEMS: EXPLORING OVERABUNDANCE OF CO2

This project compared vent fluid compositions from the ultramafic-hosted Rainbow hydrothermal field along the central Mid-Atlantic Ridge with thermodynamic calculations of seawater alteration of the entire ultramafic ternary (olivine-orthopyroxene-clinopyroxene) at elevated temperatures and pressures. Regions of the ultramafic ternary were revealed to co-precipitate minerals hypothesized to coexist from environmental samples. These regions of the ultramafic ternary were assessed for their ability to predict equilibrium abundances of metabolically significant aqueous species such as CO2. Dissolved CO2 was found to be environmentally elevated relative to equilibrium, suggesting it as a potential energy source, while simultaneously necessitating a mechanistic explanation.

Kunkle, Emily (Senior, Geology), Mentor: Lisa Thompson, Geology, Northern Arizona University. [C-5]

A FOSSILIZED ROOTLESS HYDROTHERMAL SYSTEM IN THE COTTONWOOD SUBBASIN OF THE VERDE VALLEY, AZ

This research addresses a fossilized rootless hydrothermal system in the Cottonwood subbasin of the Verde Valley, AZ as a terrestrial-Mars analog for water-lava interactions that aid in the interpretation of life in extreme environments. This fossilized system takes the form of cemented tuff columns that branch upward from the ground, that formed when a pyroclastic flow descending from the Hackberry Mountain Volcanic Center encountered surface water on the floodplain of the Verde River, 8 Ma. It is hypothesized that the pyroclastic flow flash heated the water into steam that crystallized to form various shapes of cemented tuff. To test this hypothesis, high resolution drone imagery was captured to generate a digital elevation model (DEM) from which the volumes of the cemented forms are extracted. From this, the amount of surface water can be calculated to determine the depositional setting of this terrestrial-Mars analog environment.

Kurtz, Peter (Senior, Computer Science), Mentor: Stephen Williams, Astronomy, United States Naval Observatory. [F-In Title Only]

NAVY PRECISION OPTICAL INTERFEROMETER DATA PIPELINE AND REDUCTION

Computer software has had an ever increasing role in scientific endeavors. Software is used for condensing data, controlling instruments, running simulations, the list goes on. The United States Naval Observatory(USNO), Navy

Research Laboratory(NRL), and Lowell Observatory share custody of the Navy Precision Optical Interferometer (NPOI), which allows the organizations to examine bright objects in the sky with incredible precision. The site cannot function without its tens of thousands of lines of code. The various software that was written for NPOI is under-documented, missing or not working at all. Stephen Williams, USNO, and Peter Kurtz, NAU, were tasked with assessing the current software situation. This involved reading current source code to determine corrections or upgrades that can and should be made to streamline and modularize the solutions in place at NPOI.

Landon, Parker (Sophomore, Computer Engineering and Space Physics), Mentor: Keala Martin, Aerospace Engineering, Embry-Riddle Aeronautical University. [H-5]

JULIA LANGUAGE 1.2 EPHEMERIS READER AND GRAVITATIONAL MODELING PROGRAM FOR SOLAR SYSTEM BODIES

Julia is a new programming language designed for numerical computing combining simplicity and the ease of dynamic languages with the speed of compiled languages. Julia version 1.0 was released in August of 2018, marking the first stable version of the language. An ephemeris and constant reader, capable of retrieving data for major and small bodies, does not yet exist in Julia. With user inputs, this tool stores information from NASA databases, then outputs the specific information about a body. Julia 1.2 has allowed for many improvements which include decreasing the code's runtime and new gravitational field modeling. To model the gravitational fields of major and minor bodies, the code uses both moments of inertia, polyhedral models, and spherical harmonics. The knowledge of celestial bodies and their gravitational models within one program will help continue the advancement of astrodynamics and space trajectory optimization.

Laub, Becca (Senior, Aerospace Engineering), Mentor: Daniel White, Engineering, Embry-Riddle Aeronautical University. [H-6]

EAGLESAT PROJECT MANAGEMENT

This is the first presentation for EagleSat 2, a 3-Unit CubeSat that will launch as part of NASA's CubeSat Launch Initiative program. EagleSat 2 will fly two scientific payloads. The Cosmic Ray Payload (CRP) will study cosmic rays near Earth. The Memory Degradation Experiment (MDE) will explore how radiation affects computer memory. The team is currently finishing the integration phase and preparing to enter the testing phase.This presentation will discuss the project management of EagleSat including high-level decisions made, discussions with Nanoracks/NASA, and schedule management.

Lilly, James (Senior, Astronomy and Physics), Mentor: Yancy Shirley, Astronomy, University of Arizona. [F-7]

CHARACTERIZING PHYSICAL PROPERTIES ASSOCIATED WITH HIERARCHICAL STRUCTURE IN STAR-FORMING REGIONS

You, and everything around you, are comprised of elements that were forged in the hearts of stars. Stars are born in the densest regions of molecular clouds of gas and dust which have complex filamentary structures. This work utilizes two hierarchical structure algorithms, Astrodendro and CSAR, to detect these dense regions ("cores") in the nearby Taurus molecular cloud. Using results from each algorithm, we compare the physical properties of several high-confidence starless cores detected with radio-wavelength observations of the ammonia (NH3) molecule from the Green Bank Telescope. We also compare properties of NH3-detected cores to those detected with molecular hydrogen (H2) by the Herschel Gould Belt Survey. We find excellent agreement between properties of cores detected by Astrodendro and CSAR for NH3, but find substantial differences when comparing cores detected by Astrodendro for NH3 and H2.

Lopez, Federico (Sophomore, Aerospace Engineering), Mentor: Wayne Pryor, Science, Central Arizona College. [B-In Title Only]

CAC ASCEND LAUNCH RESULTS FROM FALL 2019 AND SPRING 2020

During fall 2019, Central Arizona College joined the ASCEND program and launched a weather balloon. We successfully collected data. This semester we wanted to create a payload housing that was fun and interesting to look at as an ode to the previous CAC weather balloon interns. We created a housing inspired by Thor's Hammer (from

Marvel's "The Avengers"). The hammer was constructed using pieces of foam board carefully hot glued together. The payload was reinforced with duct tape and four lamp rods. Encased within the housing are two Mobius cameras, an Arduino UNO and an Arduino Mega. The Arduino Mega has been programmed to run our UVA/UVB sensor, a GPS sensor, and two temperature sensors. Once again, we are running a Geiger-like sensor on an Arduino Uno, this time with an optical-type radiation sensor. The payload has been packed with fiberglass to prevent jostling of our sensors while in flight.

Lopez, Brianna (Senior, Biological Sciences, Genetics, Cellular and Developmental Biology), Mentor: Heather Bean, School of Life Sciences, Arizona State University. [G-8]

THE IMPACT OF STAPHYLOCOCCUS AUREUS VOLATILES ON PSEUDOMONAS AERUGINOSA PHENOTYPES

Persons with cystic fibrosis (CF) or astronauts are highly susceptible to lung infections caused by the opportunistic pathogens Pseudomonas aeruginosa (PA) and Staphylococcus aureus (SA). By age 20, ~16% of CF patients have co-infections with these two bacteria, and this number grows as the patients get older. PA-SA co-infections are associated with worsened clinical outcomes in CF patients, but the reasons are not well understood. One hypothesis is that SA causes PA to increase production of virulence factors, such as decreased protease production, a loss of motility, and increased antibiotic resistance. We hypothesized SA produces volatile organic compounds that cause changes in PA phenotypes leading to a down-regulation of motility, protease production and increased antibiotic resistance. To test this, we exposed PA to the VOCs produced by a pre-grown lawn of SA and measured PA motility by conducting swarming, swimming, twitching, and protease assays, as well as antibiotic disc assays.

Lubeck, Mila (Junior, Geophysics), Mentor: Christopher Harig, Geosciences, University of Arizona. [C-6]

FORWARD MODEL OF GLACIAL ISOSTATIC ADJUSTMENT IN GREENLAND AND FUTURE PROJECTION OF GREENLAND ICE MASS LOSS

Since the last glacial maximum (LGM) ~20,000 years ago the Earth has deformed in response to the melting of large ice sheets. This deformation is known as glacial isostatic adjustment (GIA). The GIA is critical to understanding the rate of uplift of the rockbed which contributes to sea-level changes, flexure response of surrounding rockbed, and understanding the rheology of the mantle. This project contributes to current knowledge of how GIA uplift will change going into the future. Greenland has had significant ice mass loss since 2003 and ongoing GIA deformation since LGM. Slepian functions and GRACE gravity data were used to calculate the ice mass loss in Greenland to construct a forward model of the GIA for Greenland based on the next 100 years of ice loss. This is important for finding when the GIA signal will have a comparable value to GIA from earlier deglaciation periods.

Marquardt, Madeline (Senior, Astrobiology), Mentor: Thomas Sharp, School of Earth and Space Exploration, Arizona State University. [D-In Title Only]

ANCIENT METEORITES AND IMPACTS: WINDOWS TO THE EVOLUTION OF THE SOLAR SYSTEM

Meteorites from the asteroid, 4 Vesta, present themselves as the oldest rocks from an intact, differentiated body. Eucrites, one of the three classes of meteorites from Vesta, include in their mineralogy occasionally and exceptional mineral, zircon. The presence of zircon in these rocks would prove eucrites come from a fairly evolved magma source. Further, the mineral is very robust, surviving mechanical and chemical deformation for billions of years. Zircon serves as a way to look back in time as it records the decay of U-Pb which in essence is a very old and reliable clock we can use to date zircon crystallization and possible impact resetting events. The purpose of this study is to analyze zircon grains present in all meteorites from Vesta to better constrain this early-formed body's evolution and the igneous and metamorphic history of the magma ocean that is since lost to us.

Martinez Morales, Ivan (Junior, Computer Science), Mentor: Thomas Sharp, School of Earth and Space Exploration, Arizona State University. [B-5]

ARIZONA SPACE GRANT ASCEND! ANALYSIS OF SONORAN DESERT BIOMASS HEALTH THROUGH NORMALIZED DIFFERENCE VEGETATION INDEX DATA AT ALTITUDE

Normalized Difference Vegetation Index (NDVI) is a technique used to quantify the health of vegetation. The health of vegetation can be ascertained by the level of distinct wavelengths of visible and near-infrared sunlight reflected from its surface. The vast Sonoran Desert contains a myriad of vegetation types, which not only cyclically change with the seasons but over multiple seasons. Historical NDVI data will be compared with current data captured through a low-cost system to get an understanding of how the biomass of the Sonoran Desert changes by season and over multiple seasons. With an understanding of the changes leading up to the current state, a future outlook can be extrapolated to aid in a further understanding of how climate change is affecting the health of the Sonoran Desert.

Mata, Anyell (Sophomore, Electrical Engineering), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

GLENDALE COMMUNITY COLLEGE FALL 2019 PAYLOAD

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

May, Kevin (Sophomore, Aerospace Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

ANALYZING THE VIABILITY REGOLITH RADIATION SHIELDING AND ASSESSING A NEAR-SPACE ENVIRONMENT WITH A GENERAL DATA LOGGER

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

McConville, Daniel (Sophomore, Materials Science and Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

ANALYZING THE VIABILITY REGOLITH RADIATION SHIELDING AND ASSESSING A NEAR-SPACE ENVIRONMENT WITH A GENERAL DATA LOGGER

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained

either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

McCormick, Caroline (Junior, Astronomy), Mentor: Chun Ly, Steward Observatory, University Libraries, University of Arizona. [F-8]

THE EVOLUTION OF THE MASS-CHEMICAL ABUNDANCE-STAR FORMATION RELATION OVER SEVEN BILLION YEARS

To understand how galaxies evolve, measurements that characterize the diffuse gas within galaxies are needed. One such measurement is the chemical content produced by stars. It is a fossilized record of cumulative star formation that is impacted by gas inflows and outflows. Driven by these insights, my NASA Space Grant project focused on constructing a stellar mass--chemical abundance relation for high-redshift galaxies. Contrary to previous work, my analyses derive chemical abundances using more robust measurements sensitive to the gas temperature. This makes it one of the first extragalactic studies to do so for the early universe. Specifically, we use the [OIII]4363 emission line and implement a spectral stacking approach to increase the detection signal for this weak emission line. With stacks for different stellar mass bins, our preliminary results illustrate that a correlation exists between stellar mass and chemical abundance for high-redshift galaxies.

McCormick, Kyle (Junior, Electrical Engineering), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

GLENDALE COMMUNITY COLLEGE FALL 2019 PAYLOAD

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

Mena, Julian (Sophomore, Astrophysics), Mentor: Philip Mauskopf, School of Earth and Space Exploration, Arizona State University. [G-9]

SPHEREX: SCANNING THE SKIES

Space telescopes that orbit the Earth have been key in space exploration, and have discovered things that were once considered science fiction. These space telescopes, however, have only been able to look at one small part of the sky at a time, leaving much of the sky unobserved. The SPHEREx Satellite Telescope seeks to solve this issue. SPHEREx will orbit the Earth longitudinally with set movement constraints in order to observe the entire sky. This will be accomplished by writing a routine in Python, and using quaternions, a form of 4D algebra, to act as a coordinate system so that the satellite can move about the Earth. Because this mission does not launch until December 2023, there is not any data to share. However, current projections predict about 97% sky observance by the satellite telescope. With this increase in observed sky, countless new discoveries are sure to follow.

Meza, Constantino (Sophomore, Mechanical Engineering), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

PHOENIX COLLEGE ASCEND 2019-2020: TECHNOLOGY AND ACHIEVEMENTS

The Phoenix College payload's external housing was made from a strong lightweight carbon fiber material. This material was made of a bondo cardboard molding process rather than a vacuum seal model because it was more cost-efficient. During this process, we noticed that the result was just as good as a vacuum model. Our supplies came from a local business called "Sticky and Stuff", and according to the recommendation from the staff, we use a

2:1 ratio of epoxy and harder, allowing a 24hr cure time. For the internal housing of the structure, we decided to go with a more cubical approach allowing enough room in the center for wire space and the video stabilizing system, with a basal wood coated in epoxy as our mounting board. However, we updated this internal system to a shelving system that we 3D printed with ABS which allowed us to reduce our payload weight and empty space that we don't need.

Mobley, Forrest (Senior, Aerospace Engineering), Mentor: Shigeo Hayashibara, College of Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

Reducing the Cost of Uncertainty Quantification at Hypersonic Speeds

Commercial industry needs a solution that bridges the gap between existing uncertainty quantification (UQ) toolkits and advanced computer simulations as engineers lack adequate tools. As part of an effort to develop Spectre, a new full-stack application developed by Intelligent Light through a Department of Energy (DOE) SBIR, the purpose of this project is to develop a series of computational fluid dynamics (CFD) simulations and perform preliminary UQ analysis. Due to the unique complexities associated with hypersonic flight, such as complex boundary layer profiles due to viscous layers and high temperature gas dynamics, hypersonic simulations are not only more time consuming but also more difficult to achieve and validate; thus a hypersonic case was chosen. The target of UQ analysis was the boundary layer of an axisymmetric ogive cylinder at Mach 7. A variety of uncertainty sources were analyzed, and this analysis and process will be used to develop Spectre.

Moir, Zach (Sophomore, Computer Engineering), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-1]

PCC ASCEND Project Hexi

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, pressure, light, and radiation. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae.

Mudd, Maxx (Sophomore, Computer Science), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

Phoenix College ASCEND 2019-2020: Technology and Achievements

Content delivery systems have become an important aspect of launch capabilities. Either to update location data, stream content to social media, or increase visibility to the public, these systems require complex measures to implement and use successfully. Educating the public through measurements of atmospheric data has also become an important tool to raise environmental awareness. The Phoenix College teams have been dedicated to creating a system with these capabilities, improving upon our existing systems and adding new features to preserve the integrity of data. These components come at the cost of weight and power. Our teams have worked to mitigate these effects with new material research, streamlined payload design, enhanced battery technology, and improved power utilization efficiency. These efforts produce a system that helps reach a wider audience and exposes high-altitude ballooning to the next generation of engineers, while preparing students for success within their careers.

Murphy, Kaitlin (Junior, Environmental Studies and Sustainability), Mentor: Mansel Nelson, Institute for Tribal Professionals, Northern Arizona University. [E-3]

Monitoring and Analyzing Particulate Matter in Regard to Air Quality within an Indigenous Community

Particulate pollution is harmful to populations at high levels when exposed, especially in rural tribal communities where air quality monitoring often lacks accessibility and reliability. This study investigates particulate matter levels found in schools located within Tuba City, AZ documented over the majority of a calendar school year. Three public schools located in the area were monitored for particulate matter and Carbon Dioxide levels to determine the level of

particle pollution on the Air Quality Index (AQI). Air quality monitoring over the 2019-2020 school year between the three schools was compared to data collected to two years before in order to compare levels recorded and seek correlation. The analysis showed there was not a significant correlation of PM levels between the schools. Based on results, even if there was no clear correlation between the three school sights, the levels of PM recorded signify that more monitoring needs to be considered to gain a more accurate recording. Results also concluded that students are exposed to brief high PM levels on sporadic occasions but for most of their attendance during the school year, levels remain below national standard levels for particulate matter.

Nadkarni, Arsh (Junior, Astronomy and Applied Physics), Mentor: Michelle Coe, Department of Planetary Sciences, University of Arizona. [B-In Title Only]

ANALYZING THE VIABILITY OF A LUNAR-REGOLITH SIMULANT SHIELDED 1U CUBESAT PAYLOAD AND DIAGNOSING THE IN-FLIGHT NEAR-SPACE ENVIRONMENT USING A GENERAL DATA LOGGER

As technology is advancing in today's world, the satellite industry has progressed from following a macro-design trend to a micro-design trend. Of these trends, the advent of CubeSats is the most prevalent, owing to which the success rate of missions has increased significantly and the total mission cost has reduced over time. We present our design and observations for a 1U CubeSat mission which substantially reduces the size of High-Altitude Ballooning payloads in accordance with the constraints of the CubeSat design philosophy. The payloads are testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials which range from polymers and composites to metals and in-situ resources, such as lunar regolith. The first design iteration is intended to collect preliminary radiation data for the second launch iteration. The second version features the introduction of three Geiger Counters instead of two, as in the first version, to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions are outfitted with passive or active telemetry, atmospheric condition sensors, and a 360-degree imaging camera.

Nolan, Liam (Sophomore, Earth and Space Exploration, Astrophysics), Mentor: Rolf Jansen, School of Earth and Space Exploration, Arizona State University. [F-9]

WHAT POWERS THE FAINT (MJY) RADIO SOURCE POPULATION?

We present preliminary analysis of VLA and VLBA radio-continuum observations, and ancillary UV to Visible images with the Hubble Space Telescope (HST), in the James Webb Space Telescope (JWST) North Ecliptic Pole Time-Domain Field. This new community field for time-domain studies will be observed with JWST/NIRCam and NIRISS as part of IDS GTO program 1176 (Windhorst). Among the wealth of ancillary data in this field, we use the VLA 3 GHz (Windhorst), VLBA 4.7 GHz (Brisken), and HST 245–725 nm (Jansen) observations in this study. To date, 12 out of 64 VLA-detected sources were detected with VLBA at >30 μJy (>6σ), indicating these sources are powered primarily by an active galactic nucleus. The remaining sources are resolved out with VLBA or are not sufficiently bright, and thus are likely powered by star formation. We show radio and HST (or LBT) images for a majority of the 64 VLBA-targeted sources.

O'Brien-Metzger, Ruby (Junior, Mechanical Engineering), Mentor: Eric Betterton, Hydrology and Atmospheric Sciences, University of Arizona. [C-7]

DANGER OF DUST STORMS IN PICACHO PEAK

Dust storms on the I-10 highway near Picacho Peak, AZ are dangerous, even fatal. One factor that must be considered during the prevention process of this issue is threshold friction velocity, which quantifies the specific wind speed at a soil surface that leads to significant dust emissions. Using a portable dust generator, threshold friction velocity was measured in the field, and on manmade lab surfaces. Soil from Picacho Peak was collected and kept in relative humidity controlled areas of the Biosphere-2, and tested to analyze the influence that air relative humidity has on dust production. The results showed that disturbed soil surfaces are relatively unaffected by humidity, while undisturbed surfaces exhibited increased threshold friction velocities at relative humidities higher than 70%. The portable dust generator was also used in collaboration with other projects to evaluate the effect of surface crust on the soil on dust emissions. The process of testing each type of manmade crust for their threshold friction velocity is ongoing.

Orrill, Brianna (Junior, Astrobiology), Mentor: Everett Shock, School of Earth and Space Exploration, Arizona State University. [C-8]

Chemical Gradients, Fluid Mixing and the Influence on Biological Diversity in Yellowstone National Park

Chemical and temperature gradients are driving forces for the environment and its inhabitants. Studying a small-scale system and local ecological response to geochemical gradients may reveal information on energetics and microbial diversity which can be applied to larger systems on or off Earth. Mixing between two distinct hot spring fluids in Yellowstone National Park generates a small-scale temperature and geochemical gradient. The chemical composition of the two hot spring sources and downstream mixture were evaluated and detailed temperature measurements were taken along with biological samples. We have developed a conservative mixing model estimating chemical composition and corresponding chemical energy supplies that support microbes at each temperature point. Preliminary results show microbial diversity peaks at the greatest extent of mixing. Furthermore, distribution of microbial aerobic methane oxidizers corresponds to energy available for the redox reaction. Overall, the temperature and chemical gradients established by mixing drive the community composition in this system.

Pepel, Richard (Junior, Chemical Engineering), Mentor: Reyes Sierra, Chemical and Environmental Engineering, University of Arizona. [C-9]

Photodegradation of Onium Photoacid Generators under UV irradiation: Identification and Environmental, Safety, and Health, (ESH) Evaluation of Photoproducts

Sulfonium and iodonium salts are commonly used in photolithography as photoacid generators (PAGs). Despite their extensive use, their environmental fate and impact are poorly understood. This study investigated the photodegradation of several onium PAGs at 254 nm. Gas Chromatography-Mass Spectroscopy (GC-MS) and High Performance Liquid Chromatography with Diode Array Detector (HPLC-DAD) measurements showed that all the onium PAGs underwent rapid photodegradation, resulting in the formation of multifaceted apolar photoproducts. Additionally, ESH assays revealed that the PAGs tested featured high microbial toxicity (Microtox) and hydrophobicity (lipid membrane affinity). The environmental, safety, and health properties of these compounds are being tested since they are eventually released into the environment through the wastewater of semiconductor fabrication plants. Given the rapid photodegradation of the PAGs, future studies should be conducted to assess the ESH properties of the main photoproducts.

Perez, Savannah (Senior, Physics and Astronomy), Mentor: Lisa Chien, Astronomy and Planetary Sciences, Northern Arizona University. [E-4]

Redefine NAU Astronomy Courses with Innovative Teaching Styles

When students discover content and collaborate about it, they take ownership for the material; solidifying their ideas about the topic. Creating opportunity for discovery and collaboration encourages students to develop a deeper understanding of the material, as well as enhances participation throughout the course. Some of these effective teaching techniques help educators understand how to create student-centered content or use the content we create in their own classrooms. For this project, we focused on developing a brand new, interactive, small-classroom lab for the course of AST201, Indigenous Astronomy. This lab is designed to help students connect with traditional native astronomy while also learning modern astronomy. Collaboration in the classroom will also positively change students‘ outlook on the content and their education. By creating this new lab for AST201, we hope to demonstrate to educators that using innovative teaching styles is important for student understanding, and providing students with life experiences with content in their classroom.

Perez Torres, Javier (Junior, Electrical Engineering), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

Phoenix College ASCEND 2019-2020: Technology and Achievements

Our goal was to design a board that distributes the power efficiently from a Lipo Battery of 7.4V into two different lines using a step-up and step-down converter to 18V and 5V, respectively. It is used to power the Ubiquiti to establish a connection with the ground station and to power different components such as LEDs, Raspberry Pi, Arduinos, RunCam, and the stabilization system subsequently. Using two layers on Eagle Cad, we managed to reduce weight and wires. For our second launch, we wanted to make a big statement in weight reduction and to obtain video from launch to landing. We changed our source to another LiPo Battery that offers similar output and capacitance for 120g less than the previous one. Also, to get a complete feed of video, we add extra 5V pins in the board to power the RunCam through the external source instead of its internal battery.

Petersen, Scott (Sophomore, Aerospace Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

ANALYZING THE VIABILITY REGOLITH RADIATION SHIELDING AND ASSESSING A NEAR-SPACE ENVIRONMENT WITH A GENERAL DATA LOGGER

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

Pfefferle, Tiphanie (Senior, Chemistry), Mentor: Stephanie Hurst, Department of Chemistry and Biochemistry, Northern Arizona University. [G-10]

3-D PRINTED MICRO CILIA FOR THE REMOVAL OF BIOFILM IN SPACE CRAFTS

Biofilm removal is essential to the success of interplanetary travel as microorganisms can result in crew infections and degrade spacecraft's systems. To minimize the growth of biofilm, a flexible and durable three-dimensionally (3-D) printed micro cilia may be of interest. Adhesion of remotely actuated cilia to a spacecraft could potentially reduce, or stop, the buildup of biofilm in crucial systems. In controlling the artificial cilia, this system is analogous to the natural cilia in our body. Our work involved the growth of cilia, testing the printer's capacities, optimizing the performance of our CAD model. 3-D printing at room temperature gave poor results due to resin viscosity. A heater fan was built, lowering the viscosity producing successful prints. Ongoing work involves the incorporation of magnetic nanoparticles synthesized using the starch from potatoes and iron salt. This addition could further our understanding of interactions between the iron nanoparticles and light activated resin.

Phaklides, Nicodemus (Sophomore, Electrical Engineering), Mentor: Douglas Isenberg, Mechanical Engineering, Embry-Riddle Aeronautical University. [B-In Title Only]

ERAU ASCEND: PROJECT OVERVIEW AND SOFTWARE

Our payload was designed to study heat transfer into and out of a high altitude balloon gondola. This was accomplished using 32 calibrated thermistors distributed across the interior and exterior of the gondola. Data from the thermistors was used to build a complete model of heat transfer for future experiments. The payload also included a heating element to keep the electronics warm at high altitudes as well as a 3rd-party latex cutting experiment. Development of this payload included the design of printed circuit boards (PCBs), development of flight software, and study of systems engineering. The primary functions of the payload were handled via a BeagleBone Green microcontroller paired with a custom PCB cape to handle power management and sensor input. Flight software was developed using Python. The software was designed to be robust against the possibility of losing data due to unexpected reboots of the microcontroller during the flight.

Pomales, Briana (Sophomore, Chemistry), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-In Title Only]

PCC ASCEND PROJECT HEXI

The goal of our team at Pima Community College was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, pressure, light, and radiation in regards to the growth of moss after the launch. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae. Our team will analyze the data collected from the payload constructed to determine how the genes and protein of mosquito and the growth or appearance of moss were affected after being exposed to a different temperature, pressure, light, altitude, and radiation. We hope to see changes in the moss and mosquito to determine exactly what these living organisms can withstand.

Pudwill, Dashiel (Junior, Aerospace Engineering), Mentor: Stuart Craig, Aerospace and Mechanical Engineering, University of Arizona. [H-In Title Only]

DYNAMIC CALIBRATION IN A SHOCK TUBE: BOUNDARY LAYER STABILITY AND TRANSITION (BLST) LABORATORY

Supersonic wind-tunnels are crucial to advancing the design of next-generation high-speed vehicles for both military and civilian applications. A critical component of research in this field is the boundary-layer transition. A boundary layer is a region near the body that contains the viscous effects of the moving fluid and may be laminar or turbulent. Turbulent flow may create ten times the heat and drag on the moving body, thus, it is important to research how and why the flow transitions from laminar to turbulent. This project uses pressure transducers in wind tunnels to verify that the flow is of the correct velocity as well as provide pressure readings that indicate instabilities in the transition process. Pressure transducers have distinct characteristics, such as response time, that may be measured in a dynamic calibration cell. This information is used in output filtering to produce more accurate data from the wind-tunnels.

Queen, Samuel (Sophomore, Computer Science), Mentor: Ernest Villicaña, Engineering, Phoenix College. [B-2]

PHOENIX COLLEGE ASCEND: AUTOMATED ANTENNA AIMING

Collecting live stream information from a payload would be impossible without precise antenna calculations. This semester, Phoenix College finished designing an automated antenna aiming system. Without this system the antenna is manually controlled, sacrificing time and accuracy. Python was used to create a program that obtains ground coordinates and coordinates from the payload. The program calculates the correct bearing and elevation angle to adjust accordingly. This automatic aiming program has greatly improved the reliability of the antenna system.

Ramirez, Diana (Senior, Microbiology), Mentor: Heather Bean, School of Life Sciences, Arizona State University. [C-10]

EXPLORING THE EFFECT OF GROWTH CONDITIONS ON THE VOLATILE METABOLOME OF CHROMOBACTERIUM SPP. USING GC×GC-TOF-MS.

Chromobacterium spp. possess properties that can positively impact medicine, industry, and agriculture. We recently found that C. vaccinii, isolated from cranberry bog soil, inhibits the growth of multiple pathogenic plant fungi through the production of volatile organic compounds (VOCs). Fungal inhibition has been observed when the fungi is co-cultured with C. vaccinii in separate petri dishes but with shared gas exchange, inhibition is not observed when the fungus is exposed to C. vaccinii metabolites produced in liquid media. Based on this observation, we hypothesize that the volatiles produced in liquid media are not the same as the volatiles produced in agar. To test this hypothesis, we are studying the influence of growth conditions on C. vaccinii and C. violaceum volatile metabolites by culturing the bacteria in liquid and semi-solid media. These results will lead to a better understanding of the production of antifungal VOCs by this naturally occurring soil bacterium.

Ratto, Brad (Junior, Aerospace Engineering Astronautics), Mentor: Michele Zanolin, Physics Department, Embry-Riddle Aeronautical University. [A-3]

GRAVITATIONAL WAVE CALIBRATION ERROR FOR SUPERNOVAE CORE COLLAPSE

The existence of gravitational waves reveals yet another method in which information is transmitted across the cosmos, bringing with it further insight into the inner workings of our universe. In order to detect such phenomena, we use ground-based Laser Interferometers to measure the microscopic deformations in space-time and explore a new frontier in gravitational astronomy. However, such instrumentation also induces distortions in the gravitational waves henceforth diminishing the ability to extract accurate physical information. The aim of this study is to understand the consequences of the distortions produced by the laser interferometer on the reconstructed gravitational waves from core-collapse supernovae. We will check the impact of the distortions on the astrophysical parameters that we compute from a gravitational wave candidate as seen in the LIGO instruments and existing software excess power algorithms. The results of which will be used to quantify the calibration error for the so-called O3 data set. As a consequence, this study is to provide reports that introduce a wider range of calibration errors so that the impact on detection ranges and parameter estimations can be accurately estimated.

Reinhardt, Christianna (Post-Baccalaureate, BioMedical Sciences), Mentor: Chris Etling, Arizona Daily Sun, Arizona Daily Sun. [E-5]

NASA SPACE GRANT FOR SCIENCE WRITING

This project explored the means by which NASA's mission statement can be expressed to an everyday audience by publishing science-related topics in Flagstaff's daily newspaper as articles written for broad audience distribution. Opportunities to connect complex scientific principles with a general population occurred in the form of 750-word articles published in the Arizona Daily Sun, covering topics such as the history of Earth's moon exploration, to how NASA's research on astronauts' bone density and sleep cycles can inform health practices here on earth. Content of the articles was decided by a "pitch process" typical of submitting articles to a media outlet, including pitching ideas that fit both NASA's mission statement and subjects deemed of interest to the reading audience as determined by the managing editor of the newspaper.

Renteria, Alyssa (Sophomore, Global Environmental Science), Mentor: Angelita Denny, Legacy Management, Department of Energy. [C-11]

MES 2020 PROJECT: NEXT TOP INTERPOLATION METHOD

Spatial analysis is handy for decision-makers when it comes to predicting environmental conditions. An integral part of spatial analysis involves interpolations. Manual interpolations often cannot be independently reproduced and as a result, the supported interpretation is less defensible. With the passing of the Evidence-Based Policymaking Act, it is crucial for federal interpretations of data to be defensible. Thus, there is a need to identify a means for converting manually derived interpolations into digital. This study uses point data and manual interpolations from a Department of Energy Office of Legacy Management site to assess four different algorithms for generating digital interpolations of land and water surface. Kriging, inverse distance weighting, natural neighbor, and spline interpolation algorithms were applied and the results were compared to the manual interpolations. Inverse distance weighting most reliably produced interpolations that were similar to the manual interpolation.

Rocha, Katherine (Sophomore, Computer Engineering), Mentor: Daniel White, Mechanical Engineering, Embry-Riddle Aeronautical University. [H-7]

EAGLESAT 2: ON-BOARD COMPUTER SUBSYSTEM

The On-Board Computer subsystem (OBC) of EagleSat 2 balances out the scientific needs with the other subsystems requirements ensuring that the satellite continues operation and still sends science data to the ground. The On-Board Computer has changed to a FPGA with triple-mode redundancy. Due to the reduced cost of the FPGA the OBC team now has multiple test boards allowing the work to be more effectively divided for the new

main + interrupt service routine design. The FPGA will be running a MicroBlaze softcore with the remaining logic elements offloading processing, such as downlink packet creation, reducing the workload for the softcore. The FPGA has enabled the OBC team to design a custom PCB for unique interfacing to the other subsystems. This presentation will discuss the changes to subsystem design late in the design process and how this consistently changing approach to design has lead to our successes and failures.

Rodriguez, David (Junior, Biomedical Engineering), Mentor: Timothy Frank, Engineering, Glendale Community College. [B-4]

GLENDALE COMMUNITY COLLEGE FALL 2019 PAYLOAD

In Fall 2019, the GCC ASCEND team's goal was to design and build a balloon payload capable of recording internal and external temperature, acceleration, pressure, video, and battery voltage throughout the flight. A custom circuit board was etched and drilled, and an Arduino ProMicroprocessor was soldered onto it. The TMP-36 sensor showed the variation of temperature through different layers of the atmosphere; however, this sensor was limited to -50°C and the external sensor reached this limit during the flight. The DE-ACCMG recorded acceleration throughout the flight, but after balloon burst, it reached its limit of 6g's. The ASDX015 pressure sensor data was consistent with the reported barometric pressure. The RunCam2 camera recorded video; however, a software issue caused the camera to deactivate several times during flight, corrupting some video files. The recorded battery voltage showed an increase in voltage whenever the RunCam2 deactivated. Overall, the team successfully accomplished its goal.

Sauer, Elinor (Senior, Environmental Chemistry and Biological Sciences), Mentor: Hilairy Hartnett, School of Earth and Space Exploration, Arizona State University. [C-12]

EVALUATING THE ACCURACY OF TEMPE TOWN LAKE DATASONDE

Tempe Town Lake has been at the core of Tempe for over twenty years. The lake reflects the changes in the city around it, which makes it an excellent specimen to answer the question, "How can anthropogenic changes affect the biogeochemistry of a lake?". For 15 years, Dr. Hartnett's CANDY Lab has gathered data from TTL twice a week, measuring dissolved oxygen, conductivity, pH, dissolved organic carbon and fluorescence. The goal is to gather enough data to understand TTL's cycles. After 15 years of sampling, new technology has been developed that can help. Two years ago, a dataSONDE was placed in the lake. It measures the same factors, except it can do it every 30 minutes. The SONDE is an invaluable resource, but little has been done to evaluate its accuracy. The goal of my research is to compare lab data to the SONDE's data to ensure it is reliable.

Schulte, Jack (Junior, Physics), Mentor: Maitrayee Bose, School of Earth and Space Exploration, Arizona State University. [F-10]

THE SUPERNOVA ORIGINS OF STARDUST ENRICHED WITH 13C AND 15N

The isotope yields from two novel three-dimensional core-collapse supernova (CCSN) models and two one-dimensional CCSN models are investigated in order to constrain the origins of presolar SiC X, D, and C grains. We find that SiC D and C grains, or grains with enrichments in 13C and 15N, can condense from material deep within the interior of a 15 $M_{\odot}$ CCSN. This material is exposed to high temperatures and densities enabling proton burning and the production of 13C and 15N. It is also saturated by neutrons carried outwards by the supernova shockwave, enabling neutron captures and leading to enrichments of 29Si, 30Si, 34S, 49Ti, and 50Ti. We also explain the Al, Fe, Ni, and Ca compositions of presolar X, D, and C grains using these models. We conclude that it is possible for SiC X, D, and C grains to condense from ejecta from different regions of the same CCSN.

Scobie, Brendan (Senior, Electrical Engineering), Mentor: Jennifer Kitchen, School of Electrical, Computer and Energy Engineering, Arizona State University. [G-In Title Only]

TOTAL IONIZING DOSE EFFECTS ON ESD DIODES

Spacecraft can be susceptible to Electrostatic Discharge (ESD) caused by charge that is built up in spacecraft materials originating from charged particles in their environment. As a result, it is useful to understand the extent

and rate at which exposure to radiation will cause certain kinds of ESD protection to degrade and potentially cause a failure. This may be especially helpful for small satellite missions developed by organizations that do not have the resources needed to characterize TID effects or use radiation-hardened components.The objective of this research was to characterize the relationship between Total Ionizing Dose (TID) of radiation and the current-voltage profiles of diodes and thyristors used to protect electronic circuits from ESD. Characterized devices were Silicon Controlled Rectifiers and PN, Zener, Schottky, and Avalanche diodes.

Segapeli, Allison (Sophomore, Chemical Engineering), Mentor: Monica Ramirez-Andreotta, Environmental Science, University of Arizona. [C-13]

A Method Validation Study: Comparing field portable X-Ray Fluorescence to Laboratory Inductive Coupled-Mass Spectrometry for Five Metal(loid)s in Arizona Soils

X-Ray Fluorescence (XRF) is an instrument that is used to detect metal-contaminated zones in the field. A common use of field XRF is delineation of areas with elevated lead levels. The goal of the study was to measure the levels of lead, arsenic, cadmium, nickel, and copper yard and garden soils using a field portable XRF and compare them to the widely accepted laboratory method, inductively coupled plasma mass spectrometry (ICP-MS). A linear regression approach was used to determine the accuracy of the XRF field unit and the reference ICP-MS laboratory method. The metals with the higher R2 value were: Copper (R2 = 0.95) and Lead (R2 = 0.84). Correlations across metals improved when: (1) soil metal levels at or below Arizona soil screening levels were only included, (2) only the yard samples were analyzed. This suggests that high organic matter common in garden soils may result in a less accurate metal determination using field portable XRF. This study highlights the potential limitations of the XRF method. Since XRF is a widely used instrument in the field, these potential limitations need to be considered in environmental monitoring efforts, especially in residential areas.

Smith, Joshua (Senior, Aerospace Engineering), Mentor: Mike Parker, Rincon Research Corp, University of Arizona. [G-11]

Predicting satellite-to-ground propagation effects induced by the Ionosphere for a low orbit satellite

The Ionosphere is a layer of the atmosphere that contains a high concentration of electrons that can affect signals passing through it. My research aims to answer how the Ionosphere and Earth's magnetic field affect high-frequency signals traveling from a low orbit satellite to a given ground station. The purpose of this work was to predict changes in Group Delay, Faraday Rotation, and frequency. This will be used in the CatSat project to predict and analyze an experiment satellite-to-ground propagation effects. Equations to predict these ionospheric effects were derived starting with the satellite's orbit, ground station location, and Total Electron Content (TEC), assuming a spherical Earth, a dipole magnetic field, and a non-varying thin Ionosphere. Models verify that the slant TEC increases at lower elevations and the polarization rotation reverse direction as the satellite approaches the north magnetic pole. Future work includes finishing calculations for induced Doppler shift.

Spurling, Reed (Sophomore, Electrical and Computer Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained

either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

Staggers Jr, Rodney (Junior, Mechanical Engineering), Mentor: Jnaneshwar Das, School of Earth and Space Exploration, Arizona State University. [G-12]

THE AUTONOMOUS UNDERWATER EXPLORATION DRONE PROJECT

Coral ecosystems are dying at an alarming rate due to environmental and man-made epidemics (such as increased exposure to ultraviolet rays, ocean level temperatures, and toxic runoff pollution). Currently, one study that is being conducted to map the damage involves flights over reefs with an imaging spectrometry device (using lasers to measure the wavelengths of light from reefs), and human-diving expeditions to identify the chemical state of the coral being identified (in order to synchronize the data from the spectrometry device). However, divers are susceptible to possible health issues/fatality due to the effects of hydrostatic pressures. To eliminate the threat to human life, the solution hypothesized by this project is to construct an autonomous underwater vehicle (AUV) to maintain a constant stream of information about the fluctuations in coral reef health (up to a depth of 60ft), while staying a fixed distance (<1m) from the reef at all times.

Stephenson, Ryan (Sophomore, Electrical Engineering), Mentor: Philip Mauskopf, College of Liberal Arts and Sciences, Arizona State University. [H-8]

DEVELOPMENT OF DIGITAL READOUT FOR MICROWAVE KINETIC INDUCTANCE DETECTORS

Here we describe the development of a FPGA readout system for Microwave Kinetic Inductance Detectors (MKIDs). These detectors are novel technologies which have the capability of large pixel counts with single feed lines through the use of resonators for Frequency Division Multiplexing (FDM) while maintaining low sensitivity with a NEP shown as 10^-19 W/Hz^1/2. For multiplexed detectors high throughput readout systems are necessary to process rapid data rates required for kilo-pixel MKID arrays. Thus custom firmware was developed to meet the criteria and implemented on a Xilinx RF System on a Chip UltraScale+ (RFSOC) FPGA. The hardware of which was selected for the integrated 8 channels of 12bit 4GSPS ADCs, and 14bit 6GSPS DAQs.

Swenson, Paige (Senior, Applied Meteorology), Mentor: Curtis James, Applied Aviation Sciences, Embry-Riddle Aeronautical University. [C-In Title Only]

STATISTICAL ANALYSIS OF THE NORTHERN ARIZONA TORNADO OUTBREAK

The 2010 Tornado Outbreak in Northern Arizona was the largest tornado outbreak in history on the west side of the Continental Divide, with 11 confirmed tornadoes touching down. This event is unique because so many tornadoes occurred, touching down only in high terrain, enabling us to study how topography affects tornadogenesis. We have analyzed the precise tracks of mesocyclones identified by Doppler radar in relation to the terrain and the damage paths of the 11 confirmed tornadoes. Statistical correlations between terrain slope and elevation, with respect to normalized rotation observed by radar, reveal the influence of topography on the development of mid-level rotation along the path of every strong, persistent thunderstorm that formed. This study documents the extraordinary characteristics of the 2010 Tornado Outbreak and gains insight into the relationship between terrain and tornadogenesis.

Sypherd, Ciara (Senior, Aerospace Engineering and Astrobiology), Mentor: Jennifer Fewell, School of Life Sciences, Arizona State University. [G-In Title Only]

HABITUATION OF ALARM SIGNALLING IN HARVESTER ANTS

In social insect colonies, alarm signaling is an important adaptive behavior wherein an individual attempts to warn the collective of an incoming threat. To do this, when an individual perceives a threat, she will accelerate through the group and vigorously antennate her nestmates to stimulate them into alarm. As individuals are contacted, they in turn become agents of the alarm signal, and the signal is propagated in an expanding communication network. The size and duration of the alarm network is adaptively attuned to the perceived threat level and internal colony

conditions. This project seeks to characterize the propagation of alarm within harvester ants (Pogonomyrmex californicus) by examining the effect of habituation over short and long time spans.

Szewczyk, Kailie (Junior, Aerospace Engineering), Mentor: Jesse Little, Aerospace and Mechanical Engineering, University of Arizona. [H-In Title Only]

DEVELOPMENT OF AN IMPROVED MOTION MECHANISM TO INVESTIGATE LAMINAR SEPARATION BUBBLES SUBJECTED TO UNSTEADY PLUNGING MOTION

Composite manufacturing has demonstrated extensive application to recent aircraft, allowing for more flexible, higher aspect ratio wings. These wings, however, are susceptible to unsteady structural motion. At low speeds, a laminar separation bubble (LSB) forms over the wing and is sensitive to small disturbances such as plunging motion. The focus of this project is to develop an improved mechanism to simulate the oscillatory plunging motion experienced by these wings during flight. Whereas a previous design used a motor and linkage system to drive a scaled model from one end in a wind tunnel, the updated design drives the model from both ends, eliminating whiplash effects associated with a one-sided forcing. A complete nonlinear dynamics analysis of the mechanism afforded discrete control of the plunging amplitude. Furthermore, a composite model was conceived and sensor placement was strategically designed. This improved design will be utilized in future experiments to investigate the LSB.

Thompson, Lauren (Junior, Ecology and Evolutionary Biology), Mentor: Mary Nichols, Southwest Watershed Research Center, U.S. Department Of Agriculture - Agricultural Research Service. [C-14]

THE INFLUENCE OF WATER CONTROL STRUCTURES ON RANGELAND VEGETATION PATTERNS

Regional shifts from grasslands to shrublands are observed in the American Southwest. This trend has occurred in parallel with the construction of human-made structures for controlling rangeland erosion and runoff. Although there is a substantial amount of research describing shrub encroachment, there is little research on the long-term effects of structures such as earthen runoff control berms on vegetation patterns. We performed supervised classifications of orthographic imagery taken in June 2016 to quantify the long-term effects of berms in the uplands of the Altar Valley in Southern Arizona. Increases in bare ground and shrubs were found downslope of many berms. These increases indicate that the presence of the berms has altered the spatial patterns of vegetation and bare soil. However, in some areas within Altar Valley, vegetation and bare soil were not affected by berms. These results are important for managing landscapes where runoff is altered by conservation structures.

Tomooka, Paxton (Junior, Aerospace Engineering), Mentor: Jesse Little, Aerospace and Mechanical Engineering, University of Arizona. [H-In Title Only]

DEVELOPMENT OF AN IMPROVED MOTION MECHANISM TO INVESTIGATE LAMINAR SEPARATION BUBBLES SUBJECTED TO UNSTEADY PLUNGING MOTION

Composite manufacturing has demonstrated extensive application to recent aircraft, allowing for more flexible, higher aspect ratio wings. These wings, however, are susceptible to unsteady structural motion. At low speeds, a laminar separation bubble (LSB) forms over the wing and is sensitive to small disturbances such as plunging motion. The focus of this project is to develop an improved mechanism to simulate the oscillatory plunging motion experienced by these wings during flight. Whereas a previous design used a motor and linkage system to drive a scaled model from one end in a wind tunnel, the updated design drives the model from both ends, eliminating whiplash effects associated with a one-sided forcing. A complete nonlinear dynamics analysis of the mechanism afforded discrete control of the plunging amplitude. Furthermore, a composite model was conceived and sensor placement was strategically designed. This improved design will be utilized in future experiments to investigate the LSB.

Trail, Tara (Junior, Mechanical Engineering), Mentor: Elliott Bryner, College of Mechanical Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

FILM COOLING EFFECTIVENESS

The objective of my research was to reduce thermal damage on turbines and improve the testing apparatus to determine the effectiveness of film cooling. The overall test plan was changed from analyzing the effects on the tip of a turbine blade to a flat plate test article in order to further understand the basics of film cooling before determining the effectiveness of a turbine blade design. Although no testing was completed during my research there was a lot to learn from the different obstacles faced such as the flat plate and the functionality of the testing apparatus. Once data is taken from the flat plate test article and the correct apparatus for testing and hole setup is determined a new turbine blade test article will be implemented in order to reach our final goal of analyzing the effectiveness of film cooling on the turbine blade tip.

Van Overmeiren, Nicole (Junior, Chemical Engineering), Mentor: Monica Ramirez-Andreotta, Environmental Science, University of Arizona. [C-15]

COMMUNITY MONITORING OF ARSENIC AND LEAD IN RESIDENTIAL PROPERTIES NEIGHBORING MINING OPERATIONS

As mining activities are known to pose a threat to human health, communities adjacent to legacy/active mining operations have concerns about environmental contamination. The University of Arizona Gardenroots project aims to assess residential environmental quality in legacy mining communities through a citizen science design. After a training on how to properly collect soil, water, and dust samples, 18 community members collected samples in August 2019 from their residential property. These samples were processed and analyzed for arsenic, lead and other metals using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). A data sharing event and community meeting will be held to communicate the findings and distribute individualized results booklets to participants. This effort highlights how using a citizen science and community-centered data report back design, can work to increase environmental health literacy in rural communities.

Vandivort, Nathan (Sophomore, Pre-Engineering), Mentor: AnnMarie Condes, Chemistry, Pima Community College. [B-In Title Only]

PCC ASCEND PROJECT HEXI

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, pressure, light, and radiation. Our mosquito study is interested in how radiation affects the proteins and genes of mosquito larvae.

Velarde, Kimberly (Senior, Microbiology), Mentor: Ian Hogue, Immunotherapy, Vaccines and Virotherapy, Arizona State University. [A-4]

HERPES SIMPLEX VIRUS 1 AMPLICON VECTORS

About two-thirds of the world population is latently infected with herpes simplex virus 1 (HSV-1), and reactivation may present a problem for manned spaceflight. Small defective genomes, minimally containing an HSV-1 origin of replication and packaging signal, naturally arise via DNA recombination. These small defective genomes can be mimicked to create an HSV-1 amplicon vector by cloning an HSV-1 origin of replication and packaging signal into a bacterial plasmid. This construct can be replicated and packaged into virus particles by a defective helper virus. The absence of most viral genes in the amplicon vector allows incorporation of up to 150kbp of foreign DNA. We constructed a novel HSV-1 amplicon vector system expressing Emerald GFP using the defective helper virus HSV-1 5dl1.2 in complementing 3-3 Vero cells and demonstrate the vector can transduce and express Emerald GFP in non-complementing cells. We will further test several large human transgenes using this vector.

Villaran, Riva (Junior, Chemistry), Mentor: Stephen Kukolich, Department of Chemistry, University of Arizona. [A-In Title Only]

ELECTRONIC CIRCUITS AND COMPUTER PROGRAMS FOR MICROWAVE SPECTROMETER

Three-dimensional structures of molecules can be theorized by analyzing data retrieved by means of microwave spectroscopy. Gas-phase molecules are translated into coordinates that can be compared with computerized theoretical calculations to configure the molecular structure. Pulse boxes are a key component of microwave spectrometers and their functionality. Multiple compartments make up the base of a pulse box and perform together to transmit data to the processor. Models of these subunits were electrically engineered to recreate the base of the pulse box. Two subunits, the 555-timer, and the flip-flop were assembled using breadboards and electrical power sources. For each individual subunit that was constructed, there was an observable output via a light-emitting diode (LED) source. Future projects include constructing more subunits that will perform together with the 555-timer and flip-flop to function as a complete pulse box motor.

Walton, Taylor (Senior, Biochemistry), Mentor: Everett Shock, School of Earth and Space Exploration, Arizona State University. [C-16]

GEOCHEMISTRY AND MICROBIOLOGY OF THE PHOTOSYNTHETIC FRINGE

Yellowstone National Park is host to a diverse range of microbial life. One system of interest is the region where chemosynthetic life transitions to photosynthetic life, dubbed the 'photosynthetic fringe'. The photosynthetic fringe has been described by Cox et al. (2011) in terms of pH, sulfide, and temperature. Previous work characterized the 16srRNA and the 18srRNA from samples above, below, and near the transition to photosynthesis (Romero, 2018). In these hot springs, the dominant phototrophic communities vary with pH with bacteria dominating alkaline springs and eukaryotes dominating acidic springs. It is then expected that circumneutral springs would have mixture of eukaryotic and bacterial phototrophs. Sequencing data from the circumneutral 'Figure 8' hot spring system revealed that 2 of 4 samples sites were photosynthetic but only for eukaryotic phototrophs, with Chladymonas pitschmannii as the dominating phototroph. Next steps include geochemical modeling of the system to investigate the lack of prokaryotic phototrophs.

Wayne, Lily (Senior, Biochemistry), Mentor: Ariel Anbar, School of Molecular Science, Arizona State University. [A-5]

USING CALCIUM ISOTOPE FRACTIONATION TO MEASURE BONE MINERAL DENSITY

Bone remodeling involves the release and deposition of calcium from skeletal bones in order to maintain normal serum calcium (Ca) levels. During bone remodeling, the relative abundance of Ca isotopes varies in a process known as isotope fractionation due to the different reaction rates of each isotope. Lighter Ca isotopes are more reactive, so they are more readily released into blood or deposited into bone. This causes a shift to lighter or heavier serum Ca isotope abundance during periods of bone resorption and bone formation, respectively. The isotopic shift is a useful indicator of bone mineral balance and has important clinical applications because it can be used as a noninvasive tool to measure bone density. In this lab, 25 paired samples of bone and serum were obtained from patients undergoing hip replacement surgery and used to study the relationship between Ca isotopic ratios in the bone and blood.

Webster, Ryan (Senior, Astronomy), Mentor: Dennis Zaritsky, Department of Astronomy, University of Arizona. [F-11]

ANALYSIS OF PHYSICAL CORRELATION BETWEEN ULTRA DIFFUSE GALAXIES AND CONVENTIONAL GALAXIES

Ultra Diffuse Galaxies (UDGs) are an exotic class of galaxies, distinguished by low surface brightnesses and but with half-light radii of conventional galaxies. Despite their low surface brightness, wide-field imaging surveys have discovered UDGs in all areas of the night sky. The aim of this project is to learn about the spatial distribution and clustering of UDGs through two types of analysis: UDG density as a function of distance from conventional galaxies, and the two-point correlation function between UDGs and conventional galaxies. The former tells us where UDGs lie in relation to galaxies, and the latter tells us the probability of finding a UDG around a galaxy. For this analysis, we use UDGs found with the SMUDGes Survey (Zaritsky et al. 2019) and conventional galaxies in SDSS Stripe 82 (Jiang et al. 2014). In both methods of analysis, we find evidence that UDGs are physically correlated with conventional galaxies.

Weiler, Carlos (Senior, Chemical Engineering), Mentor: Eduardo Saez, Chemical Engineering, University of Arizona. [C-17]

Degradation of Trace Organic Compounds via Advanced Oxidation Processes

Wastewater reuse has become an important area of research due to changes in climate, drought, and population growth, each stretching the demand for water. Wastewater effluent requires an extensive cleaning process before reuse or consumption. However, even after such a cleaning process, trace organic compounds (TOrCs) still exist in the water with unknown consequences to the environment and people. It was found in prior research that some of these TOrCs have shown to degrade when exposed to light via direct photolysis and indirect photolysis through a photosensitizer. This research focused on determining the specific light wavelength that leads to the degradation of TrOCs. Early results have shown that lower energy wavelengths do not cause the degradation of TOrCS in wastewater effluent. The results from this research show that a novel process or technology can be developed to further sanitize wastewater effluent for reuse.

Werrell, Kenneth (Sophomore, Aerospace Engineering), Mentor: Michelle Coe, Lunar and Planetary Laboratory, University of Arizona. [B-In Title Only]

Analyzing the Viability Regolith Radiation Shielding and Assessing a Near-Space Environment with a General Data Logger

As technology continues to advance, the satellite industry has progressed from macro-designs to micro-designs. Of these trends, the advent of the CubeSat is the most prevalent, leading to the rise of mission success rates and the fall of costs. Designing within the constraints of the CubeSat philosophy, the parameters of internal electronics must follow accordingly. However, due to the damaging radiation present in orbit, microelectronics are more likely to fail. The University of Arizona ASCEND! 2019-2020 payloads were testbeds designed for measuring radiation and identifying the effectiveness of modern radiation-shielding materials, which range from polymers and composites to metals and in-situ resources, such as lunar regolith. With two Geiger counters, the first design iteration aimed at collecting preliminary radiation data for the subsequent launch. The second version featured an additional counter to collect two sets of control data and one set of regolith-shielded radiation measurements. Both versions contained either passive or active telemetry, atmospheric condition sensors, and a 360-degree camera for a visual from near-space.

Whitler, Lily (Senior, Physics and Mathematics), Mentor: Steven Murray, School of Earth and Space Exploration, Arizona State University. [F-12]

Validating the analysis pipeline for the Hydrogen Epoch of Reionization Array: radio frequency interference and the power spectrum

The Epoch of Reionization (EoR) is the era during which hydrogen in the universe was ionized by the first stars and accreting black holes, and the redshifted 21 cm line from neutral hydrogen shows great promise as an EoR. probe. However, detecting the 21 cm signal from the EoR requires precision of one part in 100,000 at every step, so it is crucial to validate the software performing the analysis. In this work, I investigate the performance of the Hydrogen Epoch of Reionization Array (HERA) data reduction and power spectrum estimation. I start with simulations of the 21 cm signal from the EoR and galactic and extragalactic synchrotron foregrounds to test the power spectrum estimation algorithm. Then, I add more complex analysis steps, including calibration and removal of radio frequency interference, in order to test the behavior of the HERA Collaboration's full analysis pipeline.

Wolfenbarger, Thorne (Junior, Aerospace Engineering), Mentor: Wallace Morris, Aerospace Engineering, Embry-Riddle Aeronautical University. [H-In Title Only]

Computational Flow Control: Minimum Amplitude for Effective Flow Control

Boundary layer separation, increases drag and reduces lift on an airfoil. This phenomenon dictates the minimum safe control speed for takeoff and landing of aircraft while also limiting high performance maneuverability. Implementation of actuators on the leading edge of the wing delays the onset of stall by oscillating in a certain

harmony with the flow field's shedding frequency; a type of actuator that can accomplish this is a synthetic jet. The Computational Flow Control group implements a synthetic jet design using methods described in Morris (2013) and simulates the boundary layer effects at various operating frequencies, amplitudes, and Reynold's numbers. These simulations provide data on specific jet configurations and their effectiveness at preventing flow separation for multiple Reynold's numbers. It is hypothesized that a parameter space exists which will optimize the control of boundary layers, enabling an increase in the operational envelope and capabilities of real airframes.

Worthen, Kadin (Junior, Physics), Mentor: Jennifer Patience, School of Earth and Space Exploration, Arizona State University. [F-13]

Investigating Four Newly Resolved Debris Disks in Scorpius-Centaurus

Debris disks are a collection of dust and planetesimals orbiting stars, and they are thought to be the remnants of planet formation. Mapping disk structures can give insight to the process of planet formation. This project studied debris disks around four young stars that were imaged using the Gemini Planet Imager (GPI), which is an adaptive optics system with a coronagraph to block starlight. We resolved a debris disk around each of the four target stars for the first time in scattered light. We also searched for imaged planets, but we did not detect any in our four images. By measuring contrast ratios, we determined that we could not have detected planets less than 2 Jupiter masses in wide orbits but could have detected 5 Jupiter mass planets at separations from .6 arcseconds to 1.4 arcseconds around each of the stars.

Yurgel, Christopher (Junior, Aerospace), Mentor: Thomas Sharp, School of Earth and Space Exploration, Arizona State University. [B-5]

Arizona Space Grant ASCEND! Analysis of Sonoran Desert Biomass Health Through Normalized Difference Vegetation Index Data at Altitude

Normalized Difference Vegetation Index (NDVI) is a technique used to quantify the health of vegetation. The health of vegetation can be ascertained by the level of distinct wavelengths of visible and near-infrared sunlight reflected from its surface. The vast Sonoran Desert contains a myriad of vegetation types, which not only cyclically change with the seasons but over multiple seasons. Historical NDVI data will be compared with current data captured through a low-cost system to get an understanding of how the biomass of the Sonoran Desert changes by season and over multiple seasons. With an understanding of the changes leading up to the current state, a future outlook can be extrapolated to aid in a further understanding of how climate change is affecting the health of the Sonoran Desert.

Zavala Quijada, Andres Leonardo (Sophomore, Astronomy, Computer Sciences, Mathematics, and Physics), Mentor: Ann Condes, Chemistry, Pima Community College. [B-In Title Only]

PCC ASCEND Project HEXi

The goal of our team was to design and build a payload capable of measuring altitude, temperature, pressure, light, and radiation. This sensor data will be used for the analysis of our moss and mosquito studies. The inside of our payload consists of our electronics, a moss sample, as well as a mosquito sample. Our moss study is focused on the effects of altitude, temperature, pressure, light, and radiation. Our mosquito study is interested in how radiation effects the proteins and genes of mosquito larvae.

Zigo, Hannah (Senior, Astronomy), Mentor: Christopher Edwards, Astronomy and Planetary Sciences, Northern Arizona University. [D-6]

Investigating Potential Ancient Inverted Valley Networks on Mars

Mars has been a long sought after target of interest for potential habitability, and in order to better understand the potential and duration which Mars may have been able to support life, it is vital to understand the past and current states of the martian environment. This project consisted of mapping small-scale olivine exposures across the martian surface, and consequently, identified a new and unique type of branching/dendritic, olivine-enriched deposit. We have also examined additional characteristics of the feature including; thermophysical properties,

stream order, scale, topography, etc. As a result of this analysis, we interpret this feature to be an ancient, inverted, valley network that was potentially filled by olivine-rich materials and has since been exhumed. If true, this could be one of the oldest preserved valley networks on Mars and could give us contextual clues about the timing of liquid water on the martian surface.

2019-2020 Arizona/NASA Space Grant
Program Mentors

Alarcon, Ricardo (Physics, Arizona State University) See: Grayson, Madison [A-2].

Anbar, Ariel (School of Molecular Science, Arizona State University) See: Wayne, Lily [A-5].

Arzani, Amirhossein (Mechanical Engineering, Northern Arizona University) See: Beraud Calderon, Edwin [G-1].

Barrows, Scott (Astronomy, Lowell Observatory, CU Boulder) See: Hart, Madelyn [F-6].

Bean, Heather (School of Life Sciences, Arizona State University) See:
Karanjia, Ava [G-7]
Lopez, Brianna [G-8]
Ramirez, Diana [C-10].

Best, Rebecca (School of Earth and Space Exploration, Northern Arizona University) See: Chandler, Dylan [C-2].

Betterton, Eric (Hydrology and Atmospheric Sciences, University of Arizona) See:
Almusawi, Reman [E-2]
O'Brien-Metzger, Ruby [C-7].

Borthakur, Sanchayeeta (School of Earth and Space Exploration, Arizona State University) See: Flores, Martin [F-In Title Only].

Bose, Maitrayee (School of Earth and Space Exploration, Arizona State University) See:
Duncan, Ethan [F-3]
Schulte, Jack [F-10].

Botana, Antia (Physics, Arizona State University) See: Hanson, Chase [A-In Title Only].

Bryner, Elliott (College of Mechanical Engineering, Embry-Riddle Aeronautical University) See: Trail, Tara [H- In Title Only].

Chien, Lisa (Astronomy and Planetary Sciences, Northern Arizona University) See: Perez, Savannah [E-4].

Clarke, Amanda (School of Earth and Space Exploration, Arizona State University) See: Courtney, Cara [D-3].

Coe, Michelle (Lunar and Planetary Laboratory, University of Arizona) See:
Blanchard, Nick [B-In Title Only]
Eladawy, Ahmad [B-In Title Only]
May, Kevin [B-In Title Only]

McConville, Daniel [B-In Title Only]
Nadkarni, Arsh [B-In Title Only]
Petersen, Scott [B-In Title Only]
Spurling, Reed [B-In Title Only]
Werrell, Kenneth [B-In Title Only].

Condes, AnnMarie (Chemistry, Pima Community College) See:
Bell, Quynn [B-1]
Cleveland, Estevan [B-1]
Esquivel, Maximo [B-In Title Only]
Moir, Zach [B-1]
Pomales, Briana [B-In Title Only]
Vandivort, Nathan [B-In Title Only]
Zavala Quijada, Andres Leonardo [B-In Title Only].

Craig, Stuart (Aerospace and Mechanical Engineering, University of Arizona) See: Pudwill, Dashiel [H-In Title Only].

Das, Jnaneshwar (School of Earth and Space Exploration, Arizona State University) See: Staggers Jr, Rodney [G-12].

Denny, Angelita (Legacy Management, Department of Energy) See: Renteria, Alyssa [C-11].

Desch, Steven (School of Earth and Space Exploration, Arizona State University) See: Chamberlin, Kathryn [C-1].

Duffy, Katharyn (EcoInformatics, Northern Arizona University) See: Jimenez, Christian [C-In Title Only].

Eaton, Hillary (Department of Biology and Chemistry, Embry-Riddle Aeronautical University) See: Davis, Bethany [C-In Title Only].

Edwards, Christopher (Astronomy and Planetary Sciences, Northern Arizona University) See: Zigo, Hannah [D-6].

Ertel, Steve (Astronomy, University of Arizona) See: Kirch, Zachary [D-5].

Etling, Chris (Arizona Daily Sun, Arizona Daily Sun) See: Reinhardt, Christianna [E-5].

Fewell, Jennifer (School of Life Sciences, Arizona State University) See: Sypherd, Ciara [G-In Title Only].

Fink, Wolfgang (Biomedical Engineering, and Electrical and Computer Engineering, University of Arizona) See: Brown, Shaun [H-In Title Only].

Frank, Timothy (Engineering, Glendale Community College) See:

Cooper, Genevieve [B-4]
Fell, Maxwell [B-4]
Jayyusi, Feras [B-4]
Mata, Anyell [B-4]
McCormick, Kyle [B-4]
Rodriguez, David [B-4].

Gerst, Kathy (National Phenology Network, University of Arizona) See: Filler, Sydney [C-In Title Only].

Green, Matthew (School for Engineering of Matter, Transport, and Energy, Arizona State University) See: Hocken, Alexis [G-6].

Hanley, Jennifer (Astronomy, Lowell Observatory) See: Bandelier, Zeke [D-2].

Harig, Christopher (Geosciences, University of Arizona) See: Lubeck, Mila [C-6].

Hartnett, Hilairy (School of Earth and Space Exploration, Arizona State University) See: Sauer, Elinor [C-12].

Hawthorne, Mark (Material Science, ATC Materials) See: Galus, Christopher [G-3].

Hayashibara, Shigeo (College of Engineering, Embry-Riddle Aeronautical University) See: Mobley, Forrest [H-In Title Only].

Haydel, Shelley (School of Life Sciences, Arizona State University) See: Ganser, Collin [G-4].

Hogue, Ian (Immunotherapy, Vaccines and Virotherapy, Arizona State University) See: Velarde, Kimberly [A-4].

Hood, Lon (Lunar and Planetary Laboratory, University of Arizona) See: Bustamante Torres, Cecilyn [D-In Title Only].

Hurst, Stephanie (Department of Chemistry and Biochemistry, Northern Arizona University) See: Pfefferle, Tiphanie [G-10].

Isenberg, Douglas (Mechanical Engineering, Embry-Riddle Aeronautical University) See: Fike, Thomas [B-In Title Only]
Phaklides, Nicodemus [B-In Title Only].

James, Curtis (Applied Aviation Sciences, Embry-Riddle Aeronautical University) See: Swenson, Paige [C-In Title Only].

Jansen, Rolf (School of Earth and Space Exploration, Arizona State University) See: Nolan, Liam [F-9].

Johnson, Nancy (School of Earth and Sustainability, Northern Arizona University) See: Gammon, Cedric [C-3].

Kitchen, Jennifer (School of Electrical, Computer and Energy Engineering, Arizona State University) See: Scobie, Brendan [G-In Title Only].

Kukolich, Stephen (Department of Chemistry, University of Arizona) See: Villaran, Riva [A-In Title Only].

Lestari, Wahyu (Aerospace Engineering, Embry-Riddle Aeronautical University) See: Gentile, Joseph [G-In Title Only].

Lindberg, Gerrick (Chemistry and Biochemistry, Northern Arizona University) See: Ghaby, Kyle [G-5].

Little, Jesse (Aerospace and Mechanical Engineering, University of Arizona) See:
Greene, Collin [H-4]
Szewczyk, Kailie [H-In Title Only]
Tomooka, Paxton [H-In Title Only].

Ly, Chun (Steward Observatory, University Libraries, University of Arizona) See: McCormick, Caroline [F-8].

Martin, Keala (Aerospace Engineering, Embry-Riddle Aeronautical University) See: Landon, Parker [H-5].

Martin-Garcia, Jose (Center for Applied Structural Discovery, Arizona State University) See: Jernigan, Rebecca [A-In Title Only].

Martinovic, Mihailo (Lunar and Planetary Laboratory, University of Arizona) See: Gramze, Savannah [F-In Title Only].

Mauskopf, Philip (School of Earth and Space Exploration, Arizona State University) See:
Mena, Julian [G-9]
Stephenson, Ryan [H-8].

Morris, Wallace (Aerospace Engineering, Embry-Riddle Aeronautical University) See: Wolfenbarger, Thorne [H-In Title Only].

Murray, Steven (School of Earth and Space Exploration, Arizona State University) See: Whitler, Lily [F-12].

Muscat, Anthony (Chemical and Environmental Engineering, University of Arizona) See:
Driskill, Madison [A-In Title Only]
Jacobson, Sofia [A-In Title Only].

Nelson, Mansel (Institute for Tribal Professionals, Northern Arizona University) See: Murphy, Kaitlin [E-3].

Nichols, Mary (Southwest Watershed Research Center, U.S. Department Of Agriculture - Agricultural Research Service) See: Thompson, Lauren [C-14].

Parker, Mike (Rincon Research Corp, University of Arizona) See: Smith, Joshua [G-11].

Patience, Jennifer (School of Earth and Space Exploration, Arizona State University) See: Worthen, Kadin [F-13].

Perreault, François (School of Sustainable Engineering and the Built Environment, Arizona State University) See: Januszewski, Brielle [C-4].

Propper, Catherine (Biology, Northern Arizona University) See: Cullipher, Michaela [F-1].

Pryor, Wayne (Science, Central Arizona College) See:
Anderson, Michaela [B-In Title Only]
Barkley, Daniel [B-In Title Only]
Dsouza, Gerard [B-In Title Only]
Fulton, Aerin [B-In Title Only]
Garcia, Eduardo [B-In Title Only]
Korges, Christopher [B-3]
Lopez, Federico [B-In Title Only].

Ramirez-Andreotta, Monica (Environmental Science, University of Arizona) See:
Segapeli, Allison [C-13]
Van Overmeiren, Nicole [C-15].

Riggs, Nancy (Geology, Northern Arizona University) See: Estes, Bailey [C-In Title Only].

Robinson, Tyler (Astronomy and Planetary Science, Northern Arizona University) See: Gialluca, Megan [D-4].

Saez, Eduardo (Chemical Engineering, University of Arizona) See: Weiler, Carlos [C-17].

Saltzman, Tisha (Steward Observatory, University of Arizona) See: Baller, Alyssa [H-2].

Schwarz, Kamber (Lunar and Planetary Laboratory, University of Arizona) See: Fulford, Ruby [F-4].

Scowen, Paul (School of Earth and Space Exploration, Arizona State University) See: Duarte Nevarez, Janet [H-3].

Sharp, Thomas (School of Earth and Space Exploration, Arizona State University) See: Marquardt, Madeline [D-In Title Only]

Martinez Morales, Ivan [B-5]
Yurgel, Christopher [B-5].

Shirley, Yancy (Astronomy, University of Arizona) See:
Galloway-Sprietsma, Maria [F-5]
Lilly, James [F-7].

Shock, Everett (School of Earth and Space Exploration, Arizona State University) See:
Baez, Justin [D-1]
Kubby, Crystal [A-In Title Only]
Orrill, Brianna [C-8]
Walton, Taylor [C-16].

Sierra, Reyes (Chemical and Environmental Engineering, University of Arizona) See: Pepel, Richard [C-9].

Smith, Nathan (Astronomy, University of Arizona) See: Dickinson, Danielle [F-2].

Stolte, Daniel (University Communications, University of Arizona) See: Abraham, Rachel [E-1].

Szivek, John (Orthopaedic Surgery, University of Arizona) See: Figueroa, Gerardo [G-2].

Thangavelautham, Jekan (Aerospace and Mechanical Engineering, University of Arizona) See:
Aldava, Felicity [H-1]
Johnson, Matthew [G-In Title Only]
Garcia, Francisco [G-In Title Only].

Thompson, Lisa (Geology, Northern Arizona University) See: Kunkle, Emily [C-5].

Tian, Xiaojun (School of Biological and Health Systems Engineering, Arizona State University) See: Borsenik, Andrea [G-In Title Only].

Villicaña, Ernest (Engineering, Phoenix College) See:
Boland, Meghann [B-2]
Gebremariam, Misgana [B-2]
Meza, Constantino [B-2]
Mudd, Maxx [B-2]
Perez Torres, Javier [B-2]
Queen, Samuel [B-2].

Walker, Sara (School of Earth and Space Exploration, Arizona State University) See:
Dromiack, Hannah [A-1].

Whipple, Amy (Biology, Northern Arizona University) See: Hernandez, Maria [C-In Title Only].

White, Daniel (Mechanical Engineering, Embry-Riddle Aeronautical University) See:
Butcher, Trevor [H-In Title Only]
Gray, Brennan [H-In Title Only]
Hepburn, Alexis [H-In Title Only]
Laub, Becca [H-6]
Rocha, Katherine [H-7].

Williams, Stephen (Astronomy, United States Naval Observatory) See: Kurtz, Peter [F-In Title Only].

Zaniewski, Anna (Physics, Arizona State University) See:
Gutierrez, Eric [A-In Title Only]
Johnson, Holly [A-In Title Only].

Zanolin, Michele (Physics Department, Embry-Riddle Aeronautical University) See: Ratto, Brad [A-3].

Zaritsky, Dennis (Department of Astronomy, University of Arizona) See: Webster, Ryan [F-11].