UROC Undergraduate Research Opportunities Consortium

Abstract Review

August 2014

The University of Arizona
Graduate College

UROC

Undergraduate Research Opportunities Consortium

19th Annual Undergraduate Research Opportunities Consortium (UROC) Conference

Summer Research Institute
Minority Health Disparities (MHD)
Maximizing Access to Research Careers (MARC)
Hooked on Photonics
Integrated Optics for Undergraduate Native Americans
Biosphere 2 - Research Experience for Undergraduates
Biosphere 2 - Environmental Science Internship Program
Student Affairs Research Program
UROC - PREP
CAT Vehicle / Electrical and Computer Engineering Research Experience for Undergraduates

Integrated Optics for Undergraduate Native Americans

Principal Investigator: Allison Huff MacPherson, PhD

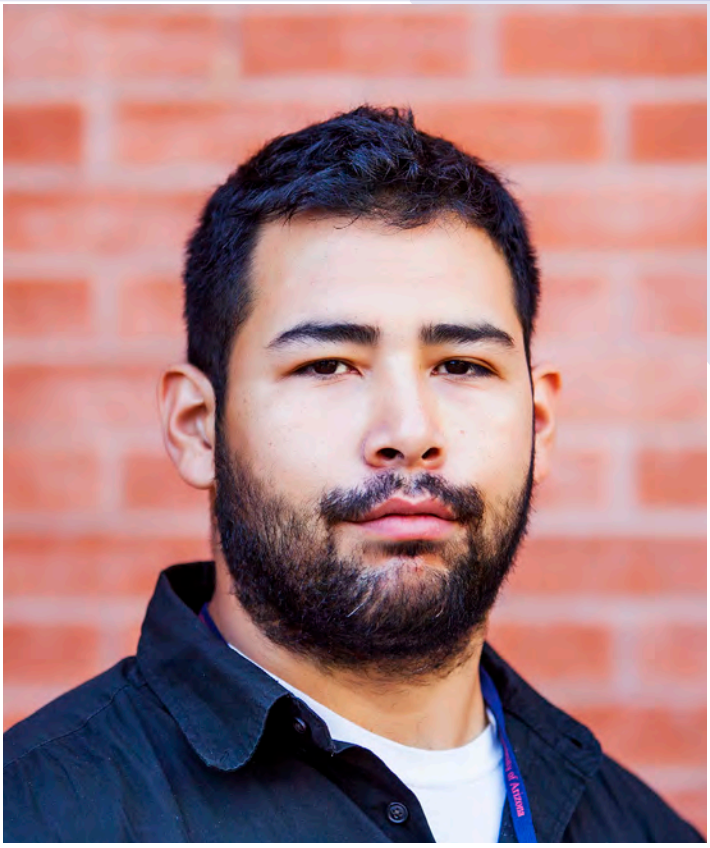
Coordinators: Ameé Hennig, Danny Lamoreaux

UA is the lead institution for the NSF Engineering Research Center, The Center for Integrated Access Networks (CIAN). The Integrated Optics for Undergraduate Native American (IOU-NA) REU program inspires undergraduate Native American students to pursue their goals in STEM research by having students work collaboratively with faculty, graduate students, and other professionals on research projects.

Research projects were conducted in optics and photonics, hydrology, atmospheric sciences, and soil sciences. As part of the program, students were introduced to Native American professionals and graduate students pursuing similar goals, research, and work in industry, and participated in workshops that focus on understanding and performing research on reservations. Students who participated in this year's IOU-NA identified with 7 different tribes.

Alexander N. Alvara

Integrated Optics for Undergraduate Native Americans
Comanche & Tohono O'odham



University of California, Irvine

Irvine, California

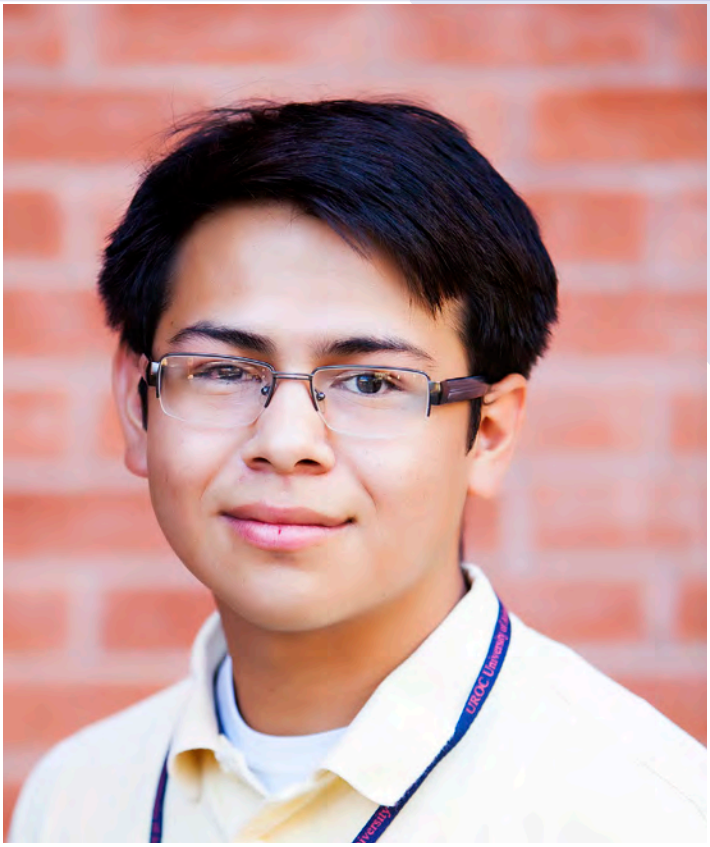
PI: Dr. Palash Gangopadhyay

THE INFLUENCE OF ORDERED NANOSTRUCTURED CARBON ELECTRODES ON SUPERCAPACITOR PERFORMANCE

Abstract: Key objective during this IOU – NA REU program is to study influence of ordered anostructured carbon electrodes on several supercapacitor devices fabricated using nanostructures of different dimensions. The base carbon electrodes were to be fabricated using carbon – graphene composites. With their high power densities, fast recharge times and long cycle life, supercapacitors are likely replacements for rechargeable batteries in the future. To meet demands for improved performance and ability to rapidly charge-discharge, new developments in electrode designs are required. This paper presents our work aimed at advancing charging rates and boosting capacities by the use of active materials whose surface to volume ratio is higher than current technology. We propose the implementation of nanoimprinted carbon based supercapacitors. Applications are numerous and may include, for example, cell phone batteries that can be recharged 5 – 10x faster and an extra 480 hp at speeds of 200 mph in high performance hybrid racecars.

Robert Castellanos

Integrated Optics for Undergraduate Native Americans
Colorado River Indian Tribes



Haskell Indian Nations University

Lawrence, Kansas

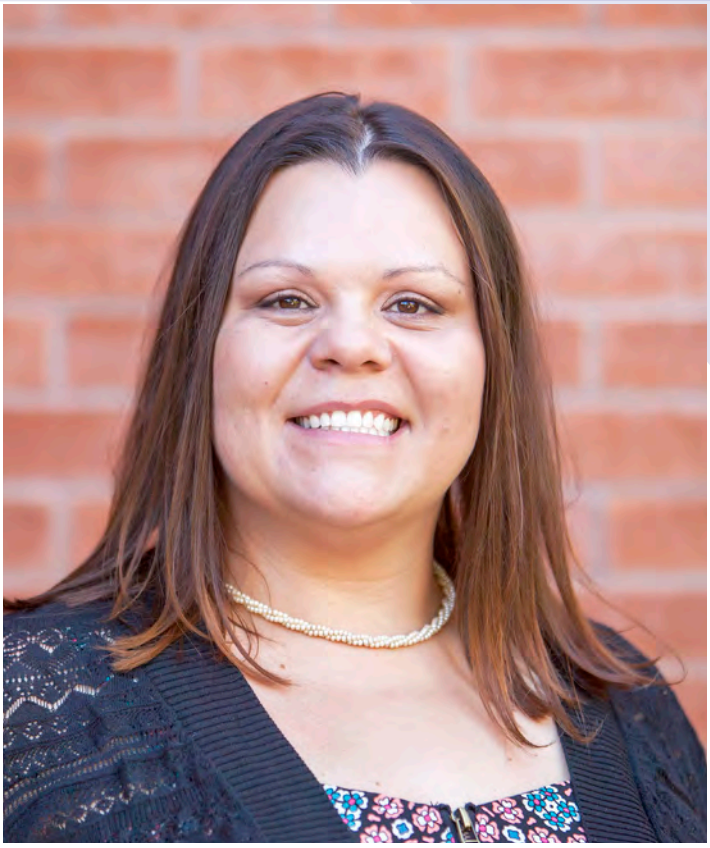
PI: Dr. Robert A. Norwood

POLYMER ANTIREFLECTION COATING FOR SULFUR COPOLYMER OPTICAL ELEMENTS

Abstract: Newly synthesized poly(S-r-DIB) has a high transmittance at lower frequencies (IR spectrum) allowing this material to compete with conventional IR materials because of its unique mechanical properties. Sulfur copolymer material has a high refractive index causing it to have high reflectance of light. In order to reduce the reflection at its surface an anti-reflection (AR) coating is applied to increase transmission of light in NIR to SWIR and MWIR bands.

Jennifer Graham

Integrated Optics for Undergraduate
Native Americans
Assiniboine



Eastern Washington University

Cheney, Washington

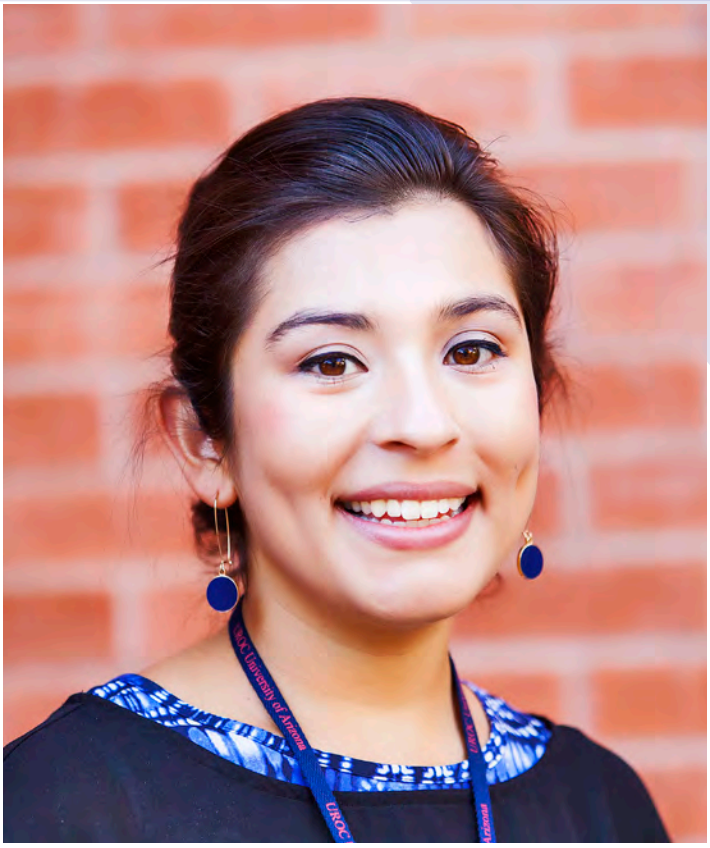
PI: Dr. Katerina Dontsova

NUTRIENT UPTAKE BY PLANTS AND THEIR ASSOCIATED MICROBIOTA GROWN IN DIFFERENT POROUS ROCK SUBSTRATE

Abstract: Weathering of rock substrates is caused by physical, chemical and biological processes. Microorganisms in contact with rocks can sometimes form bio-deteriorative patina which can help break down the rocks (De la Torre et al., 1993). There is copious research that shows that microbes can significantly weather minerals and rocks by influences pH and redox reactions. This weathering from microbiological activity has been evidenced for basaltic glass and silicates (Thorseth et al., 1992; Jongmans et al., 1997). Coevolution of bacteria and plants has given many forms of microbial interactions such as nitrogen fixation. This interaction helps promote root development which may be associated with greater rock weathering. Specifically we look at how plants grow on bare rock substrates (basalt, rhyolite, granite and schist), which nutrients they acquire, biological stoichiometry, fine fraction production from primary minerals embedded in rock structure, and how associated bacteria and mycorrhizae contribute to these processes.

Solianna Herrera

Integrated Optics for Undergraduate
Native Americans
Apache



University of South Florida

Tampa, Florida

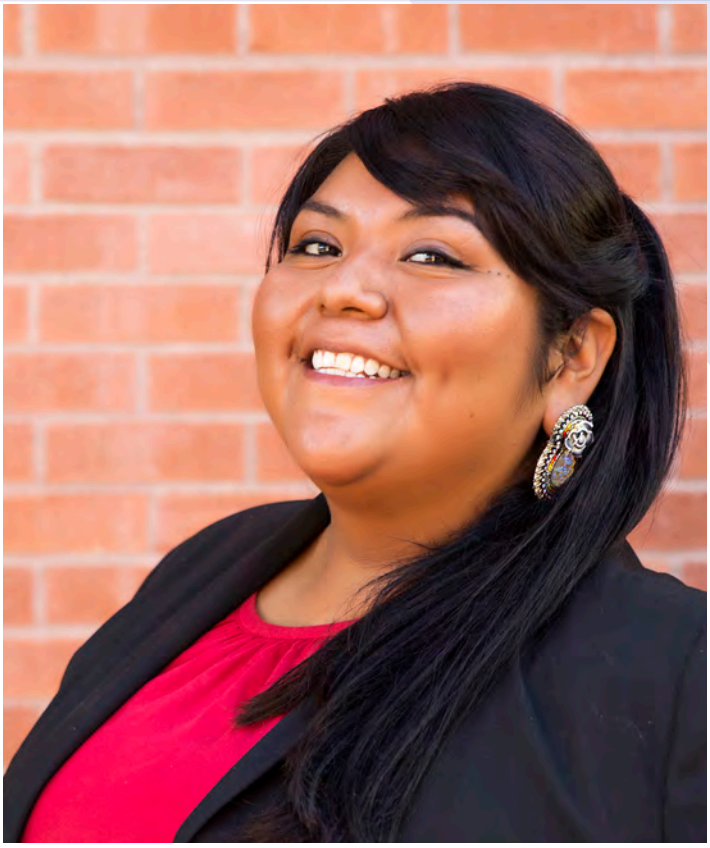
PI: Dr. Eric Betterton

ANALYSIS OF AIRBORNE CONTAMINANTS AT MINING SITES IN SOUTHERN ARIZONA

Abstract: Airborne Contaminants derived from mining operations in southern Arizona, pose various health risks to humans, and the surrounding ecology. Our study focuses on mining operations in Hayden, AZ. A recent public health assessment had reported complaints from Hayden's residents alluding to the notable differences in difficulty of breathing at night versus the daytime. The purpose of this study is to investigate these claims, and test a new filtration system from a bag-house placed over the Hayden smelter. It is suspected that an increase in sulfate concentrations are the cause of the respiratory problems the residents are claiming to, and so a series of samples were taken from the smelter sites and tested for water-soluble ion contaminants, and heavy metal contaminants. Finally, daytime data was compared with nighttime data in order to come to conclusions concerning the new filtration system, and if lead and arsenic levels are decreased as a result.

Amy Juan

Integrated Optics for Undergraduate
Native Americans
Tohono O'odham



Tohono O'odham Community College

Sells, Arizona

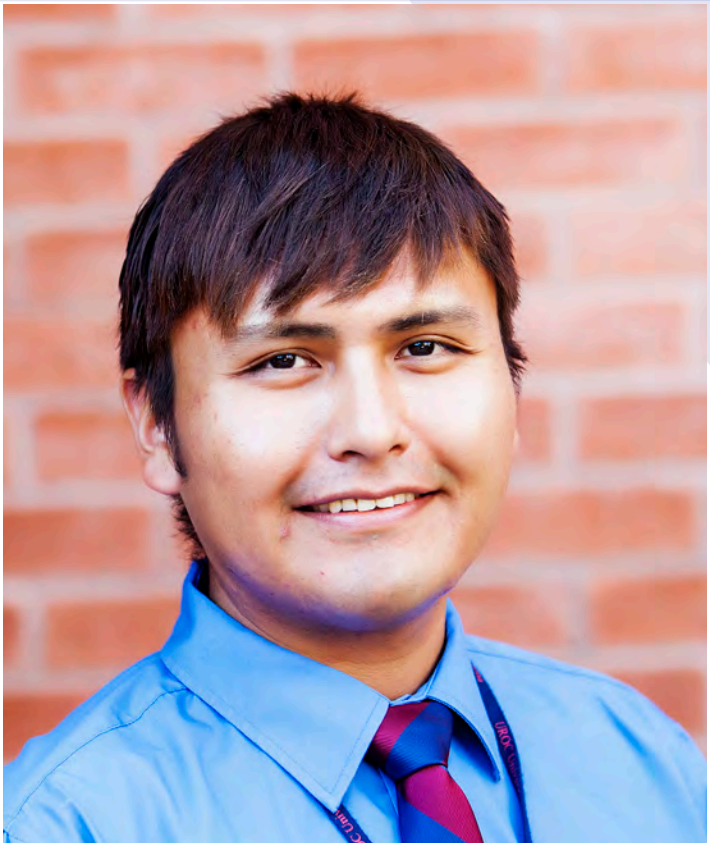
PI: Dr. Constance E. Walker

DARK SKY CONSERVATION AND LIGHT POLLUTION MEASUREMENTS OF TUCSON, ARIZONA AND SURROUNDING OBSERVATORY MOUNTAINTOPS

Abstract: Dark skies are essential to human health. With the American population growth rate at 1.5% and the development of artificial light sources growing at 6% per year, the effects of light pollution are becoming more apparent. In 2012, the American Medical Association classified artificial light pollution as a carcinogen, which suppresses melatonin production and encourages cancer cell growth in addition to other health concerns. With the popularity of citizen conducted and supported science by NOAO and the Astronomical Communities rising, we inter-compared the following measurement tools to see how well direct and indirect sources correlate when measuring light pollution. To take data, we conducted research at sixteen different locations in and around Tucson and the surrounding mountaintop observatories.

Mono Livingston

Integrated Optics for Undergraduate
Native Americans
Navajo



Boston University

Boston, Massachusetts

PI: Dr. Milorad Cvijetic

Optimization of Optical Transmission of Gigabit Ethernet Rates

Abstract: The purpose of this research project is to optimize a transmission system with Gigabit Internet Rates over the entire C-band that ranges from 1530-1560 nm. The 1Gb/s signal that is generated will be sent to and analyzed by an optical receiver. The idea is to examine the transmission changes that occur within the wavelength range to find a wavelength with the highest output power with minimized errors. Once the optical receiver detects this signal, calculation of the Bit Error Rate (BER) will be made by a code written in the Matlab Software. With the data collected, it will help elaborate on the optimization procedure to which conclusions can be made.

Scott Tan

Integrated Optics for Undergraduate
Native Americans
Blackfoot

Pomona College

Claremont, California

PI: dr. Palash Gangopadhyay

FABRICATION OF THREE-DIMENSIONAL GRIDLOCKED HIERARCHICAL NANOSTRUCTURED CARBON ELECTRODES USING GRAPHENE AND MAGNETIC FIELD ALIGNED SINGLE-WALLED CARBON NANOTUBES; AND THEIR APPLICATIONS AS SUPERCAPACITOR ELECTRODES

Abstract: Effective and low-cost energy storage devices are the key focus of extensive research efforts dedicated towards the development of a more sustainable future. Supercapacitors are unique devices that store energy with many advantages over regular rechargeable batteries. In this project we focused on optimizing a three-dimensional gridlocked hierarchical nanostructured design for carbon electrodes using graphene and magnetic field aligned carbon nanotubes. The highly porous structure, in combination with enhanced networks of conductive paths in the electrode, is expected to increase active surface area of the electrode by many-fold, thereby increasing its performance.

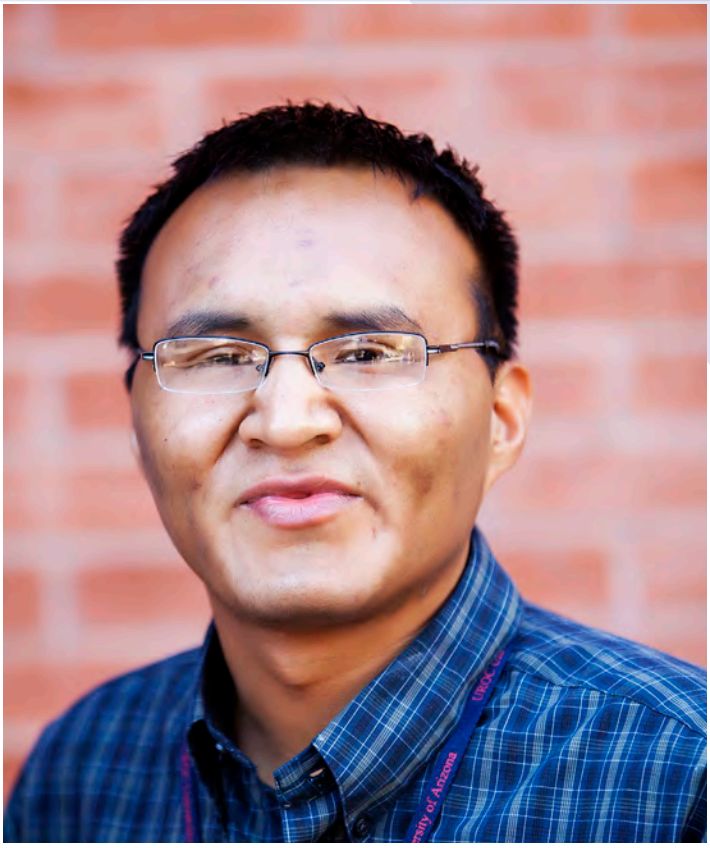
Carbon slurry composed of activated charcoal, polyvinylidene fluoride, graphene, and single-walled carbon nanotubes was dispersed in dimethylformamide and coated upon carbon coated copper foil. Samples were aligned within a magnetic field and dimethylformamide was evaporated to gridlock the electrode nanostructure. Fabricated electrodes were assembled into supercapacitor devices. Performance was tested and evaluated using cyclic voltammetry and galvanostatic charge-discharge measurements.

Results confirm that fabricated electrodes with aligned carbon nanotubes possess higher capacitance compared to those without magnetic alignment. Analysis of data shows specific capacitance as high as 67.1 F/g. Magnetic field alignment enhances specific capacitance by 259%, specific areal capacitance by 155%, Coulomb efficiency by 104%, peak energy density by 163%, and power density by 102% .

When graphene and carbon nanotubes are aligned by a magnetic field, the electrolyte in a supercapacitor is able to access an increased amount of surface area on the electrodes, thereby increasing its performance. Further research may be done to optimize electrode compositions.

Carl Whitehair

Integrated Optics for Undergraduate
Native Americans
Navajo



Fort Lewis College

Durango, Colorado

PI: Dr. Thomas Meixner

EVIDENCE FOR DEEP MOUNTAIN BLOCK CIRCULATION FROM STREAM CHEMICAL DATA IN SABINO CREEK

Abstract: A number of the Santa Catalina-Jemez Critical Zone Observatory (CZO) research sites are located in the Santa Catalina Mountains near Tucson, Arizona. The data collected from the CZO research sites allow us to understand the potential causes of observed recharge water occurring in the Santa Catalina Mountain. By connecting the site specific observation of spring and streams will enable a better understanding of the potential causes of observed stream chemical composition in the Catalina's and the underlying hydrology.

PROGRAM STAFF AND SPONSORS

SUMMER RESEARCH INSTITUTE (SRI)
Coordinator: Donna Treloar, MA
Instructors: Jose Manuel Cortez, Renee Reynolds
Sponsors: University of Arizona; Graduate College; The Partnership for Native American Cancer Prevention (NACP) training program, a collaboration between Northern Arizona University and the University of Arizona Cancer Center, funded by the National Cancer Institute; College of Medicine – Office of Diversity and Inclusion; Health Resources and Services Administration (HRSA) Centers of Excellence; Western Alliance to Expand Student Opportunities (WASEO).

MINORITY HEALTH DISPARITIES SUMMER RESEARCH PROGRAM (MHD)
Coordinator: Stephanie Adamson
Sponsors: University of Arizona; Graduate College; Western Alliance to Expand Student Opportunities (WASEO).

MAXIMIZING ACCESS TO RESEARCH CAREERS (MARC)
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Coordintor: Cindy Neal, MEd
Sponsors: NIGMS/TWD Division GM 08718

HOOKED ON PHOTONICS RESEARCH EXPERIENCE FOR UNDERGRADUATES (HOP)
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Sponsors: National Science Foundation (NSF). Funding for this research was provided by the NSF Grant No. CHE 0851730

CIAN INTEGRATED OPTICS FOR UNDERGRADUATE NATIVE AMERICANS (IOU-NA) RESEARCH EXPERIENCE FOR UNDERGRADUATES
PI: Allison Huff Mac Pherson, D.H. Ed., Robert Norwood, Ph.D.
Coordintor: Ameé J. Hennig, Daniel Lamoreaux
Sponsors: National Science Foundation (NSF) Engineering Research Center for Integrated Access Networks (ERC CIAN). Funding for this research was provided by the NSF Grant No. #EEC-1359163

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Sponsors: National Science Foundation Research Experiences for Undergraduates Program

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Sponsors: University of Arizona; Graduate College; Division of Student Affairs

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Instructor: Andrew Huerta, PhD,
Sponsors: University of Arizona; Graduate College

CAT VEHICLE PROGRAM/ ECE REU
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Coordinator: Nancy Emptage
Sponsor: National Science Foundation Research Experiences for Undergraduates Program

FRONTERA
PI: Margaret Briehl, PhD
Sponsors: Partnership for Native American Cancer Prevention (NACP) Training program, a collaboration between Northern Arizona University and the University of Arizona Cancer Center, funded by the National Cancer Institute