



NAVIGATING  
THE  
*Green*  
ROAD

A Guide to  
Northern Arizona University's  
Environmental Resources

NORTHERN  
ARIZONA  
UNIVERSITY





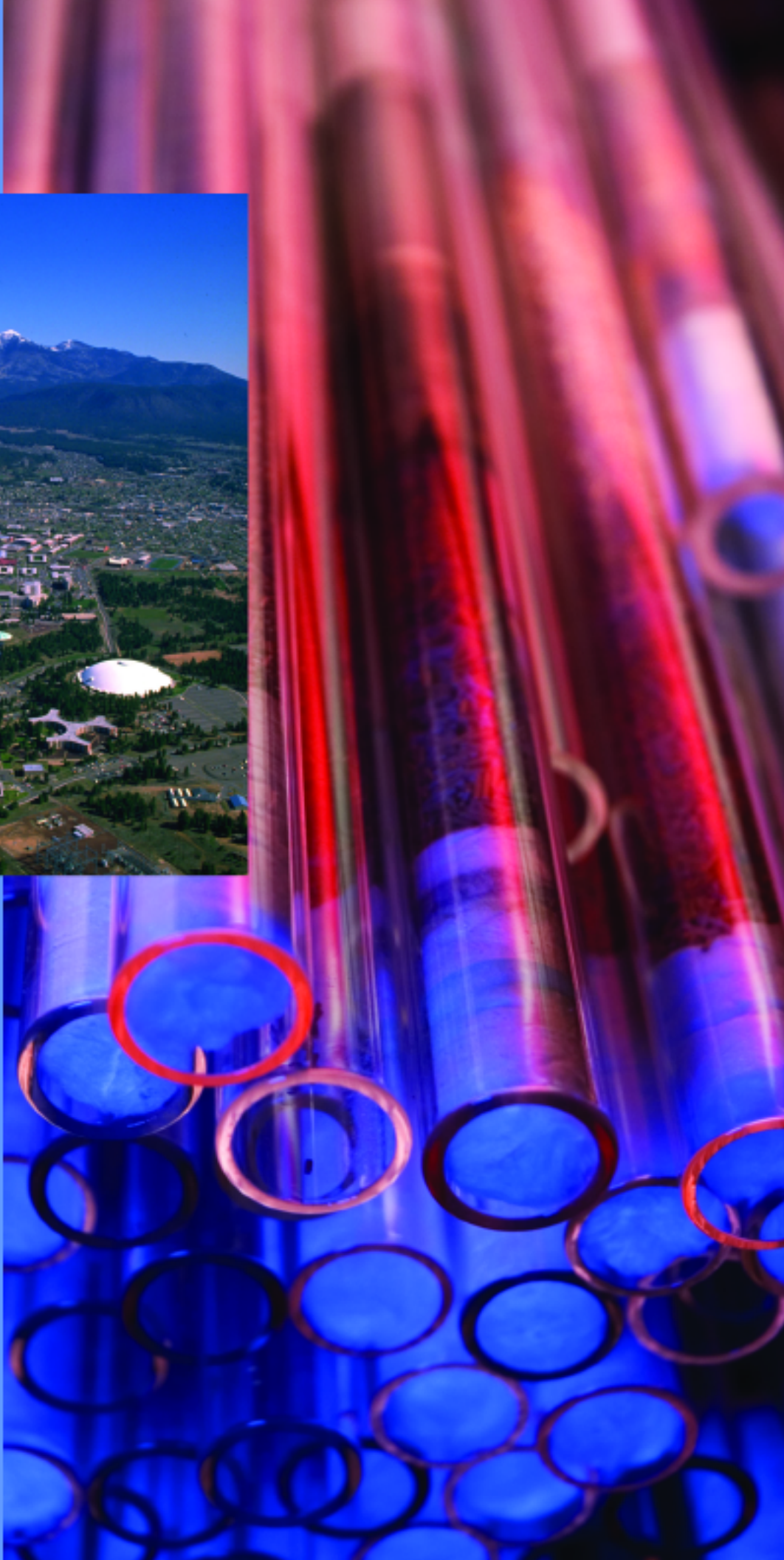
*front cover: Close-up of a cactus from the Teaching Greenhouse.  
above: Overview of the NAU campus, Flagstaff, and the San Francisco Peaks.  
right: Combustion reduction tubes used for elemental analysis in the Colorado Plateau Stable Isotope Laboratory.*

Text written and edited by the Ecological Monitoring & Assessment Program.

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## Message from the PRESIDENT

Please join me in celebrating the development of Northern Arizona University's *Environmental Resource Guide*. This monumental achievement marks the first comprehensive compilation of the university's environmental services, organizations, and programs in one complete format.

The *Guide* serves as a directory to the diverse and interconnected resources of the University and another point-of-reference for governmental, tribal, and non-governmental groups and individuals searching engagement, research, and partnership opportunities—allowing for broad environmental and community involvement.

I'd like to extend my appreciation to the many individuals who participated in the development of this guide, but also to those who have dedicated their careers to the important efforts outlined herein that are taking place across the region.

I hope you will find this information helpful and welcome your involvement in the University's environmental initiatives.

Sincerely,

A handwritten signature in black ink that reads "John D. Haeger". The signature is written in a cursive, flowing style.

John D. Haeger  
President, Northern Arizona University  
Board of Directors, EMA Foundation





## Introduction to NAU and **THE ECOLOGICAL MONITORING & ASSESSMENT PROGRAM**

Located on the Colorado Plateau, Northern Arizona University attracts educators, scientists, researchers, and students interested in working and learning within one of the world's most extraordinary ecosystems. From the depths of the Grand Canyon, where the Colorado River winds its way through millions of years of geological history, to the heights of Humphrey's Peak, Arizona's highest mountain, our institution is nestled in the heart of a region rich with ecological diversity.

This unique ecoregion has laid the foundation for NAU to develop into an integrated environmental education and research institution. For more than a century, the University has become an assemblage of people with diverse backgrounds and specific interests committed to understanding and exploring the environment. This ecoregion also houses numerous governmental agencies, private organizations and intellectual talent dedicated to the natural world.

As members of the ecological community, we have an obligation to understand our relationship with the ecosystem and inspire future generations to discover theirs. Through NAU's combined strengths of student education, organizational collaborations, and research, the academic community of NAU is changing the way society thinks about its responsibilities to a world that is now facing complex ecological problems.

One mission of the Ecological Monitoring & Assessment (EMA) Program is to identify environmental learning opportunities on campus and promote interdisciplinary cooperation. New environmental programs are continually being developed and we are constantly surprised at their rate of growth and level of integration. The wide variety of programs included in this guide establishes a valuable cornerstone for NAU. It is our hope that this guide opens the door to exploring the rich opportunities at NAU—from students choosing a future in the environmental arena to our many external partners tapping into the vast knowledge available at this institution.

We thank the many people who have helped develop the information in this guide, for their environmental leadership, and for embracing the value of collaboration. As we come to appreciate the environmental resources of NAU, we envision a future full of a wealth of opportunities that are available to meet current and future challenges.

Karan English  
Director, EMA Program  
Vice President, EMA Foundation

Carl Fox  
Vice Provost for Research, NAU  
Board of Directors, EMA Foundation

## Tools for Navigating THE GREEN ROAD



### Information for Students

- Environmental degree programs and courses of study are listed in the back of this guide. For the most up-to-date courses offered at NAU please search the online catalog at <http://www4.nau.edu/aio/AcademicCatalog/academiccatalogs.htm>.
- Student environmental clubs and organizations can be found in the back of the guide. For the most current information on active organizations and clubs registered at NAU go online to <http://www4.nau.edu/stulife/clubs.htm>.
- To find information about internships, jobs or volunteer opportunities that may be available, visit the websites listed on each program page or visit the Gateway Student Success Center for academic advising, career counseling, and employment services online at [www.nau.edu/gateway](http://www.nau.edu/gateway).

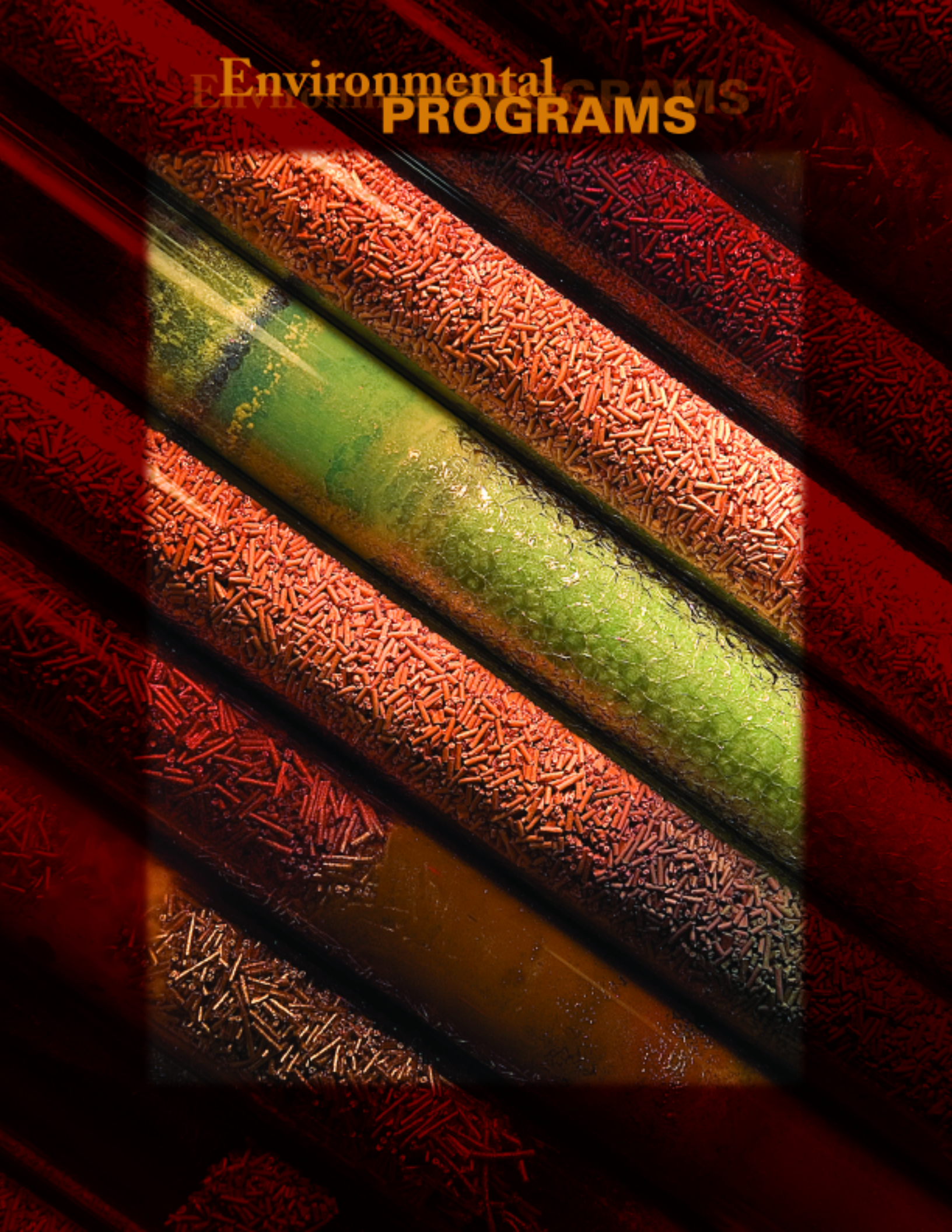
### How to Find the Most Current Version of This Guide

Navigate the green road online! For the most recent and up-to-date version of this guide, please visit the EMA website at [www.emaprogram.com](http://www.emaprogram.com).

### How to Update Guide Information

Does your department's program page need updating? Do you have a new environmental program that needs to be included in the guide? To request changes and additions please visit the Ecological Monitoring & Assessment Program & Foundation website at [www.emaprogram.com](http://www.emaprogram.com). Follow the link to the environmental guide and complete the necessary form. The staff at the EMA Program will review all requests and update the online guide before the start of the fall and spring semesters and summer session.

# Environmental PROGRAMS



## Department of ANTHROPOLOGY

NAU's Department of Anthropology offers undergraduate and graduate degrees in research or applied tracks. These degrees prepare students to answer current demands in the global village for solutions to an increasing range of problems between people, cultures and nations. NAU Anthropology majors study anthropological theory and method and the basic bodies of knowledge that make up the subdisciplines of anthropology.



- Subdisciplines include: Cultural Anthropology, Archaeology, Biological Anthropology, Linguistic Anthropology, and Applied Anthropology.
- Students in these programs benefit from the opportunity to work with professors who are active in wide-ranging research and use state of the art facilities with diverse collections from decades of investigations in the American Southwest and abroad.
- The Anthropology Laboratories are a research, educational, and service organization within the Department which includes the Ceramics Laboratory, the Laboratory of Paleoethnobotany, and the Lithics Laboratory.

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*Traditional dancers perform at the National Museum of The American Indian in Washington, DC.*

Department of  
ANTHROPOLOGY

## Ceramics Laboratory

The primary purpose of the Ceramics Lab is to identify and study prehistoric pottery from the Colorado Plateau. Staff members have honed expertise in identifying styles and technologies of prehistoric pottery using the traditional Southwestern typology and low-tech attribute analysis. Current investigations include work in the Petrified Forest, Wupatki, Sunset Crater and Agua Fria national monuments.



*Corrugated surface of a ceramic pot,  
Tusayan Gray Ware.*

- Specific technologies include light microscopy, oxidation, and comparative methods.
- Typical collaborators include NAU scientists, including those with the Navajo Nation Archaeology Department, the Hopi Cultural Preservation Office, the U.S. Forest Service, National Park Service, Museum of Northern Arizona and private environmental consulting firms.
- More detailed compositional studies of prehistoric ceramics can be arranged with the Department of Geology (optical petrography and electron microprobe analysis), and the Department of Chemistry and Biochemistry (full dissolution ICP analysis).
- The Lab maintains an extensive collection which exemplifies the types of ceramics found in northern Arizona.

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*Black and white ceramic shards from the Comparative Collection.*

Department of  
**ANTHROPOLOGY**

## Laboratory of Paleoethnobotany



Researchers in NAU's Lab of Paleoethnobotany, established in 1990, investigate historic and contemporary cultures of the Colorado Plateau. The Lab utilizes a diversity of materials, including archaeological soil samples, human fecal samples, tree-ring records and agricultural attributes.

- The Lab is equipped with soil flotation equipment, chemicals for the processing of archaeological fecal samples, and an array of low-powered microscopes.
- Primary research questions focus on: discovering subsistence strategies and changes in those strategies over time, use of wild, cultivated, and domesticated plants, environmental changes over time, and crop placement.
- Lab Director Andrea Hunter is helping to develop an interdisciplinary program between the Anthropology and Applied Indigenous Studies departments. The collaboration will result in an indigenous cultural resource management program to train tribal members.

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*Samples from the Comparative Collection.*



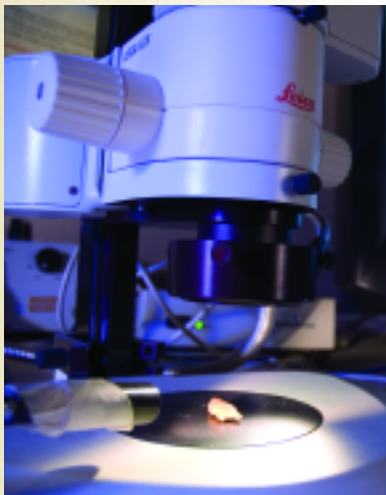
Department of  
ANTHROPOLOGY

## Lithics Laboratory



Researchers in the Lithics Lab analyze archaeologically recovered prehistoric and modern-day lithic materials. The Lithics Lab can perform contractual work for outside agencies or private companies who need lithic analytical components incorporated in their endeavors, but lack the expertise, personnel, or facilities to do so.

- The Lithics Lab supports graduate student research in lithic and related analytical domains including experimental and replication studies.
- The Lab provides facilities and direction for undergraduate researchers working on Hooper Undergraduate Research Awards.
- Currently, the Lab is working on the Colorado Plateau Agricultural Origins Project, which examines the lithic components of research on the earliest farmers in the northern Southwest.



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Department of  
ANTHROPOLOGY

## NAU/Hopi Program



The NAU/Hopi Program is a collaboration between NAU's Department of Anthropology and the Cultural Preservation Office of the Hopi Tribe. The goal of Hopi cultural preservation is to maintain the knowledge and continuity of a living culture through a combination of traditional approaches and modern technologies.

- Areas of study that further cultural preservation of the Hopi include anthropology, archaeology, linguistics, history, legal studies, and natural resource management.
- The Program is designed for exclusive participation by Hopi students who may benefit from scholarships, work-study positions at NAU, internships and employment opportunities with the Hopi tribal and governmental agencies.

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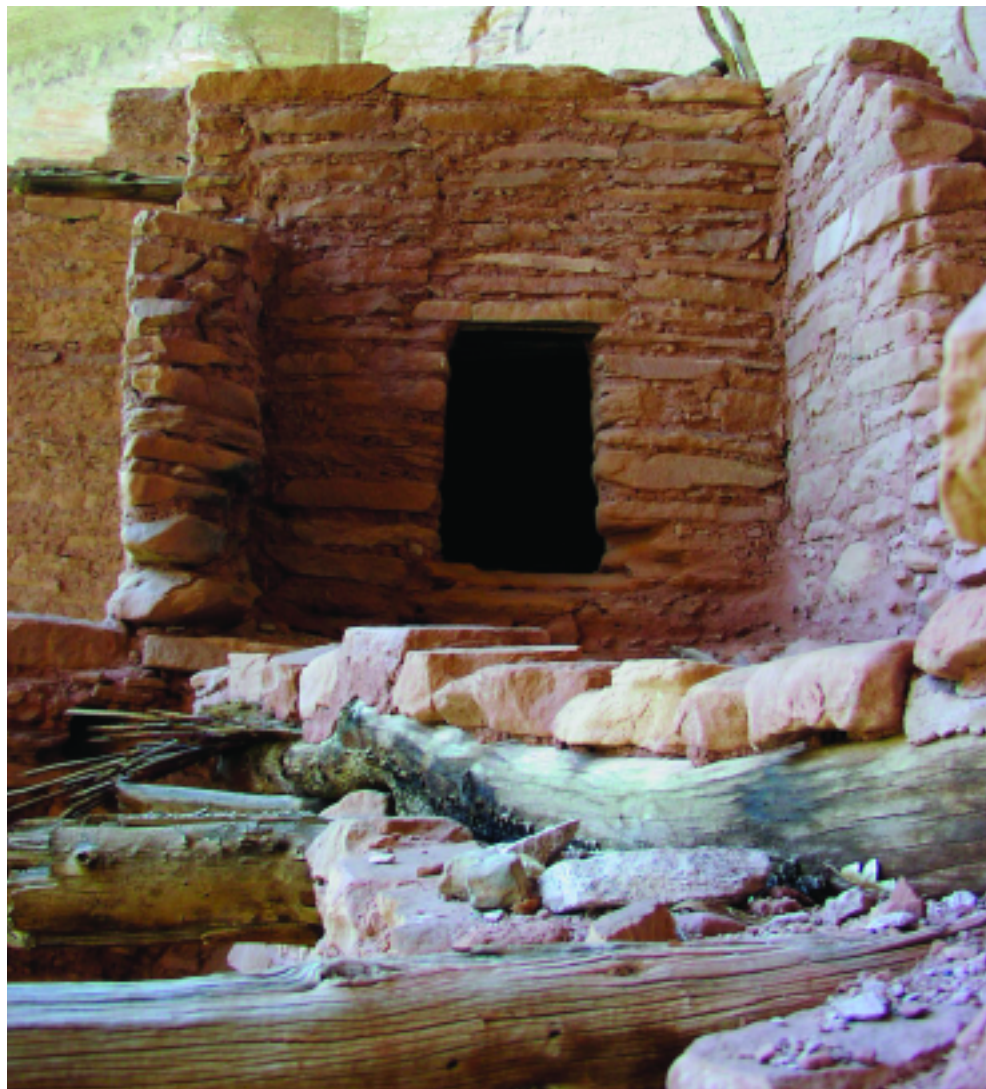
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*above: Traditional Hopi cornfield.  
right: Ruins at Kawestima, one  
of the largest cliff dwellings of  
the ancestral Puebloan people.*

## Department of APPLIED INDIGENOUS STUDIES (AIS)

NAU's Applied Indigenous Studies major combines contemporary tribal management skills with respect for indigenous culture, knowledge, values and beliefs. Students combine classroom education and traditional tribal knowledge to work effectively with indigenous communities. The Department's goal is to train individuals who can tackle the issues and challenges facing indigenous communities of today and tomorrow.



*Hogan in front of the Southwest Forest Science Complex.*

- AIS Resident Elders, Marina Xoc Castillo de Vasquez and Bob Lomadafkie are available at the Student Drop-in Center to advise students and organize socials, lectures, workshops and other functions.
- The Native American Studies minor is available to students interested in Native American culture, history, religion, and language.
- The Indigenous Health Studies minor is available to students interested in Native American health issues.

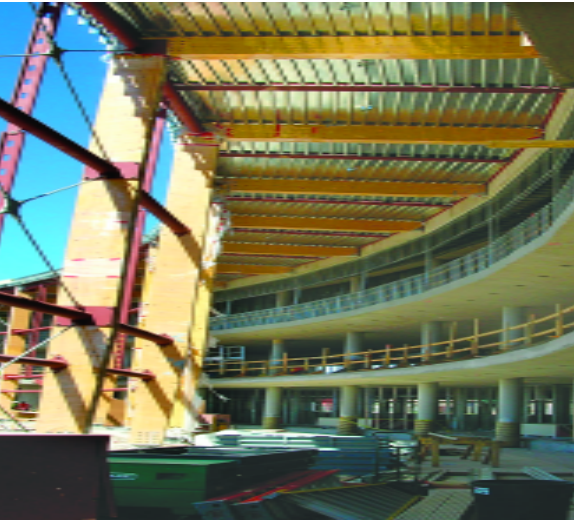


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## Applied Research AND DEVELOPMENT FACILITY (ARD)

NAU's Applied Research and Development Facility is a unique building designed to meet the expanding research needs of the University's key environmental research and outreach programs, including its public and private partners. It is designed and constructed as a "high performance building" that uses state of the art technologies and processes to reduce energy and water consumption, increase indoor air quality, and minimize resource consumption.



*top: ARD Facility under construction,  
Summer 2006.  
above: ARD Facility rendition.*

Important attributes of the ARD Facility include:

- The building is designed to meet the LEED Platinum Standard, the highest sustainability certification offered by the U.S. Green Building Council;
- Green building techniques such as improved indoor air quality, reduced energy costs, passive solar heating, and on-site waste treatment;
- Fiber optics, renewable energy, water conservation, and day lighting;
- Flexible research space to allow initiatives to move in and out of the Facility over time;
- Technology transfer space for showcasing technologies;
- A learning laboratory to teach users how to manage a building in order to improve its environmental performance and provide a working model for other regional facilities.

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# Arizona Hospitality RESEARCH & RESOURCE CENTER

The Arizona Hospitality Research and Resource Center provides research services, training programs, reports and tourism statistics for the hospitality and tourism industries, which are an economic mainstay in Arizona and the southwestern United States.

Entrepreneurs from hotels, restaurants, tour companies, casinos and other attractions benefit from the Center's longitudinal databases when executing feasibility studies, marketing or business plans.

The Center specializes in tourism survey research, which informs public agencies or private companies about economic impacts, visitor trends, quality of life, sustainability and other community and industry issues. Many customized training programs are available, offered on-line or in-person.



top: The AHRRC Team (from top left) Tim Foster, Grace Marks, Cheryl Cothran, Tom Combrink; (front left) Marilyn McDonald, Jenny Staskey  
above: Online Customer Service training, Colorado River Indian Tribes.

- Current and past clients include the Phoenix Civic Plaza, National Park Service, Arizona Office of Tourism, Bureau of Land Management, Cochise County, Hopi Tribe, Grand Canyon Railway, City of Flagstaff, Colorado River Indian tribes and Gila River Indian Community.
- In 2004, the Center and the National Park Service completed the *Grand Canyon National Park & Northern Arizona Tourism Study*. It was the first comprehensive visitation study of the Park in over a decade, synthesizing data about visitors' travel patterns and economic impacts.
- The Center received a 2003 Valle del Sol Hispanic Partnership Award in association with American Express for creating a Spanish-language customer service training program for Spanish-speaking hospitality industry employees.
- Public agencies and private interests are encouraged to seek the center's services through contracts or intergovernmental agreements.
- The Research & Resource Center is also a clearinghouse for tourism and hospitality publications that serve NAU's Hotel and Restaurant Management students, the industry and the public.

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## Arizona Water INSTITUTE (AWI)

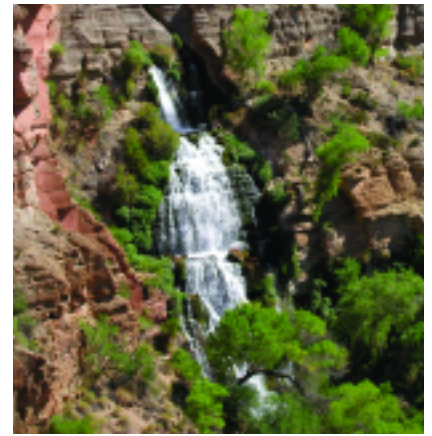
The Arizona Water Institute integrates the significant capabilities and programs of the three Arizona research universities to provide information, community assistance and technologies that support water management. NAU's mission for the AWI is to work with diverse communities, including tribes, to be a leader in addressing social, cultural, economic, engineering, and environmental issues related to water through research and education, outreach, collaboration, and discovery.



*above: Collecting water samples at Wiji Springs, Chaco Cultural Historic State Park.*

*middle: Measuring stream discharge at the scenic Verde River near Paulden.*

*right: Thunder River Springs in the Grand Canyon.*



AWI is virtual in nature, built with information technology instead of bricks and mortar, to address a three-fold mission:

- Serve as the hub of research, community assistance and analytical support to give Arizona the tools to assure clean and sustainable water resources for the next century and beyond;
- Provide education, training, and professional capacity building to the public, state, local and tribal government decision makers, water professionals, industry, and others about using, conserving and managing water in arid and semi-arid environments;
- Create water management expertise and technologies that produce new products and services for Arizona companies to export worldwide, thus creating a major new economic development driver for Arizona.

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## Bilby Research CENTER

The primary goal at the Bilby Research Center, founded in 1982, is to facilitate original research by NAU faculty, staff, and students in all departments by providing editing, illustration, web page design, photography and videography services. The center also encourages interdisciplinary collaboration and the open exchange of ideas by providing research space to NAU faculty from different but complementary departments.



- The main focus of research is the archaeology, environment, and paleoenvironment of the Colorado Plateau.
- The Bilby Center houses the Navajo Nation Archaeology Division Student Training Program, the NAU Anthropology Labs, the Laboratory of Paleoecology, the Holocene Environmental Change Lab, the Ethnoecology and Indigenous Mapping Lab, the Geomorphology Lab, the Watershed Research and Education Program, and the Electron Microprobe Lab.
- An on-site conference room, seating about 25 people, is available for meetings.

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# Biological, Environmental, and Cultural Database (BECBase)

In 2003, NAU created a relational database of several of the university's natural history collections and a custom Oracle database with Web interface tailored to the needs of NAU researchers and curators. The database provides labeling applications, loan tracking capabilities, security functions, and basic inventory and cataloging. In addition, its relational nature provides a way to access data from specific time periods or locations across the collections.

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BECBase is a collaborative effort of several campus labs, the National Park Service, U.S. Geological Survey and others. It contains unique and nationally important collections including:

- A modern pollen reference collection.
- USGS/NAU Macrobotanical Laboratory collection.
- Laboratory of Quaternary Paleontology collection.
- Modern botanical reference collection.
- Colorado Plateau Museum of Arthropod Biodiversity collection.



**Bilby Research  
CENTER**

## Navajo Nation Archaeology Department and Student Training Program



The Navajo Nation Archaeology Department is an agency of the Navajo Nation dedicated to providing the highest-quality cultural resource management consulting services to its clients at a reasonable cost, while preserving and protecting the cultural heritage of the Navajo people. Through a 1988 memorandum of agreement between the Navajo Nation and NAU, the Department operates a branch office on campus at the Bilby Research Center. As such, it is the first program of its kind to provide student training to Native American NAU students in the fields of archaeology and anthropology. The Program offers on-the-job training in survey methods, analysis of lithics and ceramics, computer skills, and tribal and federal policies regarding archaeology.

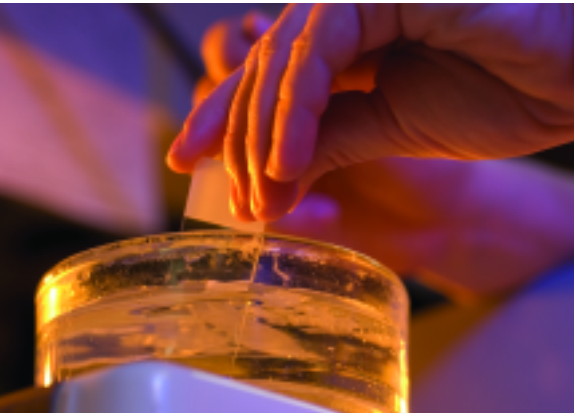
- Native American students are eligible to participate if they are majoring in anthropology or applied indigenous studies with an emphasis in cultural resource management.
- The Department primarily conducts archaeological surveys on the western part of the Navajo Nation.
- As part of their work, students also benefit from collaborations with many Navajo Nation departments and chapter houses, the National Park Service, Bureau of Land Management, and Bureau of Reclamation.
- Past students have gone on to positions in cultural resource management within the Navajo Nation and other tribal governments, as well as a variety of other occupations and higher education degree programs.
- The Program was recognized in 2000 with an award from Harvard University's Honoring Nations Awards Project through the John F. Kennedy School of Government.

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## Department of BIOLOGICAL SCIENCES

The Department of Biological Sciences, established in the 1950s, offers bachelor's degrees in biology with extended major options in fish and wildlife management, cellular and molecular biology, botany, physiology and exercise science, science teaching and zoology, among others. In addition, students may pursue minors in biology, microbiology or biology secondary education. Graduate options include a master's degree or doctorate in biology, and a master of arts in science teaching with research and extended coursework plans for teaching at the middle school, high school, and community college levels.



above: Preparing a microscope slide.  
below: Arthropods from the Colorado Plateau  
Museum of Arthropod Biodiversity Collection.

- The Department supports 105 graduate students. One third of those are doctoral candidates and the rest are seeking master's degrees.
- There are approximately 900 biology undergraduate majors with 190 graduates each year.
- The Department also houses the Avian Cognition Laboratory, Colorado Plateau Museum of Arthropod Biodiversity, Cottonwood Ecology Group, Deaver Herbarium, Environmental Endocrinology Laboratory, and the Teaching Greenhouse.

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Department of  
BIOLOGICAL SCIENCES

## Avian Cognition Laboratory

The Avian Cognition Laboratory is dedicated to investigating the behavior, ecology, genetics, learning and memory of seed-caching birds in the family Corvidae. Drs. Russell Balda and Alan Kamil designed the research facility in 1986 within the NAU Department of Biological Sciences.



above: Pinyon jay.  
below: One of the rooms in the Avian Cognition Laboratory.

- The Lab consists of several rooms for researching spatial memory and social cognition, as well as indoor and outdoor aviaries for other types of experiments. A freestanding experimental aviary is used for studying spatial navigation.
- The research program integrates ecological, psychological and molecular techniques, emphasizing the importance of natural history in the evolution of behavioral traits, especially those associated with the mental capabilities of organisms.
- Initial laboratory studies were designed to explore the spatial memory of the Clark's nutcracker—which may have better spatial memory than any other species, including humans.
- Studies have been expanded to include population studies of local pinyon jays and analyses of social learning, parenting, home range and habitat use.

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Department of  
BIOLOGICAL SCIENCES

## Colorado Plateau Museum of Arthropod Biodiversity

NAU's Museum of Arthropod Biodiversity houses an arthropod collection of over 250,000 specimens, primarily from the Western United States and Mexico, with a focus on the Colorado Plateau. A major goal of the museum is to make the collection more relevant to ecologists, especially those working on research related to issues of conservation and biodiversity.



*top: A young bird-eating tarantula crawls on the hand of Robert Delph, Assistant Museum Curator.*

*above: A western Hercules beetle and a giant silkworm moth.*

*below: A western Hercules beetle.*

Current projects include:

- All Taxa Biodiversity Inventory at Canyon de Chelly National Monument;
- Enhancement of a database that already contains research collections centered on the Colorado Plateau, including digital photographs of Orthoptera, Lepidoptera, Carabid beetles, and cicadas;
- Passerine diet studies including a whole arthropod and "diet parts" collection, serve as a resource for regional ecological studies interested in understanding the role of arthropods in the diet of passerine birds;
- A digital and physical library of arthropods utilized as prey by lizards from Beaver Creek, Arizona and the Caribbean;
- Separate educational outreach and teaching collections;
- Specific collections from various landscape types around northern Arizona including grasslands, pinyon-juniper woodlands and cottonwoods.

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Department of  
BIOLOGICAL SCIENCES

## Cottonwood Ecology Group

The Cottonwood Ecology Group, established in 1979, is an interdisciplinary research team comprised of scientists from NAU and several other universities across the country. Current research focuses on the development of community and ecosystem genetics using cottonwoods as a model system. These collaborative studies show how communities and ecosystem processes are affected by plant genotype, which is important for understanding community evolution and can help improve environmental restoration.



- The Cottonwood Ecology Group is currently working with \$5.5 million in grants, much of which comes from a National Science Foundation Frontiers in Integrative Biological Research (FIBR) grant and a Bureau of Reclamation grant that emphasizes riparian habitat restoration.
- The work has contributed to more than 30 graduate degrees and yielded more than 85 papers in peer-reviewed journals, one of which earned the Mercer Award as an outstanding paper published in the journal *Ecology*.
- More than 175 invited talks and symposia have focused on the Group's research.
- The Group's work is also informing decisions by local land managers seeking to restore habitats and maximize biodiversity. Its investigators have testified on the federal level as part of far-reaching dialogues about the Endangered Species Act and genetically modified food.



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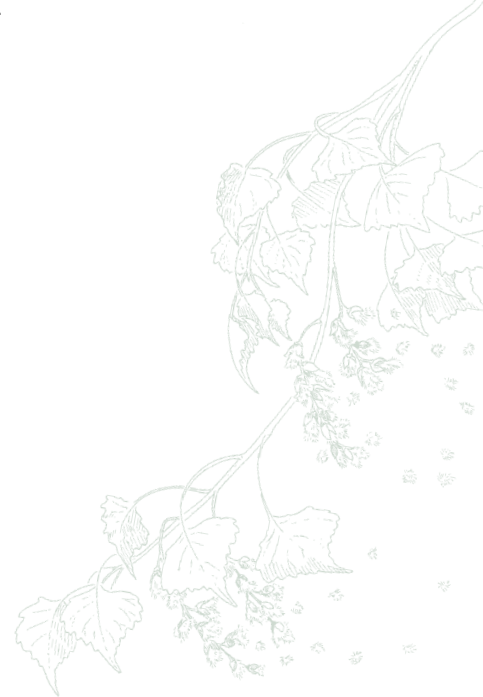
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Department of  
BIOLOGICAL SCIENCES

## Deaver Herbarium

NAU's Deaver Herbarium is named for its first curator, Chester "Danny" Deaver, who started the herbarium in 1930. According to the International Association for Plant Taxonomy, the umbrella organization that tracks important research collections, it is officially known by the acronym ASC, a relic of the days when NAU was called Arizona State College. Herbarium staff members work to document plants mainly in northern Arizona, an ecologically diverse and extremely botanically rich area.



- The collection contains a total of 80,000 vascular plants and 2300 non-vascular plants representing habitats from alpine tundra atop the San Francisco Peaks to the Great Basin, Mohave, and Sonoran deserts.
- Data from Arizona's other herbaria are maintained at Arizona State University, online at: <http://seinet.asu.edu/collections/selection.jsp/>.
- Current work includes curating the family Asteraceae, documenting the flora of the San Francisco Peaks, and working with two state herbaria to publish a new guide to the flora of Arizona.
- Staff members are available to identify and label plants for members of the public. For-profit organizations are charged a small fee for this service.
- Herbarium staff administers a loan and exchange program where specimens are sent to and received from other recognized research herbaria.

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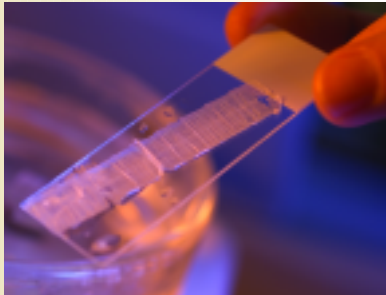
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Department of  
BIOLOGICAL SCIENCES

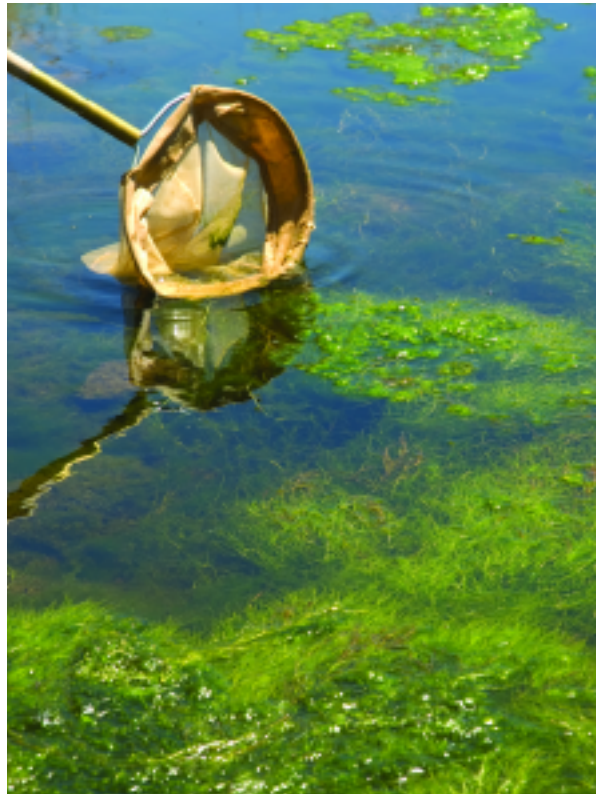
## Environmental Endocrinology Laboratory

Researchers in the Environmental Endocrinology Lab are seeking to understand how environmental information gets translated into behavioral, reproductive, and developmental responses. The current focus of the Lab is to understand how environmental chemical contamination impacts endocrine function and disrupts physiology, behavior and development.



*top: Preparing a microtome slide.  
above: Microtome slide.  
below: Collecting samples from a  
wastewater pond.*

- Specifically, lab researchers have been investigating two contaminants, a common pesticide, endosulfan, and an industrial and household contaminant, octylphenol, and their effects on reproduction and development.
- The Lab is using wastewater effluent as a model contaminant mix to determine how organisms in nature may be impacted by exposure to compounds released into the environment.



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Department of  
BIOLOGICAL SCIENCES

## Teaching Greenhouse



NAU's teaching greenhouse was built in 1970 to provide living plant material for a number of lab courses in the Department of Biological Sciences. The facility includes 2,000 square feet of greenhouse and 150 square feet of preparation area organized to provide specific habitats such as hot dry deserts and a cool moist cloud forest. Tree frogs breed in the two ponds that house the aquatic plant collections.

- One to two student workers typically staff the facility and provide year-round care for the collections. The NAU Botany Club also helps maintain the greenhouse.
- Each year, three to four tours are given to K-12 school classes from the Flagstaff area and the Navajo and Hopi reservations.
- The facility also houses extensive collections of orchids and succulents from the tropics.

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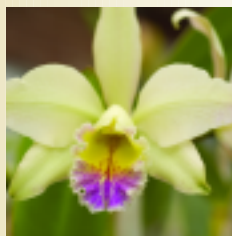
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## Bureau of BUSINESS AND ECONOMIC RESEARCH

The Bureau of Business and Economic Research, established in 1984, is a unit of the Center for Business Outreach in the College of Business Administration. It serves the economic and business information needs of individuals, businesses, government agencies and other organizations, especially in northern Arizona and rural communities throughout the state. Much of the information requested from the Bureau can be found in a variety of sources maintained in an in-house library.



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- As a principal agency in the State Data Center organization, the Bureau maintains volumes of data from the U.S. Census Bureau. Much of the information is kept in computer databases which can be used to create custom reports.
- Original research by the Bureau includes a 2003 study of Northern Arizona University's economic impact to the state of Arizona, a background report for a Verde Valley community forum regarding rural development, and an economic impact study for the Discovery Channel Telescope at Lowell Observatory now under construction.
- Because the Bureau's goal is also to enhance NAU's educational mission, undergraduate and graduate assistance is utilized whenever possible.
- The Bureau library also maintains data on local economic activity such as building permits, sales taxes and other economic indicators at the state and county levels. These data are available for interested members of the public.



## Center for American Indian ECONOMIC DEVELOPMENT



The Center for American Indian Economic Development, established in 1985 by the Arizona Legislature, is a unique information and resource center for Arizona's tribal nations. The Center collaborates with tribal communities and groups to achieve self-sufficiency through community, economic, and business development. Its services include training and education, development projects, a monthly American Indian Economic Development Forum and semi-annual Tribal Leadership Summit. With continued federal funding, the Center will be able to provide free training and services to tribes that ask for assistance.

Recent projects have included:

- Tourism training and strategic planning for the Hopi Tribe and Diné Development Corporation;
- Feasibility studies for an Alamo mini-mall and the Cameron Artisans' Association, and entrepreneurship training with the White Mountain Apache, Fort Yuma Quechan and Colorado River Indian Tribes;
- A resource library with information about Arizona tribes, Indian economic development, and general development issues in Indian country;
- Conducting management leadership training for the Yavapai-Apache Nation and research on behalf of the Hopi Tribe on the Excise Fuel Tax;
- Providing technical assistance to communities and entrepreneurs through the Business Technical Assistance Circuit Rider;
- Seeking an Economic Development Administration Grant to conduct an asset inventory study of the Black Mesa Mine.



*top: Gary Tom, Chairman of the Kaibab Paiute Tribe playing the Honor Song at the Tribal Leader Speaker Series.  
above: John E. Echohawk, the Executive Director of the Native American Rights Fund, meeting with the College of Business Administration Dean, Mason Gerety.*

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# Center for DATA INSIGHT (CDI)

The Center for Data Insight is an applied research center partnering with vendors of enterprise-ready products canvassing the entire spectrum of the Knowledge Discovery and Data Mining process. The Center has established itself as a leader in the area of environmental and scientific database design and implementation by undertaking numerous projects from a variety of clients—many of which have involved complete system design.



Recent environmental applications of these technologies include:

- A database system to store environmental data for the U.S. Geological Survey's Grand Canyon Monitoring and Research Center, allowing users to gain a comprehensive picture of the state of the Grand Canyon at any point in time.
- A publicly accessible weather database designed for NAU's Merriam-Powell Center for Environmental Research, that includes automatically collected weather data from around northern Arizona.
- A document archival system for NAU's Ecological Monitoring & Assessment Program & Foundation, which incorporates GIS technology with relational database technology.
- A forest thinning cost and revenue estimator for the U.S. Forest Service, the Pacific Northwest Research Station, and the U.S. Geological Survey.

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## Center for ENVIRONMENTAL SCIENCES AND EDUCATION (CESE)

NAU's Center for Environmental Sciences and Education was established in 1973 as a multi-college center providing interdisciplinary environmental degree programs offered by NAU. The Center supports bachelors and master's degrees in environmental sciences and a graduate certificate in conservation biology. Eleven tenured or tenure-track faculty hold appointments in Environmental Sciences along with shared appointments in other departments including biology, chemistry, forestry, geology, political science, and Quaternary sciences.



top: Caitilin McCracken examining flowers.  
above: Caleb Schiff working with a lake sediment core.

- Researchers and students conduct field research that includes opportunities to work with ranchers, Native American tribes and others who own northern Arizona's biologically significant lands.
- A National Science Foundation-funded Undergraduate Mentoring in Environmental Biology Program is geared toward increasing research opportunities and support for minority students.
- CESE has organized a new environmental sciences field course on the ecology and geology of the San Juan River, culminating in a weeklong San Juan River trip during the spring semester.
- CESE houses the Center for Science Teaching and Learning, the Laboratory of Paleoecology, the Quaternary Sediment Laboratory, and the Laboratory of Conservation Biology and Landscape Ecology.

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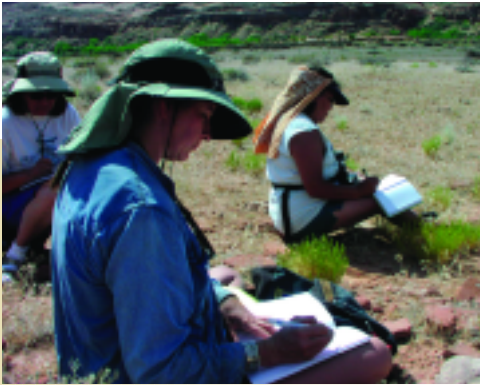
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Center for  
ENVIRONMENTAL SCIENCES AND EDUCATION

## Center for Science Teaching and Learning (CSTL)

The Center for Science Teaching and Learning is a teaching, research, evaluation, and materials resource for science faculty and students across the NAU campus, K – 12 science teachers, and informal educators statewide.



CSTL is responsible for the recruitment, advising, and student teaching placement and supervision of secondary science teachers. The Center also collaborates with the College of Education in support of elementary science methods courses and provides extensive curriculum resources for K–12 pre-service and in-service teachers.

The Center's vision is to be a regional leader in standards-based science education through:

- Science teacher preparation and certification;
- Collaborations with schools and partnerships with professional development centers;
- Science education leadership through technical assistance, program design and evaluation and science education research;
- Maintenance of the Arizona Science Teachers Association web site;
- Sponsorship of the Science Leadership Academies.



top: Teachers take notes during a field course on the San Juan River.  
above: Ruby Chimerica examines a rock art panel near Bluff, Utah.  
Photos by Joella Clark

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Center for  
ENVIRONMENTAL SCIENCES AND EDUCATION

## Isotopic Analysis Laboratory

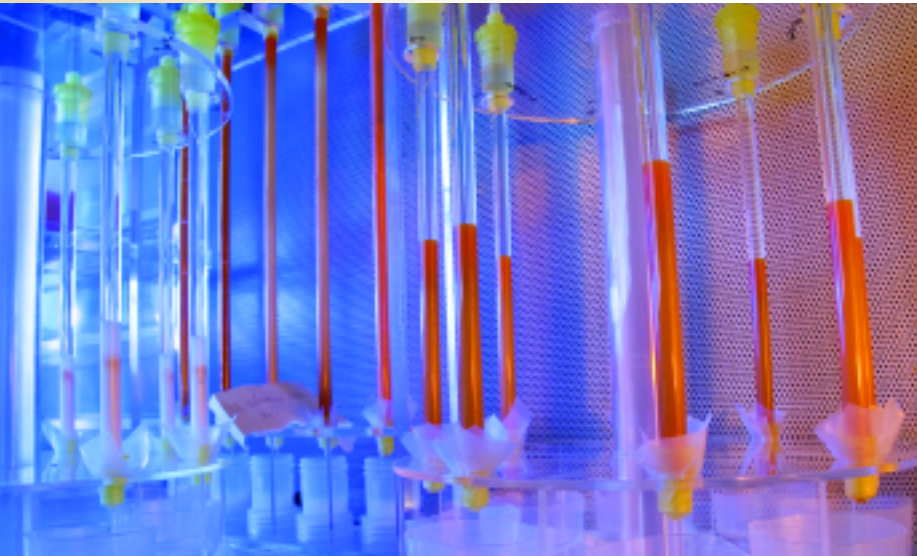


top: Michael Ort in the lab.

below: Sample preparation area in the lab.

The Isotopic Analysis Lab is headed by Professor Michael Ort of Environmental Sciences and Geology. It is a well-equipped isotope clean lab where researchers conduct a number of projects in geology, and environmental and Quaternary sciences.

- The Lab has two large laminar flow workstations for column chemistry, two HEPA-filtered clean hoods with two-bottle stills and evaporation plates, a fume hood, oven, centrifuge, balance, and DI water system.
- The Lab is equipped to analyze geologic and biologic samples for most elements and a number of different isotopes.
- Analysis occurs at NAU, the University of California, Los Angeles, or the University of California, Santa Barbara.
- In his separate Paleomagnetism Laboratory, Dr. Ort and his students date young volcanic units. Currently, the researchers are dating Holocene flows in the Southwest.



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Center for  
ENVIRONMENTAL SCIENCES AND EDUCATION

## Lab of Conservation Biology and Landscape Ecology



top: The ForestERA team working with stakeholders in the Apache-Sitgreaves National Forest.

above: Students collecting field data for a long-term study on grassland ecology and health on Anderson Mesa.

Most conservation challenges involve multiple species and driving forces that manifest at landscape scales. The Conservation Biology and Landscape Ecology Lab addresses these issues through basic and applied research in ecology; the synthesis and application of research results in policy and management; and education and public outreach.

Research projects include:

- *ForestERA* is a set of powerful data and modeling tools that assist communities and land management agencies to collaboratively develop landscape-scale solutions for forest ecosystem restoration and community protection in the American Southwest. <http://forestera.nau.edu>.
- The *Ecology and Conservation of Arid Grasslands* project documents the ecological effects of alternative management practices and develops tools to assist managers in adaptive management for sustainable practices. [http://www.envsci.nau.edu/sisklab/research\\_projects/rangelands\\_website/index.htm](http://www.envsci.nau.edu/sisklab/research_projects/rangelands_website/index.htm)
- *Edge Effects and Effective Area Models* examines the predicted effects of landscape change in riparian habitats along the San Pedro River adjacent to Ft. Huachuca, AZ and demonstrates how different species are expected to respond in dramatically different ways to environmental change, such as groundwater pumping, fire, and habitat restoration efforts. [http://www.envsci.nau.edu/sisklab/research\\_projects/EAM/index.htm](http://www.envsci.nau.edu/sisklab/research_projects/EAM/index.htm)
- *Canyons, Cultures and Environmental Change: An Introduction to the Land Use History of the Colorado Plateau* summarizes a vast body of research from multiple disciplines in an easily accessible web format. <http://www.cpluhna.nau.edu/>

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Center for  
ENVIRONMENTAL SCIENCES AND EDUCATION

## Laboratory of Paleoecology

The Laboratory of Paleoecology uses the largest pollen analytical laboratory in the western United States to investigate late-Quaternary environmental change through the analysis of pollen, plant macrofossils and charcoal from stratigraphic profiles, sediment cores, archaeological sites and packrat midden assemblages. The facility, established in 1987, attracts visiting researchers from all over the world.



- Facilities include a state-of-the-art pollen processing room, several microscopes for a variety of analyses, a magnetic susceptibility system, and a reference collection with about 2,700 modern pollen specimens and 1,200 macrofossil specimens.
- The Lab owns coring and boat equipment for collecting sediment cores from a variety of environments.
- Recent projects have been conducted in the western states (California, Colorado, New Mexico, Arizona), as well as Alaska, Mexico, Argentina, Spain and New England.
- The Lab has secured over \$870,000 in research funds for these and other projects since 2003.
- The Lab also offers contract analytical services to collaborating researchers and industry clients.



top: Centrifuge.  
middle: Caitilin McCracken examining  
flowers.  
above: Pollen preparation.

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Center for  
ENVIRONMENTAL SCIENCES AND EDUCATION

## Quaternary Sediment Laboratory

NAU's Quaternary Sediment Laboratory was established in 1998 to analyze the physical properties of soils and sediment, especially lake sediment, to interpret past environmental changes.



*series: Extracting and analyzing surface sediment cores.*



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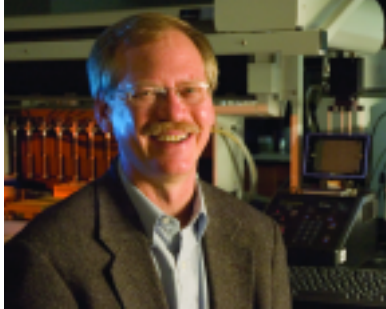
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- The Lab features a Beckman-Coulter LS230 particle size analyzer, capable of measuring the distribution of particle sizes from 0.04 micrometers to 2 millimeters in a single scan.
- Facilities include cold-room storage for lake cores and are equipped for core photography, magnetic susceptibility, and micromorphic analysis.
- Current projects include analysis of climate variability based on lake sediment from Alaska, and hydrologic variability from spring-fed deposits in the Mojave Basin.
- Significant grants have been awarded for collaborative research into Holocene climatic variation in southern Alaska.

## Center for MICROBIAL GENETICS AND GENOMICS (MGen)



top: Dr. Paul Keim, Director.  
above: Robotic instrumentation provides for high throughput automation at MGen.

The Center for Microbial Genetics and Genomics at NAU is a state-of-the-art research facility focused on understanding the evolution, ecology and epidemiology of a number of disease causing bacteria, including *Bacillus anthracis* (anthrax), *Yersinia pestis* (plague), and other organisms important to biodefense and bacteria involved in community-acquired infections. The combination of cutting edge instrumentation and expert personnel has enabled the center to develop powerful laboratory and data analysis techniques for detecting and characterizing these pathogens in environmental and clinical settings, and understanding their interaction with host organisms. This work is important for tracking and understanding the spread of these pathogens in the environment during natural and human-caused disease outbreaks.

- The Center is internationally known for its work and has ongoing collaborations with various governmental agencies and institutions.
- Dr. Paul Keim, an NAU Regents Professor and Director of MGen, is also the Director of Pathogen Genomics at the Transitional Genomics Research Institute (TGen) in Phoenix, AZ.
- In May of 2006, TGen launched the Center for Pathogen Diagnostics, or TGen North, which will be located in Flagstaff, AZ.
- The Center is committed to undergraduate research training and further development of the workforce.
- There are over 40 faculty, full time staff, graduate and undergraduate students currently working in the center in addition to researchers closely associated with the Center working throughout the NAU campus.

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## Center for SUSTAINABLE ENVIRONMENTS (CSE)

NAU's Center for Sustainable Environments, established in 2000, brings together diverse community members to seek creative solutions to environmental problems. The Center's initiatives emphasize the conservation of biological and cultural diversity and the promotion of sustainability. Director Gary Nabhan, is an ecologist, ethnobotanist, and renowned writer.



top: Participants enjoy a variety of foods during the Annual Foraged Feast.  
above: The Center's latest book, "A New Plateau; Sustaining the Lands and Peoples of Canyon Country," chronicles the achievements of an inspired group of people working towards a more sustainable future.

- Locally, CSE has helped create and implement the NAU Campus Sustainability Plan and promote sustainable building and renewable energy.
- For five years, the Center has promoted local foods through a food directory, eco-labeling, the Flagstaff Community Supported Agriculture program, and the Flagstaff Community Farmers Market.
- CSE sends its scientists out for regular foraging trips as part of the Flagstaff Wild Foraging Project, encouraging sustainable use of wild foods.
- Regionally, CSE works to conserve and protect rural land and water resources, support local agricultural traditions, identify sustainable income for rural residents, and work with tribes to protect sacred lands and gathering grounds.
- National and international projects include the Renewing America's Food Traditions campaign (RAFT), a national effort which documents, celebrates and safeguards America's native seeds and breeds while linking communities to place and cultural heritage.

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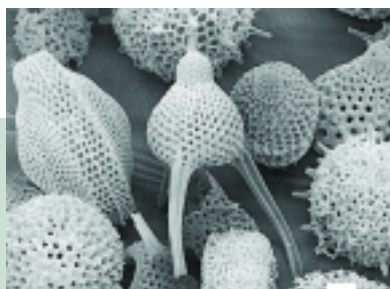
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\* Applied Research and Development (ARD)  
Facility, Bldg 56, early 2007



## Department of CHEMISTRY AND BIOCHEMISTRY

NAU's Department of Chemistry & Biochemistry offers an American Chemical Society-approved undergraduate degree, an accredited major in environmental chemistry and biochemistry and interdisciplinary programs in preforensic chemistry, criminalistics and geochemistry. The department also offers academic programs leading to the Master of Science degree in chemistry.



above: Radiolaria.  
below: Gonothyrea.

All of the academic programs enjoy more than \$1.5 million in cutting-edge technical support including:

- A variety of modern instruments such as a 200 & 400 MHz FT-NMR, a 200 MHz solid-state FT-NMR, two FT-IR spectrometers, an ESR and a GC mass spectrometer.
- The adjacent Physics & Astronomy Department operates an atomic force microscope, scanning tunneling microscope and X-ray photoelectron spectrometer. The Department has excellent computer facilities, including Apollo and Silicon Graphics computer workstations for research and teaching.
- Completed in 2000, a new biochemistry building, named for John C. Wettaw, includes state-of-the-art classrooms, labs, transmission electron microscopy, a scanning electron microscope, and nuclear magnetic spectroscopy.
- Faculty members have access to a fully equipped machine shop and experienced machinist for design, fabrication, and repair of instruments.
- The Department supports the Imaging and Histology Core Facility (Electron Microscopy Laboratory).

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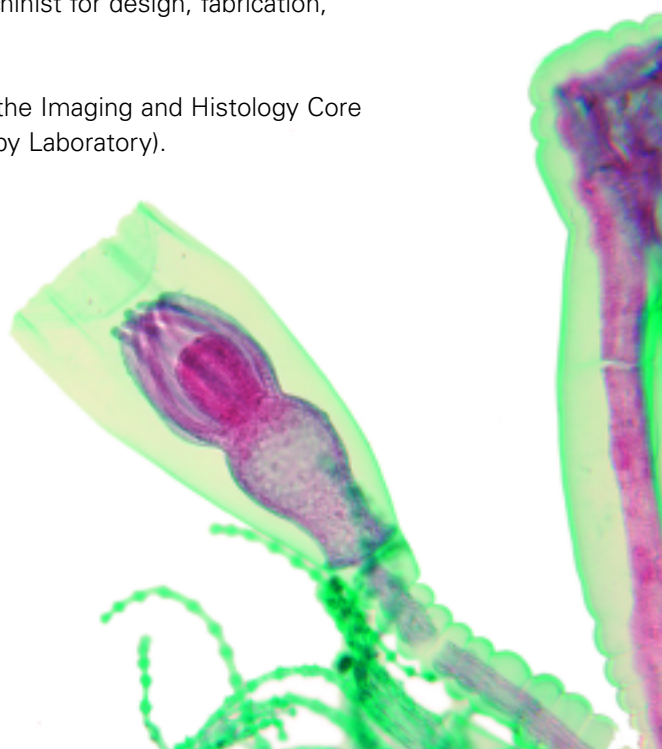
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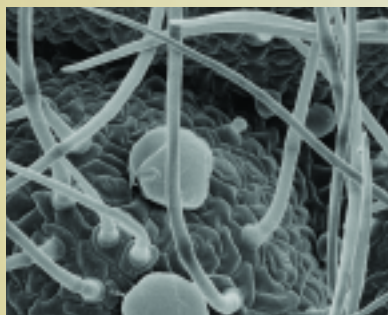
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Department of  
CHEMISTRY AND BIOCHEMISTRY

## Imaging and Histology Core Facility (Electron Microscopy Laboratory)



top: Scanning electron microscope.  
above: *Salvia officinalis* as seen through  
an electron microscope.

NAU's Imaging and Histology Core Facility is a multi-user training and research facility that has served the University and the northern Arizona community for more than 30 years. The Facility, which is available for scheduled tours, includes a transmission electron microscope (JEOL 1200EX II), scanning electron microscope (ZEISS 425VP) with variable vacuum, an X-ray microanalyzer and a confocal microscope. The Lab also offers specimen fixation and preparation, including cryopreparations, image processing and storage, and histological processing equipment. Modest user fees apply.

- Lab researchers have contributed to more than 250 publications, presentations, theses and dissertations.
- Images from the Facility have been used in publications all over the world, including the *New York Times*.
- More than 170 undergraduate, graduate students and faculty have received training in the Facility, and its technology has benefited research in a wide variety of departments.
- Graduates trained in the Lab have gone on to work at Children's Hospital Boston, Harvard University, the Albert Einstein Institute, Rutgers University and Merck Pharmaceuticals, among others.

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# Department of CIVIL AND ENVIRONMENTAL ENGINEERING

The Department of Civil and Environmental Engineering at NAU is a national leader in the personalized education of practice-oriented civil and environmental engineers and for technical innovations that directly benefit industry and society. Departmental research is currently focused on the movement of toxins in aquatic environments, modeling of anaerobic digesters, algal biomass for energy or other bioproducts, urban drainage, flood modeling, river and stream restoration and air quality, with particular interest in wood smoke impacts.



*top: Students participate in a survey class field trip at Cave Creek.  
above: Dr. Paul Gremillion in the Holocene Environmental Change Lab.*

- Recent funding and prestige for the Department has come from Dr. Bridget Bero's research into the utilization of small-diameter pine slash, Dr. Paul Gremillion's work in the Holocene Environmental Change Lab, and Dr. Paul Trotta's work with the Maricopa County Flood Control District.
- NAU faculty researchers in environmental engineering collaborate with outside entities including the U.S. Forest Service, APS, University of Idaho, University of Nevada-Las Vegas, Bureau of Reclamation, Environmental Protection Agency, and the Salt River Project.
- The Department supports the On-Site Wastewater Demonstration Program.
- Arizona's three state universities, NAU, Arizona State University, and the University of Arizona, offer a tri-university master of engineering degree with courses provided through a variety of flexible formats.



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Department of  
CIVIL AND ENVIRONMENTAL ENGINEERING

## On-Site Wastewater Demonstration Program

NAU's On-Site Wastewater Demonstration Program, established in 1998, provides a training, demonstration, and research facility to encourage the use of the best available technologies for the treatment and disposal of residential wastewater from individual homes and small communities.



Directed by the Department of Civil and Environmental Engineering, the Program aims to foster improved surface and groundwater quality and overall public and environmental health. As such, the Program demonstrates new and alternative technologies suitable for use in environmentally sensitive areas in Arizona and provides training for professionals in the field.

- The initial concept, funded by the Arizona Department of Environmental Quality and the EPA, was designed to demonstrate state-of-the-art technologies and take advantage of effluent from a nearby student housing complex for research and equipment testing.
- The facility is a teaching resource for System Control and Data Acquisition (SCADA), as well as a research facility for NAU's diverse environmental programs.
- This project's research and development capability is focused on the propagation of alternative wastewater options for those that are "off the grid" as well as resolution of new and emerging issues in the field.
- Program researchers pursue funded research in response to emerging issues relating to onsite treatment and disposal of wastewater effluent.



*top: Dr. Paul D. Trotta, standing in front of NAU's unique design for a real time wastewater controller divider, which distributes wastewater to the faculty's six research sites.*

*above: Close up of the SCADA controlled valve assembly which directs wastewater to the research sites.*

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## Cline Library's COLORADO PLATEAU RESOURCES

Cline Library provides a rich array of archival and published material that documents the history and development of the Colorado Plateau in a variety of disciplines. The Library is committed to sharing with a global audience the millions of items within the archives that reveal the regional heritage of the Colorado Plateau.



The Library's Colorado Plateau Digital Archives provides access to thousands of vintage and contemporary photographs, diaries, letters, oral history interviews, films, and maps which document the history of the region and NAU. Current digital exhibits include "Fire on the Plateau," "Kolb Brothers' Grand Canyon Film Show" and "The Perils of Delphine: Adventures on the Colorado River." Collection strengths include:

- Colorado River and Grand Canyon;
- Native American history and culture in the Four Corners area;
- Land use and the environment;
- Economic development.



top: "Navajo Woman," Joseph Muench Collection, NAU.PH.2003.11.10.1.A275.  
above: "Guiding the Horse Through," James J. Hanks Collection, NAU.PH.2005.3.2.19.9.

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# Colorado Plateau COOPERATIVE ECOSYSTEM STUDIES UNIT (CPCESU)

Housed at NAU since 1999, CPCESU helps secure federal funding for technical assistance, research, and education on the natural and cultural resources of the Colorado Plateau. Projects are generated through collaboration between federal and institutional partners. Seven federal agencies participate in the network, along with 20 universities and non-governmental organizations throughout the West. CPCESU is part of a national network of 17 regional Cooperative Ecosystem Studies Units.



above: Sifting through sand for ground dwelling arthropods at Canyon de Chelly National Park.  
right: Preparing collected arthropods in a field laboratory.



In fiscal year 2005, CPCESU funded a total of 88 projects for more than \$6.6 million. Thirty-one of the projects were based at NAU with total funding reaching \$1 million. Examples of CPCESU-funded projects include:

- Determining movement routes of Rocky Mountain bighorn sheep to and from Sheep Lakes mineral site;
- Development of a Restoration Rapid Assessment Tool to prioritize disturbed areas based upon departure from desired condition, site value, and ability to mitigate stressors;
- NAU Anthropology Laboratories projects, including 43 projects with an average yearly funding of \$146,000. A total of 36 anthropology graduate and four undergraduate students received support.

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## Construction Management PROGRAM

NAU's Construction Management Program emphasizes sustainable building and development systems throughout its curriculum. NAU was among the first four universities across the country to join the U.S. Green Building Council (USGBC), and NAU's department was one of the founding members of the Arizona chapter. Dr. Thomas Rogers, the department chair, was the principal author of the chapter's initial strategic plan and currently chairs the USGBC education committee.



*top: Construction Management majors at graduation, May 2006.  
above: Science Lab Facility under construction, summer 2006.*

- Professors Dr. Thomas Rogers and Dr. Stephen Mead are active in the green building community in Arizona and nationally.
- Both professors helped establish the Coconino County Green Building Program and the Northern Arizona Building Association certification programs.
- Dr. Mead is part of the Labs21 Program sponsored by the U.S. Department of Energy and EPA, which aims to improve the energy efficiency and environmental performance of U.S. laboratories.
- Both Drs. Mead and Rogers are regarded as experts in low impact construction and development as well as green building programs for rural areas.

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## Earth Notes ON KNAU



above and below right: The benefits of eating local food are among Earth Note's diverse topics.

KNAU, Northern Arizona's National Public Radio member station, is a public service of the University. Its locally produced news stories and national programs reach Flagstaff, Prescott, Page, Sedona and beyond.

Earth Notes is a weekly series of radio features focusing on the Four Corners region of the Southwest. Segments explore the area by telling fascinating stories about wildlife, environmental issues and the intersections between the natural world and our daily lives.

Earth Notes are written by freelance writers in Flagstaff and the Southwest and co-produced by KNAU/Arizona Public Radio and NAU's Center for Sustainable Environments. Past stories can be heard at [knau.org](http://knau.org), and selected scripts have recently been published in a book called *Earth Notes: Exploring the Southwest's Canyon Country from the Airwaves*.

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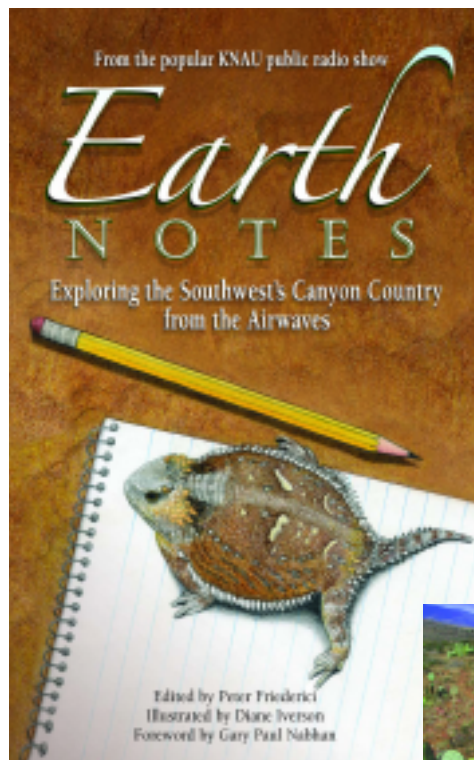
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# Ecological Monitoring & Assessment PROGRAM & FOUNDATION (EMA)

© EWEA



*top: EMA has begun work on several alternative energy projects.*

*above: The San Juan River provides scientific, cultural, and educational opportunities at NAU.*

The Ecological Monitoring & Assessment Program & Foundation has a bold vision—to be the evolving model for land stewardship by advancing the understanding of social, economic, and ecological factors affecting lands of the Southwest, and provide public and private land stewards with better information for decisions about their lands and other natural and cultural resources. EMA supports research and education programs that provide hands-on experiential learning opportunities for students through internships, student projects, and service programs, giving them an opportunity to work with local agencies and land stewardship organizations throughout Northern Arizona.

Among its most recent programs:

- The San Juan Science and Recreation Program provides multi-disciplinary San Juan River trips and natural resource projects that focus on research, education, and recreation. EMA's collaborative partnership with the Bureau of Land Management connects resource managers with research professionals, educators, and students at NAU.
- The Slide Rock State Park Partnership Program includes a variety of projects such as working with the Center for Sustainable Environments and the Research Greenhouse on restoration of the historic orchard, development of a water systems evaluation and assessment plan with the College of Engineering and Natural Sciences and student service days.
- The Wind Energy Programs in Northern Arizona include avian and bat inventory at the proposed Sunshine Wind Park, wind monitoring on the Babbitt Ranches, and publicly accessible wind maps created by Sustainable Energy Solutions.
- The Ecological Oral Histories Program gathers the land-wisdom of long-time residents of the Colorado Plateau, including land managers, ranchers, Native Americans, and scientists.
- The planned Wild Bill Ecological Center will showcase sustainable processes and serve as a living laboratory and gathering place for ranchers, scientists, land stewards, community organizations, and teachers and students of all ages.

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\* Applied Research and Development (ARD)  
Facility, Bldg 56, early 2007

## Ecological Restoration INSTITUTE (ERI)

NAU's Ecological Restoration Institute works to heal fire-adapted forests and other ecosystems in western North America. Its science-based restoration treatments, which return forests to ecological health while reducing threats of unnatural wildfire, have consistently earned recognition and significant financial backing from various federal government programs and agencies. The ERI gives back to the community by providing practical information about restoration techniques to the public, land managers, nongovernmental and conservation groups, researchers and decision-makers.



*top: Doc Smith, one of the founding members of ERI, explains restoration efforts in the Ponderosa Pine Forests in Northern Arizona.*

*above: Staff and students on the San Francisco Peaks accessing plots.*

- Since 1999, the ERI has attracted over \$15 million in federal dollars to NAU, shared amongst faculty and students across campus.
- The ERI supports 25 undergraduate and about a dozen graduate students in more than 20 different majors across campus each year.
- Undergraduates accrue field experience in restoration and complete senior projects linking their studies with vital restoration issues. In fact, many senior projects are published in peer-reviewed literature.
- The ERI helps graduate research assistants develop restoration-related master's and doctoral projects. Fields of study may include plant, animal or microbial ecology, fire, ecosystem management, silviculture, ecophysiology, landscape ecology, economics, sociology or policy.

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## Environmental Communication RESOURCE CENTER



*The new communications building at NAU was awarded with the "Best Renovation over \$5 million" by the Phoenix-based magazine Southwest Contractor out of 90 submissions for its unique features and media capabilities.*

The Environmental Communication Resource Center, based in NAU's School of Communication, is a resource center for information, research and discussion about environmental communication. The program works to promote scholarship, pedagogy and public service in all aspects of environmental communication.

- Environmental communication courses at NAU include Environmental Communication (COM 150), Environmental Perspectives on Communication Arts (COM 250), Environmental Research & Reporting (JLS 440) and Advanced Organizational Communication (SC 467).
- Co-Director Lea Parker has written two textbooks, *Environmental Communication: Messages, Media & Methods* and *EcoCulture: Environmental Messages in Music, Art and Literature*. A journalist for more than 15 years, she has also authored hundreds of published popular articles.
- Co-Director Dr. Brant Short wrote *Ronald Reagan and the Public Lands: America's Conservation Debate 1979-1984* and a number of scholarly essays, including studies of Earth First!'s agitative rhetoric and Edward Abbey's political discourse.

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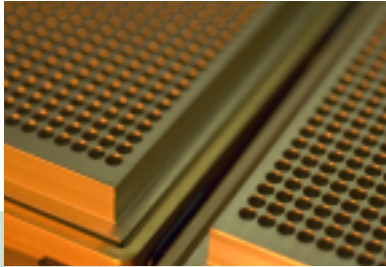
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## Environmental Genetics AND GENOMICS FACILITY (EnGGen)

The Environmental Genetics and Genomics Facility at NAU is a multi-user research laboratory designed for diverse biological applications. The laboratory supports molecular genetic analysis and training for a diverse user base, including regional academic, government, and private institutions. Users of the Facility study plant evolution, ecological community genetics, conservation genetics, microbial diversity, molecular epidemiology, and molecular forensics.



*"Robot" prepares samples for DNA sequencing.*

- The core instrumentation for this facility includes a 3730xl DNA sequencer for DNA sequencing and fingerprinting analyses, a fluid handling robotics platform, a MJ Research Tetrad thermocycler with 384 well capacity, several BioRad 96 well thermocyclers, and a computational system based upon a core server, memory, data backup systems and individual workstations.
- Additionally, a sample preparation laboratory is available for basic molecular protocols including DNA extractions, PCR and cloning.
- The EnGGen Facility sponsors workshops, courses, and seminars designed to assist scientists who lack the familiarity or facilities to utilize the benefits of genetics or genomic analysis for their studies. The education program is designed to benefit novice users, but training is also available for more experienced users.
- Funding typically stems from extramural grants obtained by the individual clients.
- The Facility employs a research staff for contract work such as genetic sequencing and fingerprinting.

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\* Applied Research and Development (ARD)  
Facility, Bldg 56, early 2007

## Environmental Research, Development and Education FOR THE NEW ECONOMY (ERDENE)

ERDENE program funds are provided to NAU staff, faculty, and research teams whose work promotes the program's mission and goals. ERDENE supports innovative research, education and outreach initiatives seeking to understand, sustain or restore environmental and ecological health. Its goals include promoting environmental health, addressing significant real world problems and supporting environmental initiatives that have economic and social benefits in Arizona.



*top: EnGGEN Facility.  
above: Barb Honchak and Katie Mayer  
in the EnGGEN Facility.  
below: Lar Reiboldt at the prototype  
reactor used in the study of utilization  
of small-diameter pine slash.*

Examples of projects funded in fiscal year 2005 included:

- Utilization of Small-diameter Pine Slash;
- NAU-BIORIN BIOremediation Research Initiative;
- Genetic Tracking of Bark Beetle Populations in Arizona;
- Using Biotechnology to Restore Riparian Habitats in the West: Genetic and Genomic Studies of Biodiversity and Drought Tolerance;
- Analyzing energy and water use on Arizona farms and ranches.



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\* Applied Research and Development  
(ARD) Facility, Bldg 56, early 2007

# School of Forestry AND THE SOUTHWEST FOREST SCIENCE COMPLEX



above: Forestry student checking for signs of pine bark beetles.

The NAU School of Forestry offers a program that is nationally regarded for its unique approach to undergraduate education and is accredited by the Society of American Foresters. The Southwest Forest Science Complex, a state-of-the-art facility, houses the School of Forestry, the Ecological Restoration Institute, NAU Centennial Forest administrative offices, and the U.S. Forest Service Rocky Mountain Research Station. The complex includes classrooms, an undergraduate computer lab, graduate computer lab, and research labs.

- The undergraduate academic program is unique because the junior and senior years of study focus on an integrated ecosystem management approach to the environment rather than isolated, specialty-oriented courses.
- Students must specialize in one of several areas including conservation biology, ecological restoration, forest health, indigenous forestry, or international forestry.
- The School of Forestry is surrounded by the largest contiguous ponderosa pine forest in the world, where a wealth of departmental research is conducted.
- Within a two-hour radius are the Sonoran desert at 2,000 feet and an alpine forest at 11,000 feet, giving forestry students and their instructors the widest variety of natural vegetation in the country.
- NAU's forestry professors are nationally and internationally recognized, and generously funded, for their cutting-edge research in the fields of ecological restoration and wildlife conservation.

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School of Forestry  
AND THE SOUTHWEST FOREST SCIENCE COMPLEX

## Centennial Forest



In 1959, the Arizona State Land Department designated 4,000 acres of forestland as an “outdoor laboratory” for the School of Forestry. The resulting research and education programs helped establish the school as one of the top-rated forestry institutions in the country. In 2000, the Centennial Forest was created on nearly 50,000 acres of Arizona State Trust Land. These acres are divided roughly in half: one half north of Flagstaff, just west of Wupatki National Monument, and the other half southwest of town which includes the Historic School Forest of 1959, and is interspersed in a checkerboard pattern of land ownership within the Coconino National Forest. Together, the tracts serve as NAU’s research, teaching, and demonstration forest.



*top: Staff member assisting a Junior Forester Academy member in boring a ponderosa tree.  
above: The northern range of Centennial Forest encompasses pinyon-juniper grasslands west of Wupatki National Monument.*

- The Centennial Forest is a cooperative venture between NAU and the Arizona State Land Department.
- Other agencies and community groups participate by serving on the Centennial Forest Advisory Committee, which provides oversight and helps develop management plans.
- Researchers in anthropology, geology, geography and public planning, biology, and others study the unique combination of past volcanic activity, historic settlement and land use, variable terrain and the role of climate and weather on myriad ecosystems within the forest.
- Portions of the Centennial Forest are being thinned to restore damaged ecosystems and safeguard against catastrophic fire. Other parts are under lease for commercial grazing operations through the Arizona State Land Department.
- During the summer, Centennial Forest sponsors the Junior Forester Academy, a summer camp program for youth ages 9-18 offering outdoor and hands-on activities, nature-based art and games, critical thinking and team building.

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School of Forestry  
AND THE SOUTHWEST FOREST SCIENCE COMPLEX

## Conservation Biology and Wildlife Ecology Laboratory



This lab focuses on research that promotes wildlife conservation, with projects that range from pioneering science-based design of wildlife corridors in the Southwest to working with West African villages and chiefs to create sanctuaries for hippos and elephants. Much of the research conducted under the leadership of Dr. Paul Beier attempts to understand the importance and extent of the interconnectedness that defines the natural world. The Lab is tackling such ecological questions as whether forest birds eat enough leaf-chewing insects to improve forest health, and how small rodents transmit bubonic plague to Gunnison's prairie dogs.

Specific research projects in 2006 include:



*top: By developing and designing wildlife corridors throughout Arizona, the lab works to promote movement by all native species.*

*above: Members of the Lab work to conserve this bare-headed rockfowl that was re-discovered in Ghana.*

- Participation in the South Coast Missing Linkages Project, which is preparing detailed designs for 15 habitat corridors in southern California, and in the upstart Arizona Wildlife Linkages Workgroup;
- A detailed map of population genetics of puma in the southwestern United States;
- Plague dynamics in prairie dog colonies, including the prevalence of plague and host-changing behavior of fleas in relation to rodent population changes, climate, and habitat;
- An ecotourism project in Ghana that will promote conservation of the spectacular and vulnerable bare-headed rockfowl;
- A National Science Foundation project to determine the relationship between bird predation, forest insects, and growth of cottonwood trees.

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School of Forestry  
AND THE SOUTHWEST FOREST SCIENCE COMPLEX

## Ecosystem Ecology Laboratory



Ecosystem Ecology is a sub-discipline of ecology that uses ecosystems as the observational unit, and attempts to understand the biotic and abiotic factors that regulate ecosystem structure and function. Researchers in this lab focus on basic and applied ecosystem research primarily in forests of the western U.S. The Lab uses a variety of tools in these studies ranging from ecological genetics and isotopic analyses to computer simulation modeling.

Current projects include assessing:

- Effects of forest restoration treatments (e.g., thinning and prescribed fire) and wildfire on ecosystem carbon storage, soil microbial communities, and underground processes;
- The impact of climate change on soil-plant-atmosphere interactions;
- Biotic and geochemical controls on ecosystem development;
- The influence of plant genes on ecosystem processes;
- The utility of the natural abundance of  $^{15}\text{N}$  as an integrator of nitrogen cycling processes.

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School of Forestry  
AND THE SOUTHWEST FOREST SCIENCE COMPLEX

## Forest Health Program



NAU's Forest Health Program includes a series of graduate-level courses and is rapidly expanding into several new research areas, all of which attempt to address a gap in science's understanding of how landscape-level operational silviculture affects forest ecosystem health in northern Arizona. The Program is pursuing a multi-year, multiple-investigator research project in the ponderosa pine forests of the Coconino and Mogollon Plateaus.

The objectives of this program include:

- Characterizing and comparing thinned, thinned and broadcast burned, wildfire, and no treatment stands in terms of overstory and understory vegetation parameters;
- Characterizing and comparing the four treatments in terms of community organization and structure of insects, insect resistance and fungal response;
- Soliciting cooperative research in areas of tree physiology, small mammal and bird communities, aesthetics and human perception, recreation potential, nutrient cycling, forage quality, and botanical invasions;
- Developing insect and fungal ecological indicators of stand conditions and testing the robustness of these indicators;
- Using experimental treatments to assess ecosystem functioning, based on ecological indicators under various management strategies.

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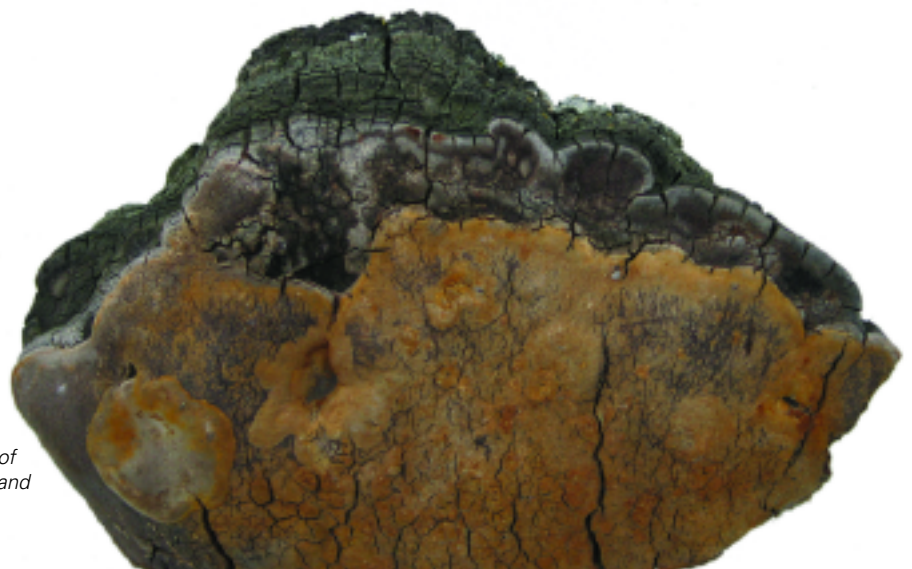
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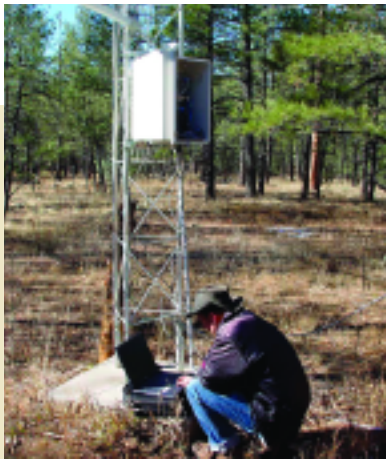
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*This conk, a hard, shelf-like, spore-bearing structure of certain wood-decaying fungi, can be found on trees and is one indicator of the organism's health.*



School of Forestry  
AND THE SOUTHWEST FOREST SCIENCE COMPLEX

## Hydrology Laboratory



NAU's Hydrology Lab focuses on holistic watershed management including the study of the interaction of forest users, forest restoration treatments, vegetation management and fire on surface hydrology. Other topics include mountain riparian ecosystem restoration, hydrologic modeling, including precipitation-runoff relationships, water yield, and peak flow from forest and wildland watersheds in the Southwest, watershed delineation, and conflict resolution concerning socioeconomic issues in watershed management and water supply. In addition, the Lab collaborates with the Watersheds and Riparian Ecosystems Project of the USDA Forest Service Rocky Mountain Research Station in Flagstaff, as well as the Water Resources Group at the USGS Flagstaff Field Center.

Current research includes:

- Wildfire and forest restoration treatment effects on the Rio de Flag watershed;
- Developing dynamic Multi-Objective Decision-Making (MODM) models for use in forest management in Northern Arizona and North Central Mexico;
- Monitoring and maintaining five stream gauging stations and one weather station in the former USDA Forest Service Beaver Creek Experimental Watershed;
- Studying the hydrology and water quality of southwest forests;
- Examining the impact of climate change on the hydrology and water resources in the southwest.

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## Department of GEOGRAPHY, PUBLIC PLANNING AND RECREATION

The Department of Geography, Planning and Recreation was formed in 2003 when the former Department of Geography and Public Planning merged with the program in Parks and Recreation Management. The Department offers bachelor's degrees in geography, GIS, public (urban and regional) planning, and parks and recreation, as well as master's degrees in rural geography and applied geographic information science. In addition, a Park Ranger Training Program awards a seasonal law enforcement Certificate of Completion recognized by the National Park Service, U.S. Fish and Wildlife Service and various state park systems. Fully online programs are available in park and recreation management, community planning and international tourism management.



above: A student assesses the human impacts at an archeological site in the backcountry of the Grand Staircase/ Escalante National Monument.  
below: Paul Lauck checks energy balances for his thesis work on snow evaporation/sublimation rates across northern Arizona.

Much of the coursework in the Department is project-oriented, working directly with local communities and federal land management agencies in northern Arizona. The Department also houses the international journal *Tourism Geographies* (Routledge), and department faculty are frequently involved in global climate change, international tourism development, and wilderness recreation management projects.

Department teaching and research strengths include:

- Geographic Information Systems (GIS);
- Public (Urban & Regional) Planning;
- Remote Sensing;
- Global Climate Change;
- Rural and Small Town Geography;
- Recreation Impacts on Federal Lands.

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## Department of GEOLOGY

Northern Arizona University's Geology Department is an undergraduate and graduate program focusing on applied and fundamental research on the Colorado Plateau and in the Grand Canyon, and extending broadly throughout North America, South America, Europe, Australia, New Zealand, and the Middle East. Besides bachelors and master's degrees in geology, the department also offers degrees for prospective and practicing earth science teachers.



*top: Sandstone formations from the Ron Blakey Collection.*

*above: Fossils in sandstone, Ron Blakey Collection.*

- With an average of 200 majors, NAU's geology program ranks in the upper 10 percent of geology departments in the country in undergraduate enrollment. More than half of those majors are transfer students who come to NAU specifically to study geology.
- According to a 1999 alumni survey, 95 percent of geology master's graduates moved into professional career tracks or graduate programs immediately upon graduation. About a fifth went on to pursue doctoral degrees.
- The geology degree programs produce graduates highly prized by private industry including in the fields of oil and gas, mining and environmental consulting.
- Over the past few years, geology faculty members averaged over \$1.1 million in new and active external grants and contracts per year.

The Geology Department hosts the Amino Acid Geochronology Laboratory, Arizona Earthquake Information Center, Electron Microprobe Laboratory, Environmental Geochemistry Laboratory Hydrogeology Laboratory, Mineral Separation Laboratory, Soil, Sediment, and Landform Analysis Laboratory, and Grand Canyon Sandbars/Habitats Monitoring Center.

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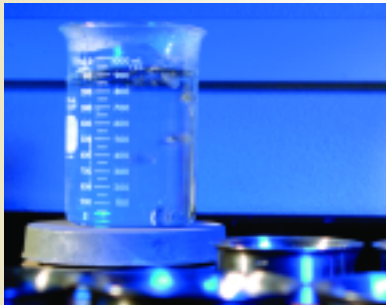
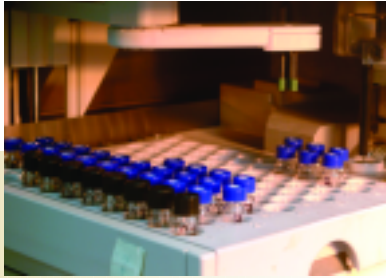
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Department of  
GEOLOGY

## Amino Acid Geochronology Laboratory (AAGL)



Researchers in NAU's Amino Acid Geochronology Laboratory analyze fossil shells and other materials to determine the ages of sediment deposited in lakes and other depositional basins hundreds to hundreds of thousands of years ago.

- The AAGL is a Shared National Facility funded in part by the National Science Foundation, the U.S. Geological Survey and contracts from other university researchers.
- The Lab maintains both an ion exchange and a reverse-phase liquid chromatograph.
- In addition to amino acid analysis, the AAGL also specializes in micro-crustacean taxonomy, sample preparation for Carbon-14 analysis, and biogenic silica determination of sediment.
- Screening for paleoDNA preservation is provided through a cooperative agreement with MicroAnalytica, a large, Florida-based commercial research lab.
- In the past decade, the AAGL has analyzed thousands of samples from around the world. Results have been included in 23 peer-reviewed publications.



*Jordan Bright at a microscope.*

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Department of  
GEOLOGY

## Arizona Earthquake Information Center (AEIC)



The Arizona Earthquake Information Center documents and researches Arizona earthquakes dating back to the 1960s using eight seismograph stations and the most comprehensive library of seismic activity in the region. The AEIC's overarching goal is to contribute to increased knowledge about why earthquakes occur in the state and the potential hazards to the populace. The northern Arizona Seismic network and the AEIC started in 1986 with three seismic stations at Flagstaff, Williams, and the Grand Canyon. Today, the seismic network includes eight stations stretching from the Utah border to the southern edge of the Colorado Plateau.

- The AEIC's archives contain 25,000 paper records of earthquakes, as well as microfilm, microfiche, and original seismograph logbooks.
- Records in the archives dating back to 1906 are found nowhere else and provide a valuable data source to scientists and historians.
- The AEIC maintains working relationships with the Arizona Division of Emergency Management in Phoenix, the Arizona Geological Survey in Tucson and the Kandilli Earthquake Observatory and Research Institute in Turkey.
- Through a node at the University of Utah, NAU's network contributes to Advanced National Seismic System, a federally funded seismic monitoring system that links data throughout the country.

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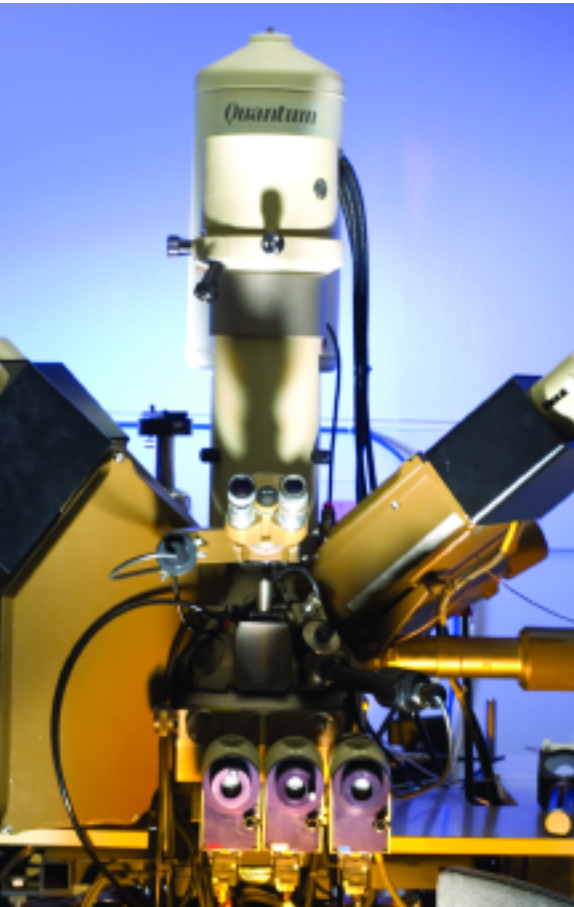
Online: [www.nau.edu/geology/aeic/aeic.html](http://www.nau.edu/geology/aeic/aeic.html)

*top: Seismograph.  
left: Seismic readings.*

Department of  
GEOLOGY

## Electron Microprobe Laboratory

NAU's Electron Microprobe Laboratory is located in Bilby Research Center. In 1990, the Lab started with a fully automated ETEC Autoprobe. In 1999, the lab installed a Cameca MBX microprobe on permanent loan from NASA, appreciably enhancing its analytical capabilities. Both tools help in the goal of non-destructive assessment of the chemical composition of tiny amounts of solid materials.



Features of the electron microprobe include:

- Use of a high-energy focused beam of electrons to generate X-rays characteristic of the elements within a sample from tiny volumes.
- Ability to quantitatively analyze elements from fluorine (Z=9) to uranium (Z=92) at routine levels as low as 100 parts per million.
- Available for use by all researchers in the university, community and beyond.
- Projects have included research in metamorphic and igneous petrology and studies of archaeological materials such as pottery (paste and temper, glazes), glass, and lithics.

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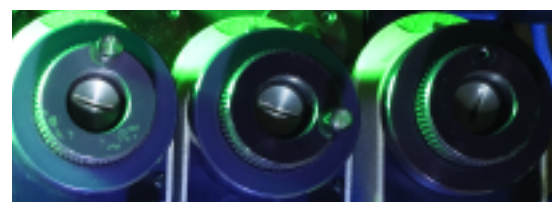
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## Grand Canyon SEMESTER

NAU's Grand Canyon Semester is a unique, experiential program wherein students are immersed in a variety of topics relevant to the Grand Canyon, one of the world's most extraordinary treasures, and the surrounding Colorado Plateau. Normally, each student completes 15 to 18 hours of advanced course work, including a required independent research project. Faculty members represent various programs across campus, including geology, geography, forestry, parks and recreation management, anthropology, political science, applied indigenous studies and the Program in Community, Culture and the Environment.



*Oar-powered rafts and an abundance of sand and sun are an everyday occurrence on the 9-day river trip.*

- The Grand Canyon Semester is co-sponsored by the National Park Service (NPS) at Grand Canyon National Park, and partners include the Museum of Northern Arizona and the Grand Canyon Association.
- Students work closely with experts from partner and other institutions, including the U.S. Geological Survey, Bureau of Reclamation and Bureau of Land Management.
- Dozens of guest artists, photographers, writers, political activists, native leaders and scholars are included in the program of lectures, presentations and guided trips.
- Participants hike in and out of the Grand Canyon in addition to studying at NPS facilities on the South Rim.
- Typically, there is a river trip on the Colorado River through the Grand Canyon.
- There is almost always a chance to participate in field study in remote areas at high elevations, thus participants should be in good health and comfortable in physically challenging environments.

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## Department of HISTORY

The curriculum of NAU's Department of History has been shaped by the distinctive landscape of the American Southwest and the rich diversity of peoples and cultures which have called the land home for centuries. The Department uniquely integrates into its curriculum the role of the arid southwest environment in shaping western identity. The program emphasizes history's role as a fundamental indicator of a culture's self-perception, which consequently affects that society's assessment of the natural world. Dr. George Lubick, an NAU professor since 1977, has taken the lead in incorporating environmental history into the Department.



George Lubick, Professor of History.

- Dr. Lubick is particularly fascinated by the history of the United State's national parks and wilderness areas. His latest book, entitled *Petrified Forest National Park: A Wilderness Bound in Time*, exemplifies his interest. Currently, his interests are focused upon the role of science and scientists in establishing Yosemite, Yellowstone, Grand Canyon, and Glacier national parks.
- Dr. Lubick is the co-recipient of a 2005 National Science Foundation grant on the history of ecological restoration and social dimensions of science and technology.
- The Department of History offers both undergraduate and graduate-level environmental history courses. The offerings currently include:

#### Undergraduate:

HIS 395: Surveys of American Environmental History  
HIS 405: Topics in Environmental History

#### Graduate:

HIS 568: Topics in Environmental History  
HIS 568: Research Seminar in American Environmental History

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## Institute for TRIBAL ENVIRONMENTAL PROFESSIONALS (ITEP)

NAU's Institute for Tribal Environmental Professionals was created to act as a catalyst for collaborative partnerships between tribal governments, university resources, government agencies, and the private sector in support of environmental protection of Native American natural resources. ITEP works closely with the U.S. Environmental Protection Agency (EPA), and has twice earned the EPA's Clean Air Act Committee Excellence Award. ITEP welcomes participation by researchers and agency partners in the area of environmental management, health and risk assessment, environmental education, renewable energy, and pollution prevention.



*top: A tribal environmental professional from the Mescalero Apache Indian Reservation learning how to operate an air monitoring instrument.*

*above: Students from the Navajo Nation come to NAU to learn about science and education.*

ITEP offers resources to tribal communities including:

- Training and technical assistance in various environmental disciplines, such as air quality management, water resources, and solid waste;
- Tribal Environmental Resource Center (TERC): Offers technical resources including GIS maps, an online library, mentorship network, and toll-free help desk.
- Air pollution maps showing toxins such as mercury emissions in relation to Native American reservation lands;
- Internships catering to tribal professionals who work to develop environmental programs for the improvement of air quality in Indian country.

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Institute for  
TRIBAL ENVIRONMENTAL PROFESSIONALS

## Environmental Education Outreach Program (EEOP)

The purpose of EEOP is to interest Native American students in environmental careers and assist schools in improving environmental science literacy. EEOP's work includes presentations and activities at tribal schools, mentoring programs for students and tribal environmental professionals, coordinating high school and college student internships, and collaborating with tribes and other agencies in public outreach campaigns.



Ongoing EEOP projects include:

- Air Quality Education and Outreach Project: Educational program that gives teachers and students the tools to study local air quality issues. Project staff assists educators with the identification and selection of curriculum resources.
- Water Education and Outreach Project: Water education workshops for diverse groups within the community.
- Engineering Outreach Project: Increase middle and high school student awareness of engineering careers.
- Summer Scholars Project: Provides a one-week on-campus program for tribal middle and high school students. The students learn how to apply science and technology to local environmental issues, such as air quality, global warming, and the use of reclaimed water at Snowbowl.
- Training courses on air quality for tribal environmental professionals.
- EEOP Newsletter: Provides information on EEOP activities and a wide variety of environmental issues.



*top: An EEOP instructor talks to Summer Scholar participants about the impacts of forest fires and controlled burns on air quality. above: Grand Canyon Air Quality Coordinator, Carl Bowman, talks to participants about the importance of air quality and visibility at the Grand Canyon.*

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Institute for  
TRIBAL ENVIRONMENTAL PROFESSIONALS

## Tribal Air Monitoring Support Center (TAMS)



The Tribal Air Monitoring Support Center was created by ITEP as part of the American Indian Air Quality Training Program through a partnership among the tribes, ITEP, and the U.S. Environmental Protection Agency. Its mission is to develop tribal capacity to assess, understand, and prevent environmental impacts that adversely affect health, cultural, and natural resources. Training and support is available free of charge to all federally recognized tribes in such topics as air pollution technology, modeling, and data management, meteorological monitoring and data analysis. The TAMS Center is located in Las Vegas, Nevada at the EPA Radiation and Indoor Environments Laboratory.

TAMS Center programs and services include:

- Professional Assistance Program: Specialized training to individuals based on tribal requests.
- Technical Training Platform: Provides hands-on training in a simulated environment to demonstrate technical procedures.
- Laboratory Services: Provides gravimetric services for tribes conducting PM<sub>2.5</sub> and PM<sub>10</sub> filter-based monitoring.
- Technical Expertise: Technical experts available to tribes to answer questions and provide other support services.



*top: TAMS Center Technical Training Platform.  
above: TAMS Center staff providing training on the operation of an ambient air monitoring instrument.*

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## Integrative Graduate Education AND RESEARCH TRAINEESHIP (IGERT)

The IGERT program of the National Science Foundation has funded the “Integrative Bioscience: Genes to Environment” program at NAU beginning in the 2006-2007 academic year. This graduate research and education program seeks to identify the key links between genes and the environment and is designed to train students in molecular genetics, environmental sciences, and spatial and temporal modeling in a format that fosters intellectual development.



*Owen Leiser and Theresa McHugh, former NAU students, collect samples for molecular analysis for a research project linking genetic information with cleanup of pollutants in regional constructed wetlands. This type of research integration is characteristic of IGERT projects.*

- The program offers a unique curriculum that includes professional development activities, such as an internship program designed to develop skills in communicating sciences to diverse audiences. IGERT fellows are expected to be future leaders in environmental science, teaching, and the application of science to problems facing society.
- Each year, six Ph.D fellowships will be awarded. The award will include a generous stipend, travel support, and some funding for research supplies. IGERT fellows can pursue Ph.D degrees in Biology or Forestry. The interdisciplinary program draws on faculty from Biological Sciences, Mathematics and Statistics, Computer Science, Electrical Engineering, and the School of Forestry.

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## Laboratory for ADVANCED INSTRUMENTATION

The Laboratory for Advanced Instrumentation is NAU's facility for design and fabrication of research equipment and everyday-use items. The Lab has an established reputation for saving researchers considerable time and money.



- More than 2,100 projects have been completed in the last 15 years.
- Machining services offered are milling, lathe work, grinding, welding and cutting of all types of materials.
- With 10 years of experience, Instrument Maker/Designer Greg Florian provides a broad base of knowledge for new projects, modifications of existing equipment or needed repairs.
- The Lab supports research projects and laboratories at NAU by creating and repairing hardware. For example, the Laboratory has repaired centrifuges for the Biology Department, built filter-box interfaces that communicate between telescopes and CCD cameras, constructed DNA gel boxes, fabricated and manufactured blood-pressure cuffs for frogs, and various other types of research related equipment.
- The lab charges \$20 an hour for design and \$35 an hour for fabrication.

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*Samples of custom made research  
instruments created by the Lab.*



## Master of LIBERAL STUDIES PROGRAM (MLS)



above: MLS students celebrating a successful first semester of the program.  
below: During a Summer Institute course, students discover how to use documentary film to communicate messages to a diverse audience base.

NAU's Master of Liberal Studies Program brings together interdisciplinary research on sustainability and community development with real world applications. Students confront the complex problems that transcend the limits of any single discipline, addressing the interface of science, technology, social science and the humanities. Contemporary challenges to the planet are considered within their historical context and students are given the chance to explore innovative solutions, develop strategies for implementation, and work within real communities to restructure the human relationship with the natural world.

- In core MLS courses, students study models of community life, theories of human nature, world views, the impact of technology on the environment and humanity, and strategies for implementing more sustainable practices in contemporary life.
- The MLS Summer Institute for Sustainable Communities offers short courses with nationally-renowned guest lecturers, including Wes Jackson, John B. Cobb, Jr., Yi Fu Tuan, David Orr, C.A. Bowers, and William Jordan, III. The summer institute also offers courses that develop community building skills, including grant-writing, working with foundations, and environmental conflict resolution.
- Each student develops an individualized program of study pertaining to sustainable community development and public engagement, such as sustainable design, food security, environmental policy, and urban planning systems.

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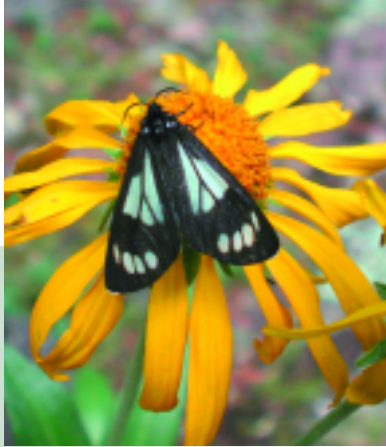
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# Merriam-Powell CENTER FOR ENVIRONMENTAL RESEARCH



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\* Applied Research and Development (ARD) Facility, Bldg 56, early 2007

The Colorado Plateau region supports an immense diversity of ecosystems, which are primarily managed by a variety of federal, tribal, and state agencies. The region is experiencing the fastest rate of human population growth in the country, exposing these ecosystems to tremendous environmental challenges in the next century. The Merriam-Powell Center promotes environmental research, education and outreach activities that seek to understand the implications of environmental change on the Colorado Plateau from a global perspective.

The Center is engaged in the following activities:

- Promotion of collaborative research that will allow an understanding of the changes that occur as natural ecosystems continue to transition into human-dominated environments;
- Establishment and maintenance of field facilities, experiments, and accompanying field courses that advance our understanding of ecological and environmental sciences when in collaboration with scientific research;
- Development of regional environmental databases and online information nodes, accessible to researchers, managers, students and the public, to promote an informed management of natural resources;
- Construction of the Merriam-Powell Research Station at The Arboretum at Flagstaff, funded by NAU and the National Science Foundation, which will provide housing and meeting space for field researchers and students researching and teaching about the Arboretum, NAU's Centennial Forest, and other public and private lands in northern Arizona.



Merriam-Powell Center  
FOR ENVIRONMENTAL RESEARCH

## Colorado Plateau Stable Isotope Laboratory (CPSIL)

NAU's Colorado Plateau Stable Isotope Laboratory is designed to serve undergraduate and graduate students, postdoctoral researchers and faculty at NAU whose research requires analysis of C, N, S, O, and H isotope compositions of gases (either purified or in mixtures at atmospheric concentrations), organics (solid and liquid, of plant and animal origin), inorganics and water. Scientists from other institutions are also welcome to send samples.



*above: Student weighs plant tissue samples for nitrogen isotope analysis.  
below: This TOC (total organic carbon) analyzer is used to determine carbon isotope ratios in water samples.*

- CPSIL currently houses four Thermo Finnigan gas isotope-ratio mass spectrometers and has analyzed over 112,000 samples for more than 90 local, state, national, and international researchers over the last few years.
- Stable isotope techniques are used in a variety of scientific areas including ecology, geology, hydrology, forestry, environmental sciences and paleoecology.

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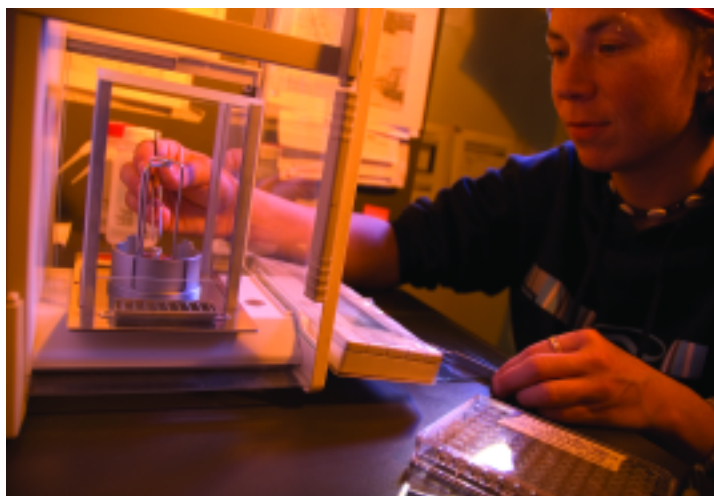
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Merriam-Powell Center  
FOR ENVIRONMENTAL RESEARCH

## Geospatial Research and Information Laboratory (GRAIL)

The Geospatial Research and Information Lab provide campus-wide support for Geographic Information Systems (GIS) and related technologies. GRAIL functions as a regional GIS clearinghouse that connects people and institutions within NAU to each other and the rest of the world.

GRAIL engages in the following specific activities:

- Supports GIS-related research and spatial data management;
- Offers regional to global spatial data to NAU and partners;
- Provides training for science and non-science programs;
- Training of undergraduate and graduate students working on research projects;
- Technical support for satellite facilities maintained in academic units on campus;
- Data storage and server facilities for research projects;
- Promotion of integrative activities associated with spatial technologies, including environmental database modeling, ubiquitous knowledge environments, research forums, visualization design and related emerging technologies.

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\* Applied Research and Development  
(ARD) Facility, Bldg 56, early 2007



## National Institute for CLIMATIC CHANGE RESEARCH (NICCR)

NAU hosts the Western Regional Center of the NICCR. The goal of NICCR is to mobilize university researchers from all regions of the country in support of the climatic change research objectives of the U.S. Department of Energy. The Western Regional Center facilitates climate change research in 13 states in the western U.S. including Alaska and Hawaii.



*above: NICCR research study site in Colorado.*

*below: Researchers in Alaska's black spruce forest study site.*

- The NICCR is managed and coordinated through four Regional Centers hosted by Pennsylvania State University, Duke University, Michigan Technological University, and NAU.
- Research pursued by the NICCR is focused around two main topics: the effects of potential climatic changes on important U.S. terrestrial ecosystems and potential feedbacks from U.S. terrestrial ecosystems to the climatic system.
- Through a peer-review process, the NICCR solicits proposals and selects those to receive funding. In the initial year (2005), the Western Regional Center awarded funding to four universities including NAU's Merriam-Powell Center.



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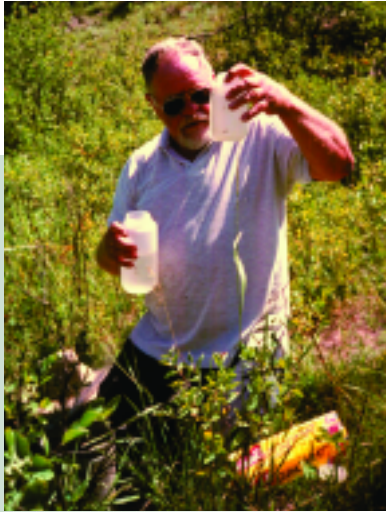
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## National Park Service AT NAU (NPS)

A partnership between the National Park Service and NAU offers needed research, technical assistance, and education services to the NPS so it can effectively administer its lands on the Colorado Plateau. In return, faculty and students gain resources and opportunities to work in parks throughout the Plateau and beyond.



*above: Ron Hiebert collects a water sample for analysis.*

*below: Trail along the South Rim of Grand Canyon National Park.*

- The Southern Colorado Plateau Network is implementing a long-term vital signs monitoring program in 19 NPS units. Vital signs include vegetation, springs and seeps, water quality, and invasive species.
- The Colorado Plateau Cooperative Ecosystem Studies Unit facilitates research and technical assistance between the NPS and NAU. The scope of topics is broad, incorporating ecology, sociology, policy, geology and archeology.
- NPS staff participate in research, teach classes and direct undergraduate and graduate research. Numerous opportunities exist for students to receive support for work in national parks while going to school.

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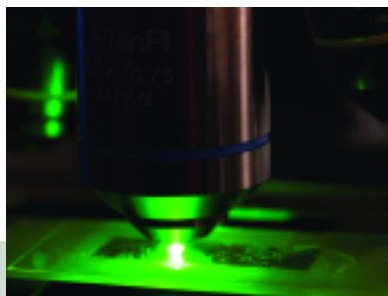
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\* Applied Research and Development (ARD) Facility, Bldg 56, early 2007



## Native American CANCER RESEARCH PARTNERSHIP (NACRP)

NACRP is a cooperative agreement sponsored by the National Cancer Institute dedicated to alleviating the unequal burden of cancer within underserved populations. It is administered jointly between NAU and the University of Arizona's Arizona Cancer Center. The Partnership aims to initiate cancer research programs at NAU that will enhance career development of NAU faculty and students, create stable, long-term collaboration between NAU and the University of Arizona in cancer research and to improve the effectiveness of both partners in reducing cancer and cancer deaths among American Indians in the Southwest.



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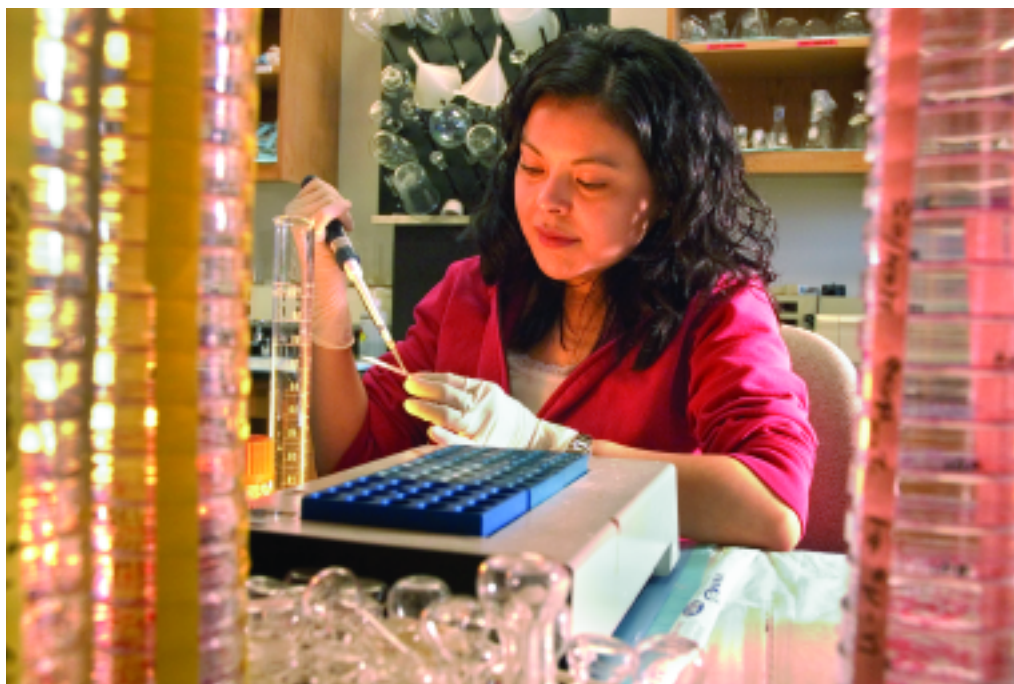
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*Hertha Woody in the laboratory.*

- NACRP's current research focus includes the relationship of uranium mining to cancer among the Navajo. Although high rates of some types of cancer and mining are associated, there is controversy about the causal agent.
- An outreach component of the Partnership builds and maintains relationships with Native American communities to hear their ideas and concerns about cancer education and research.

# NAU OUTDOORS

NAU Outdoors utilizes outdoor adventure programming to help individuals learn and develop leadership skills, teamwork and effective group interaction skills. Established in 1991, the program annually serves 4,000 students in various outdoor programs. Numerous university student leaders are responsible for outfitting, leading, facilitating, and instructing programs.



- Outdoor adventure opportunities include river trips, backpacking, hiking, caving, outdoor education workshops and rescue courses.
- The Challenge Course is a series of adventure-based learning activities designed to facilitate group and individual growth and success.
- The NAU Adventure Center utilizes an indoor ropes course, and is available for staff retreats and other group functions that call for fun and adventure.
- A climbing wall at the NAU Recreation Center features a challenging crack and a number of top-rope routes and boulder problems that vary in difficulty.
- NAU students, faculty, staff and members of the Flagstaff community can rent equipment for camping, backpacking, boating, winter activities, and other sports, as well as hand and power tools.

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## The NAU Research Greenhouse Complex AND THE NAU ARBORETUM

The NAU Greenhouse Complex contains eight full greenhouses, lath houses, environmentally controlled rooms, and a laboratory facility where NAU faculty and other researchers conduct a variety of experiments related to forestry, biology, ecology and environmental science.



NAU has cultivated a campus-wide arboretum, with signed walks featuring plants and trees from various ecosystems and life zones of the Colorado Plateau as well as adaptable trees from around the world. Self-guided tours offer newcomers and locals alike the chance to learn about the region's ecology without hiking for miles with field guides. An online version allows non-locals a chance to explore the arboretum and campus.

The NAU Arboretum is a partnership among NAU's School of Forestry, Department of Biological Sciences, AZ State Land Department, U.S. Forest Service, and Office of the Vice Provost for Research and Graduate Studies.

- The Womack Tree Walk starts at the Bloom Building, leading south to the Eastburn Education Building, and features plants and trees from throughout the world.
- The Littleman Tree Walk starts south of the North Union to the Old Main entrance and exhibits historic campus landscaping including roses and fruit trees.
- A Life Zones Garden in the Biological Sciences courtyard displays native plants of northern Arizona.
- The School of Forestry Tree Walk contains a small, interesting collection of native and adapted trees of northern Arizona.



top: Ashni Belnap on the NAU Arboretum Littleman Tree Walk.  
above: Research Greenhouse.

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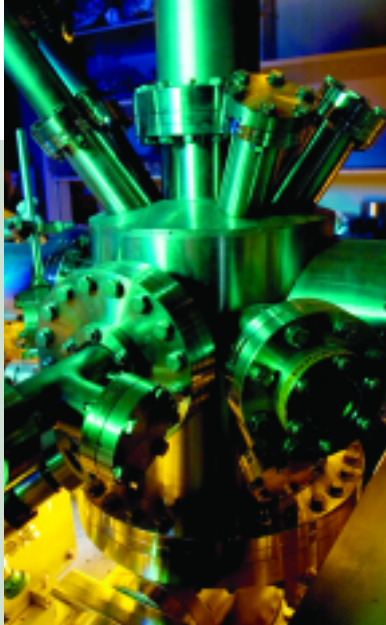
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## Department of PHYSICS AND ASTRONOMY



above: Surface Analysis System.  
below: Ion Gauge Tube for measuring  
"ultra high vacuum" levels.

NAU's Department of Physics and Astronomy is actively engaged in cutting-edge research in physics and astronomy and public outreach programs that foster scientific understanding within the program and extending to the community as a whole.

- For the last 15 years, NAU has served as a Research Experiences for Undergraduates site sponsored by the National Science Foundation.
- The department hosts the National Undergraduate Research Observatory, a consortium of private and public undergraduate institutions. The consortium shares 120 nights per year at Flagstaff's Lowell Observatory with NAU, offering students the opportunity to use a modern research-grade telescope.
- The Mars Crater Consortium (MCC) was co-founded in 1997 by NAU astronomer Nadine Barlow and continues to grow as new crater data are obtained and theoretical/experimental advances are made in understanding Martian crater formation.
- The NStars research project was started in 1998 and is based at NAU. It aims to be the most current, complete and accurate source of scientific data about nearby stellar objects.
- A long-term sensor program uses piezoelectric elements embedded in polymer films to detect the presence of trace amounts of dangerous chemicals, such as nerve agents. This work is being done in conjunction with NAU's corporate partner, Bay Materials.
- Multi-purpose surface science systems are currently being used on projects ranging from the study of astrophysical ices to the deposition of metal films on semiconductor surfaces.

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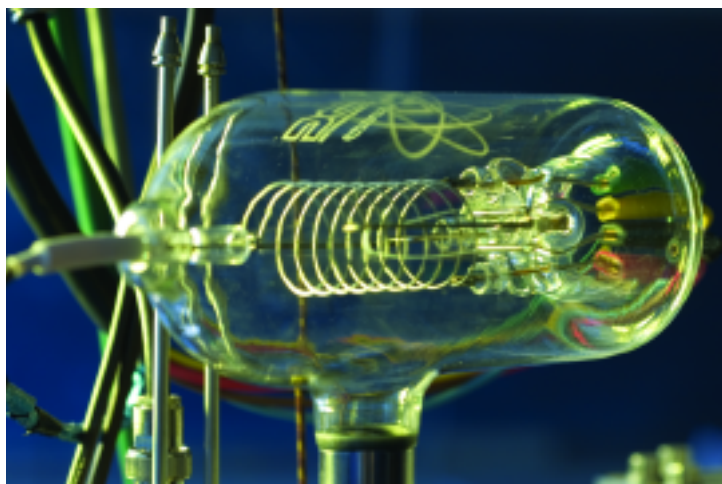
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Department of  
PHYSICS AND ASTRONOMY

## Atmospheric Research Observatory



The Atmospheric Research Observatory was originally built in 1952, and now serves as an emblem of Flagstaff's rich astronomical history. The facility was constructed under the supervision of Dr. Arthur Adel, a professor at Arizona State College, as NAU was known from 1945-66. One of NAU's most noteworthy professors, Dr. Adel's extensive research into the Earth's atmosphere earned him the reputation as the "father of NAU research." Home to five observatories, Flagstaff today continues to be an important site for astronomical observation for professionals and amateurs alike due to the city's high elevation and dark skies.

- The Observatory houses a 24-inch cassegrain reflector telescope used by NAU students for labs and independent research.
- Six, ten-inch telescopes are housed in an annexed building adjacent to the main facility.
- The observatory is open for public viewing every clear Friday night of the year from 7:30pm – 10:00pm. Admission is free, donations gratefully accepted.
- Additionally, the facility is available for field trip and private tours, and is an integral part of the annual Flagstaff Festival of Science.

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Department of  
PHYSICS AND ASTRONOMY

## NASA Space Grant at NAU



The National Space Grant College and Fellowship Program was established by Congress in 1988 to contribute to the nation's science enterprise by implementing research, education and public service projects through a national network of university-based Space Grant consortia. The original Space Grant competition resulted in the selection of 21 independent consortia, including Arizona's. Space Grant consortia have since been established in all 50 states, the District of Columbia and Puerto Rico. The programs integrate research with education to help build a diverse, scientifically literate citizenry and a well-prepared science, engineering and technology workforce. The Arizona consortium has been ranked among the top for the past 15 years.

NAU's activities include:

- Undergraduate internships to conduct research with NAU faculty and scientists at other institutions;
- ASCEND! a program that supports an NAU team of undergraduates to design, construct and fly their own atmospheric experiments on high altitude weather balloons;
- Changes in Altitudes, a program that teaches middle and high school students and teachers how to construct and fly a simple atmospheric payload that measures temperature and pressure, and takes photographs of the earth from a high altitude weather balloon;
- American Indian Mobile Educational Resources (AIMER) classroom, a mobile computer laboratory used to teach concepts of physics and astronomy and engineering to pre-college Native American students on Arizona's rural reservations.



*top: Arizona Near Space Research:  
preparing balloon launch instrumentation.  
above: Dan McParland at a telescope.*

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## Department of POLITICAL SCIENCE

NAU's Department of Political Science offers traditional bachelor's degrees in political science focusing on government and politics. Undergraduate and graduate students have the opportunity to choose from a variety of environmental courses to fulfill their degree requirements. Undergraduates can choose to pursue an extended bachelor's degree which allows them to integrate studies of the environment in political science with numerous other disciplines, including biology, history, philosophy, psychology, economics, anthropology, environmental sciences, and humanities.



- The bachelor's in International Affairs assists students in understanding the complex global issues of our times, including global environmental policies.
- The Department offers both an M.A. and Ph.D. in Public Administration with an emphasis in environmental studies.
- The internationally recognized and widely published faculty has received grant support to examine issues such as forest restoration policies under the Bush administration, the impact of collaborative policy design processes on participants, and the move to web-based public participation in environmental rulemaking.
- The Department was recognized by the American Political Association for mentoring and graduating women in its doctoral program.

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Photos by Andy Bessler

## Ponderosa PROJECT

The Ponderosa Project at NAU is an interdisciplinary faculty effort to incorporate environmental sustainability issues into NAU courses. The Ponderosa Group offers faculty workshops and seminars that support the curricular innovation required for teaching about environmental sustainability.

The Ponderosa Project is focused on the following specific goals:

- “Greening the Curriculum” so that the theme of environmental sustainability is introduced and reinforced throughout students’ educational experiences;
- Supporting and assisting faculty in curricular innovation, and promoting interaction that enables faculty to collaborate around issues of sustainability;
- Providing students with environmental “competencies” that they can take into future leadership roles, such as problem-solving techniques, interdisciplinary research methods and collaborative skills;
- Integrating environmental issues with campus stewardship to gain an understanding that the classroom extends to the entire campus—including facilities, grounds and the built environment;
- Encouraging service learning experiences that extend academic studies of environmental sustainability into the community.



top: Students at Badwater Wash, Death Valley National Monument.  
above: Students at Moenkops Wash.

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## Program in Community, Culture AND THE ENVIRONMENT (CC&E)

NAU's Program in Community, Culture and Environment hosts workshops, symposia, exhibitions, issue forums and other sponsored activities that allow community leaders, cultural organizations and citizens to interact with each other and with the environment they share. The program started in 1998, when local philanthropist Frances B. McAllister established an Endowed Chair in Community, Culture, and the Environment at NAU. The Program embodies McAllister's commitment to civic life, the role of the arts in culture, the natural environment, and to the intentional, collaborative shaping of sustainable communities.



above: Community members visit the Places of the Heart Exhibit. An interactive community map is pictured here.  
below: "Art in Action" mural at the Southside Community Garden.

Examples of the program's activities include:

- Two annual exhibits at the Coconino Center for the Arts, "cARTography" and "Places of the Heart," featuring juried submissions from members of the public that showcase their favorite aspects of landscape, both internal and external;
- Summer art workshops, affording locals the chance to display their place-based art in a relaxed and supportive setting;
- An all-day native foods workshop in the summer of 2005, featuring Gary Nabhan, celebrated author of *Coming Home to Eat* and other local food experts;
- Numerous lectures and workshops by a variety of presenters such as John Todd, Lucy Lippard, Timothy Beatley, Melissa Nelson, Vivienne Jake, Sim van der Ryn, and Lily Yeh.

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# Quaternary Sciences PROGRAM



In geologic time, the Quaternary Period is represented by the Pleistocene (the Ice Age) and the Holocene, or Recent, epochs. Over the last 1.6 million years, dynamic changes in climate, vegetation, fauna, and geologic and pedogenic (soils) processes have been registered in the geologic record. The period has witnessed the development of the human species and the arrival of early humans in the Western Hemisphere. NAU's Quaternary Sciences Program involves interdisciplinary research into Earth's present environmental conditions and biota in comparison with the Quaternary geologic record.

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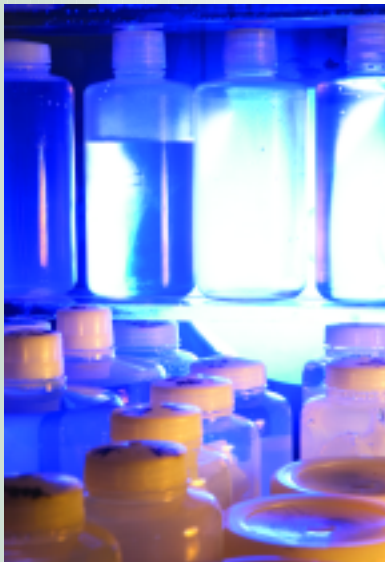
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- The Program's goals are to provide academic and field experience for master's degree students and to develop state-of-the-art quality research and data dissemination regarding the Quaternary period of arid, western North America.
- Students are expected to master a variety of topics to obtain a degree in Quaternary Sciences, including archaeological method and theory, alluvial stratigraphy, paleoclimatology, geochronology, paleoecology, paleontology, and statistics or computer analysis.



*top: Reptile skull.  
left: Isotopic Analysis Lab.  
above: Prepared snake skeleton from the  
Comparative Collection.*

Quaternary Sciences  
PROGRAM

## Laboratory of Quaternary Paleontology



above: Jim Mead in the Reptile Collection, holding the skull of a five meter long American Crocodile.

This lab contains the largest collection of modern and fossil vertebrate and invertebrate remains from the Colorado Plateau and greater Southwest region.

- A National Park Service repository of 15,000 specimens housed at the facility contains specimens from national parks in the Southwest including Arches, Black Canyon, Bryce, Canyonlands, Capitol Reef, Grand Canyon, Mesa Verde, Natural Bridges, Wind Cave, and Zion.
- The Quaternary Sciences Program's teaching and research comparative collection is a combination of 16,000 modern and fossil specimens, including shells of gastropods and bivalves, and skeletons of amphibians, reptiles, and mammals.
- The Lab also houses what may be the world's most complete collection—and certainly one of the very few in existence—of the stomach contents (fossil dung) of extinct Pleistocene megafauna.
- The Lab's collection of lizards is one of the largest and most complete in North America, and the terrestrial gastropod and mollusk collections among the best and most comprehensive in the Southwest.

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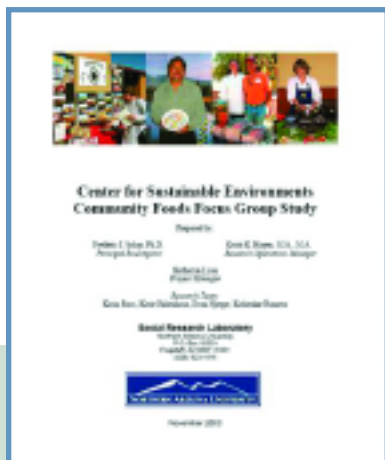
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# Social Research LABORATORY (SRL)

The Social Research Laboratory (SRL) is a full-service research and teaching facility located within NAU's College of Social and Behavioral Sciences. The SRL offers research services to public and nonprofit clients while providing graduate and undergraduate students at NAU with applied research instruction and experience. SRL has more than 18 years of experience conducting applied research for clients throughout Arizona and the nation. It specializes in conducting public opinion studies, needs assessments, program evaluations, and demographic and social issues analyses. The lab regularly utilizes telephone survey, mail survey, and focus group methodologies in research projects.



- Environmental projects completed by the SRL to date include the first comprehensive survey of the American public for the National Park Service, a land use planning survey for the Bureau of Land Management, a recreation survey for the U.S. Forest Service in Sedona, and studies for the NAU Ecological Restoration Institute and the Center for Sustainable Environments.
- The SRL can assist clients with developing proposals for outside funding, including writing grant proposals and preparing Institutional Review Board documentation.
- The SRL works with clients to determine the best research designs to find the answers they seek.
- Equipped with a state-of-the-art 20-station calling center staffed with experienced telephone interviewers, the SRL is capable of quickly conducting large or small telephone surveys.
- SRL staff members are skilled in both quantitative and qualitative analysis of data. The SRL produces in-depth reports that present information in ways that are easy to understand and insightful.
- The SRL research team is trained in conducting comprehensive evaluations of programs, including helping to define program goals and objectives, and monitoring program implementation.

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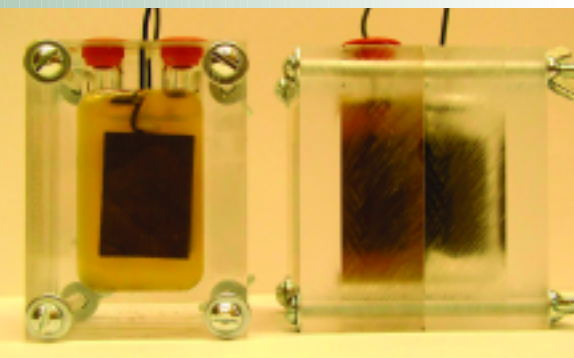
## Strategic Alliance for BIOSCIENCE RESEARCH AND EDUCATION (SABRE)

NAU's Strategic Alliance for Bioscience Research and Education, known as SABRE, emphasizes an interdisciplinary approach to bioscience research and education for undergraduates and graduate students. SABRE unites the life sciences, chemistry, environmental science, physics, and engineering for collaborative research.



SABRE's goals are to:

- Coordinate and promote interdisciplinary research and development at NAU in the biotechnology and bioengineering sciences;
- Work with existing NAU units to facilitate interdisciplinary projects in the broad areas of biotechnology and bioengineering, including environmental bioengineering and medical bioengineering;
- Foster education and curriculum development throughout Arizona in biotechnology and bioengineering;
- Promote workforce development in the fields of biotechnology and bioengineering;
- Foster partnerships, including existing alliances with Arizona technology enterprises, Northern Arizona Technology and Business Incubator and Northern Arizona Biopartners, and interface with other Arizona industrial and educational bioscience units.



top: Colonies of extreme halophiles.  
above: Fuel cells.

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## Sustainable Energy SOLUTIONS (SES)

The Sustainable Energy Solutions group consists of faculty members from the College of Engineering and Natural Sciences and College of Business Administration who work with industry, policy makers and national laboratories. Their main goal is to develop sustainable energy-based applications such as wind and solar power by producing students trained in renewable energy related technologies. Using their training, students work on improving renewable energy-favorable public policy through basic and applied research projects, assisting policy makers by providing technical assistance, and increasing public energy literacy through various forums.



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Recent SES accomplishments:

- Operating Agent (Leader) of International Energy Agency Annex 24 on Integration Wind and Hydropower Systems.
- Established TecVerde, LLC, a spinoff consulting firm that provides solutions to engineering challenges.
- Organized the 5th annual Southwest Renewable Energy Conference, a forum for the exchange of ideas and information about renewable energy.
- Arizona Anemometer Loan Resource Assessment Program: Assists landowners prospect for and develop utility-scale wind production.
- Arizona State Land Wind Resource Assessment: Assess wind resources that may exist on state owned or administered lands.
- Wind-desalination GIS mapping project: Develops GIS-based maps showing the best opportunities for wind desalination.

## Tozan GARDEN



*The Japanese Teahouse.*

Northern Arizona University boasts the largest wood kiln facility in the United States with seven kilns of different design, size and purpose. This facility was started in 1985 with the building of two Tozan kilns, Noborigama and Anagama, by Don Bendel and Yukio Yamamoto. Traditional in design, the two Tozan kilns were intended to be a cultural bridge between the United States and Japan. A tea-house and Japanese garden complement the Tozan kilns and enhance the cultural exchange. The garden combines traditional Japanese elements with native plants appropriate for the arid climate, creating a space of beauty, contemplation, and serenity. The notion of rustic beauty, a reference to nature, is a prevailing theme in the garden.

- After months of preparation and hundreds of hours of labor, the Tozan kilns were first fired in 1986, and have consistently been used by the Ceramics Department for NAU students and internationally renowned conferences and workshops.
- In 1990, a new Ceramic Art Building was constructed. It was decided in 1994 that a Japanese-inspired garden and tea-house should be constructed to complete the project. Final plans were submitted in 1996 by the Himeji Gardening and Construction Contractors Association.
- In accordance with the plans, Warner's Nursery and Garden Center in Flagstaff planted aspen trees along the perimeter of the site in 1999. Construction of the teahouse was completed in the summer of 2002. In 2005, a drip irrigation system was installed by Flagstaff Native Plant and Seed, the existing landscape was prepared and circular hedges and native groundcovers were installed by Brad Blake from the NAU Research Greenhouse.



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# USGS Southwest Biological Science Center COLORADO PLATEAU RESEARCH STATION (CPRS) AT NAU



*top: Wildlife biologist and herpetologist Erika Nowak handling a rattlesnake as part of a long-term research project on the effects of displacing snakes from the National Park Service lands.*

*above: This harvest mouse, captured by USGS zoologist Charles Drost, is part of a long-term small mammal population monitoring program on the Colorado Plateau.*

The majority of the U.S. Geological Survey's CPRS research occurs within or adjacent to the Colorado Plateau ecoregion, rated by the World Wildlife Fund and The Nature Conservancy as the top ecoregion in North America in endemism, and among the top five in biodiversity or species richness. CPRS works closely with many federal, state, and tribal agencies, as well as non-governmental groups, to provide biological expertise and research capability, with an emphasis toward conservation and management of biological resources. CPRS supports NAU's mission in numerous ways: by participating in collaborative research projects with NAU professors, serving as NAU adjunct faculty, providing lectures and research experience to undergraduates, and integrating graduate student research into ongoing studies.

Research at the station includes:

- Studies on the biology, conservation, and management of rare and endangered species, including grizzly bears, cougars, narrow-headed garter snakes, yellow-billed cuckoos, and southwestern willow flycatchers
- Inventory, monitoring and mapping of natural resources across the Colorado Plateau
- Studies of human-wildlife interactions in the urban-wildland interface
- Regional data collection to help address bigger-picture investigations into paleoecology, global change and vegetation ecology

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\* Applied Research and Development (ARD) Facility, Bldg 56, early 2007



## Walnut Creek Center for EDUCATION AND RESEARCH (WCCER)

The Walnut Creek Center for Education and Research houses an educational and research partnership between NAU, Prescott College, Sharlot Hall Museum, and Yavapai College. The Center is located 35 miles northwest of Prescott in the Williamson Valley on the Prescott National Forest. Since its conception in 1998, the Center has supported diverse scientific studies, and currently hosts a hantavirus longitudinal study funded by the Center for Disease Control. Most recently, the Center has become home to the Research Experiences for Undergraduates Program Shima' nahasdza'a'n bee 'iina' (Mother Earth Gives Life). In this program, students study how management and environmental changes are affecting the site. Most essentially, the WCCER serves as a base of operations for courses, research, and other activities on the Prescott National Forest.



The WCCER aims to:

- Provide field-based experiences in environmental education, appreciation and research;
- Develop, maintain and operate a multi-disciplinary field station and campus for education and research in the central Arizona highlands;
- Create and deliver innovative, collaborative educational programs for colleges, universities, museums, and non-profit organizations.

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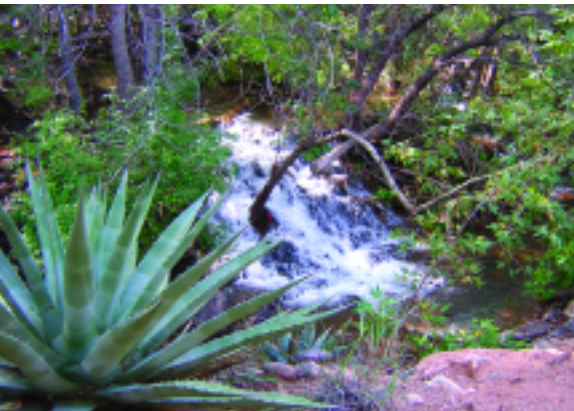
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## Watershed Research AND EDUCATION PROGRAM (WREP)



NAU's Watershed Research & Education Program began in 2000 by means of a gift from the Salt River Project's New Century Capital Campaign. For the first four years of its existence, the program was known as the Verde Watershed Research and Education Program, and was focused on the 5,500 square-mile Verde River watershed. The watershed encompasses unique and spectacular areas in central Arizona and parts of Yavapai, Coconino, and Gila Counties. Although the program continues to be a highly involved in the Verde River watershed, it began to study all watersheds in north-central Arizona in 2004.



In 2004, SRP once again presented WREP with a generous financial gift which will provide support through 2009. Other financial backing comes from the U.S. Forest Service, the Central Arizona Project, U.S. Bureau of Reclamation, Yavapai County, and other project-specific grants.

Additionally, WREP organizes annual field schools to increase public knowledge and facilitate informed public policy regarding water-related issues in Arizona. Every even year, a high-quality, low-cost field school is offered to K-12 educators throughout north-central Arizona to provide material for use in their curricula. Every odd year, the field school is structured to provide water science, policy, and law information to the region's elected officials.



*top: Electroshocking at Fossil Creek.*

*middle: Fossil Springs.*

*Photo by Ian Reed, U.S. Forest Service*

*above: Native desert sucker at Fossil Creek. Photo by Shaula Hedwall, U.S. Fish and Wildlife Service*

WREP objectives include:

- Development, coordination, and promotion of research, education and outreach programs related to water resources in north-central Arizona watersheds;
- Providing a centralized, coordinated and supported location for storage and exchange of north-central Arizona watershed information.

### CONTACT

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Degree Programs, Courses  
& STUDENT ASSOCIATIONS



# Environmental Degree PROGRAMS

*Detailed program information can be found in the NAU Undergraduate Catalog and the NAU Graduate Catalog. This information courtesy of Merriam-Powell Center for Environmental Research and the Ponderosa Project.*

## Undergraduate Programs

**B.A./B.S. in Applied Indigenous Studies:** Certificate in Applied Indigenous Environmental Studies

**B.S. in Biology:** Extended major with an emphasis in ecology

**B.S. in Biology:** Extended major in fish and wildlife management

**B.S. in Environmental Chemistry:** The ACS-certified B.S. in Environmental Chemistry prepares a student to be a practicing environmental chemist, or to pursue graduate study in environmental chemistry.

**B.S. in Journalism:** Environmental Communication Emphasis

**B.S. in Economics:** Environmental Focus

**B.S.E. in Engineering:** Extended major in Environmental Engineering; a minor is also available.

**B.S. in Environmental Sciences:** Extended major with an emphasis in one of the following: Biology, Chemistry, Applied Geology, Applied Mathematics, Microbiology, Environmental Administration and Policy, Environmental Communication, or Environmental Management. A minor is available as is a Bachelors in Liberal Studies with an emphasis in Environmental Sciences.

**Interdisciplinary Minor in Environmental Studies:** Environmental Studies is an interdisciplinary exploration of environmental issues and sustainable solutions. By selecting courses from a wide range of disciplines, such as Political Science, Philosophy, Environmental Science, Geology, Forestry, Sociology, and others, students will better understand the complexity of environmental issues and explore a range of viable solutions.

**Interdisciplinary Minor in Southwest Studies:** The Southwest Studies Minor curriculum consists of a total of 18 units to be distributed in three areas. Other courses may be substituted for those listed with the consent of the Southwest Studies Advisor.

**B.S. in Forestry:** A professional program that is unique in the country, offering a holistic approach to the environment rather than isolated, specialty-oriented courses. Outdoor and Environmental Leadership emphasis; Interpretation emphasis.

**B.S. in Parks and Recreation Management:** Extended major. A minor and a certificate program are also available.

**B.S. in Physics and Astronomy:** Extended major with an environmental emphasis

**B.S. in Public Planning:** Extended major in Environmental Planning; a minor is also available

**B.S. in Public Planning:** Extended major in Land-Use Planning; a minor is also available

**B.S. in Geology:** Extended major in Environmental Geology

**B.A. in Humanities:** Environmental Humanities Emphasis

**B.S. in Humanities:** Extended major in Public Humanities

**B.A. in Liberal Studies:** Emphasis areas in Environmental Communication, Environmental Sciences, and Parks and Recreation Management

**B.A./B.S. in Political Science:** Environment Focus

**Honors Program: Grand Canyon Semester:** An integrated learning experience for students from across the U.S., examining the challenges facing people in an ancient and modern environment, from the perspectives of the natural sciences, social sciences, and humanities.

## Graduate Programs

*This information courtesy of Merriam-Powell Center for Environmental Research and the Ponderosa Project.*

**M.S. Engineering: Environmental Engineering Emphasis:** Focuses on the development of constructed systems that achieve benign interactions with natural environmental systems, promoting sustainability for both. Emphasizes a strong background in physical and organic chemistry and microbiology along with the chance to develop proficiency in water and wastewater treatment, water quality engineering, air pollution control, hazardous and solid waste management, and site remediation and pollution prevention.

**Master of Liberal Studies Program, “Visions of Good and Sustainable Societies”:** An interdisciplinary graduate program, focusing on the environmental and social dimensions of sustainable community life. Offered on a flexible schedule for both traditional and non-traditional students. Includes a regional cohort in the Valley, focusing on “bioregionalism and sense of place.”

**M.A./M.PA./Ph.D. in Political Science with an emphasis in Environmental and Natural Resources Policy:** Students in each graduate program may develop an environmental emphasis. In addition to coursework in the discipline, students take relevant courses in disciplines with an environmental focus, such as history, forestry, or environmental sciences.

**M.S. Environmental Sciences and Policy:** This flexible, interdisciplinary program focuses on the interface between natural sciences and public policy. The program combines advanced academic training with practical problem-solving or original scientific research. Interdisciplinary core classes are combined with a large selection of specialized courses from across the university. The program core includes courses with emphasis on the environmental sciences-policy interface, land and water resources, atmosphere and climate, and environmental law, regulation and policy. Many of the specialty courses are drawn from existing graduate courses in biology, geology, political sciences, forestry, chemistry, and other NAU departments.

**Conservation Ecology Graduate Certificate:** Conservation Ecology is a synthetic discipline that provides a scientific foundation for resource management efforts aimed to conserve, restore and sustain the full range of biological diversity in a particular landscape. The Conservation Ecology Graduate Certificate program at NAU provides a means for early- and mid-career professionals to gain exposure and competence in the theory and practice of conservation ecology. This 18-credit hour program focuses on field research, habitat restoration, endangered species recovery, and conservation management with an emphasis on human dimensions of landscape-level and biological conservation.

**M.S. Quaternary Sciences:** Provides academic and field experience for master’s degree graduate students in the context of developing state-of-the-art quality research and data dissemination regarding the Quaternary period of the arid western North America

**M.S. /Ph.D. Forestry:** Graduate education and research opportunities in the School of Forestry provide motivated individuals with the knowledge and expertise necessary to successfully pursue their career objectives in forest land management or research.

# Environmental Degree COURSES

## Undergraduate Courses

*This information courtesy of Merriam-Powell Center for Environmental Research and the Ponderosa Project.*

Note: courses may not be offered every semester of every year. Search the NAU Schedule of Classes or the respective department to find out if and when specific courses will be offered. Weblinks are indicated by underlined blue text. The number of credits is in parenthesis.

**AIS 320 American Indian Politics and Policy** (3). Examines the development of political and policy relationships between Native American nations and the U.S government, using a political, social, economic, and cultural context. Cross listed as POS 320. Prerequisite: POS 110. Karen.Ziemski@nau.edu

**ANT 104 Lost Tribes Buried Cities** (3). Archaeology and culture evolution of the world, from the early Pleistocene to the rise of civilization. Vero.Perez@nau.edu

**ANT 205 Native People/North America** (3). Ethnographic survey of Indian societies in the United States and Canada , their cultural and linguistic development, and their current status. Scott.Antes@nau.edu

**ANT 250 Principles of Archaeology** (3). Method, theory, goals, and history of archaeology as a subdiscipline of anthropology. Joshua.Edwards@nau.edu, Frederick.OHara@nau.edu, Francis.Smiley@nau.edu

**ANT 301 Peoples Of The World** (3). Ethnographic survey of selected native peoples and cultures of the world. Michael.Vasquez@nau.edu

**ANT 306 Peoples Of The SW** (3). Introduces the greater Southwest as a major world culture area, including recent and contemporary peoples, the nature of multi-ethnic society, current directions of change, and pockets of persistence. Robin.Rickli@nau.edu

**ANT 351 Southwestern Archeology** (3). Origins, characteristics, and relationships of the prehistoric cultures of the American Southwest. Chris.Downum@nau.edu

**ANT 370 Human Ecology** (3). General survey of ecological relationships and the cultural environment as these affect human behavior, demographic characteristics, and variations in human types, past and present, including discussion of current issues and future prospects of human population development, and practical applications of current knowledge. Mark.Taylor@nau.edu

**ANT 379 Biological Anthropology** (4). In-depth survey of topics and methods in physical anthropology: paleoanthropology, primate ecology, method and theory. Required for major. 3 hrs. lecture, 3 hrs. lab. Prerequisites: major in anthropology, at least junior status, and course in statistics, or instructor's consent. Mark.Taylor@nau.edu

**ANT 390 Cultural Simulation** (4). Collaborative project to build and document a historically and scientifically plausible "working model" of the first permanent settlement on Mars. 3 hrs. lecture, 2 hrs. lab. Reed.Riner@nau.edu

**ANT 459 Indigenous Perspectives in Cultural Resource Management** (3). Introduces Native American perspectives on cultural resource management. Addresses three main questions: Who owns the past? Who manages the past? Who tells the stories? Prerequisite: junior or senior status, or instructor's consent.

**ART 123 Color And Light** (3). The study of color vision, the history of pigments and dyes from Lascaux to present, the development of knowledge about light and color, and the application of theory to practice. 1 hr. lecture, 4 hrs. studio. E.Groenhout@nau.edu

**ART 150 Two-Dimensional Design** (3). Studio course. Explores art elements and design principles applicable to all the visual arts, with an emphasis on two-dimensional organization and color theory. Prerequisite: ART 135. Jim.O'hara@nau.edu

**ART 151 Three-Dimensional Design** (3). Studio course. Explores the fundamental design principles involved in organizing three-dimensional space, with an emphasis on three-dimensional concepts and materials. Lynne.Oulman@nau.edu

**ART 161 Ceramics I** (3). Studio course with emphasis in creating ceramic art. Includes hand building, wheel throwing, and modes of criticism. 5 hrs. studio. Open to all students. Edward.Adler@nau.edu

**ART 171 Jewelry/Metals I** (3). Studio course. Broad-based exposure to the methods, techniques, and materials of jewelry and metalsmithing, with emphasis on jewelry and metals history and modes of criticism. Open to all students. Joe.Cornett@nau.edu

**BIO 100** Environmental issues are examined that are related to human impact on the biosphere. Environmental degradation is addressed when landfill capacity and recycling efforts collide. Agricultural and forests managements issues are stressed as humans compete for space and thus threaten biodiversity around the Earth. The importance of conservation of resource and alternative fuels are topics that can be easily woven into the general biology curriculum. SYL.Allred@nau.edu

**BIO 100L Biology Concepts Lab** (1). Investigates examples of life, with focus on our understanding of evolution, environment, heredity, body form, and function. Not available for credit in the major. 1 hr. lab. Corequisite: BIO 100.

**BIO 182 Unity/Life II** (3). Introductory course for biology majors. Emphasizes the unifying organismal principles of life on earth. 3 hrs. lecture, 3 hrs. lab. Prerequisite: BIO 181 or BIO 181H. SYL.Allred@nau.edu

**BIO 205 Microbiology** (4). Basic concepts of microbiology emphasizing the characteristics of pathogenic microorganisms, disease mechanisms, the immune response, vaccinations and other public health procedures. Intended for students in the biological sciences and health professions. 3 hrs. lecture, 3 hrs. lab. Recommended: CHM 130 or 151. Prerequisite: BIO 181 or BIO 181H and Corequisite: BIO 305W. Maribeth.Watwood@nau.edu

**BIO 220 Biology of Microorganisms** (4). Fundamental concepts of microbiology with emphasis on anatomy, metabolism, genetics, and ecology of microorganisms. 3 hrs. lecture, 3 hrs. lab. Prerequisites: one semester each of college biology and chemistry (two semesters of each preferred). Richard.Shand@nau.edu

**BIO 221 Lower Invertebrates** (4). Surveys the "lower" invertebrate phyla using selected taxa to illustrate concepts in evolution, ecology, and behavior. 3 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Stephen.Shuster@nau.edu

**BIO 222 Higher Invertebrates** (4). Surveys the "higher" invertebrate phyla using selected taxa to illustrate concepts in evolution, ecology, and behavior. 3 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course.

**BIO 223 Vertebrate Zoology** (4). Evolution, systematics, distribution, ecology, and primary adaptations of the major vertebrate groups. 3 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course.

**BIO 227 Intertidal Invertebrates** (1). Surveys invertebrate diversity in the northern Gulf of California, with emphasis on common living and fossil species. Includes a five-day field trip to Puerto Peñasco, Mexico. Instructor's Consent. Prerequisite: BIO 221 or BIO 222. Stephen.Shuster@nau.edu

**BIO 284 Botany** (3). Surveys botanical principles from an evolutionary perspective, including cell biology, inheritance, development, ecological roles, reproduction, and classification. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Peggy.Pollak@nau.edu

**BIO 300 Human Biology** (1). Series of independent minicourses dealing with aspects of biology and human conditions. SYL.Allred@nau.edu, Randall.Scott@nau.edu, Cheryl.Dyer@nau.edu, Steven.Hempleman@nau.edu, Peggy.Pollak@nau.edu, Con.Slobodchikoff@nau.edu, Bill.Gaud@nau.edu

**BIO 322 Entomology** (4). Classification, identification, ecology, physiology, and economic importance of insects. 3 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Neil.Cobb@nau.edu

**BIO 326 Ecology** (3). Introduces ecological principles, including the distribution and abundance of organisms, population dynamics, community organization, energy flow, and nutrient cycling. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Bruce.Hungate@nau.edu, George.Koch@nau.edu

**BIO 326L Principles of Ecology Lab** (1). Introduces the experimental analysis of plant and animal interactions within terrestrial and aquatic ecosystems, including community dynamics, ecological processes, and biotic inventories. Prerequisite or corequisite: BIO 326. Bruce.Hungate@nau.edu, George.Koch@nau.edu

**BIO 340 Genetics & Evolution** (3). Fundamental concepts of inheritance, including genetic and chromosomal character determination, and natural selection leading to population changes and speciation. Prerequisite: ( BIO 181 or BIO 181H ) and BIO 182. Philip.Service@nau.edu

**BIO 345 Plant Propagation** (3). Applies plant science principles to plant propagation, including elements of pathology, physiology entomology, landscaping, orchard, garden, and greenhouse science. 2 hrs. lecture, 3 hrs. lab. Prerequisite: ( BIO 181 or BIO 181H ) and BIO 182. Peggy.Pollak@nau.edu

**BIO 366 Behavior of Animals** (3 ). Surveys the theories and reasons that explain the behavior of animals. Con.Slobodchikoff@nau.edu

**BIO 369 Environmental Microbiology** (4). Microorganisms in the air, food, soil, and water, and their interaction with the environment. 3 hrs. lecture, 3 hrs. lab. Prerequisite: BIO 220 or 205. Pre-biology majors may not take this course. Egbert.Schwartz@nau.edu , Maribeth.Watwood@nau.edu

**BIO 372 Revolutionary Thought in Biology** (3). Biological theories, such as those on the origin of life, evolution, and extinction; the immune response; sex; cancer; and behavior. Pre-biology majors may not take this course. Bill.Gaud@nau.edu

**BIO 373 Marine Biology** (3). Behavior, ecology, biogeography, and evolution of marine organisms relative to the physics and geology of the ocean. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Linn.Montgomery@nau.edu

**BIO 374 Economic Botany** (3). Surveys plants used by humans including plant parts or products used and their geographic origin and distribution. 2 hrs. lecture, 3 hrs. lab. Prerequisite: ( BIO 181 or BIO 181H ) and BIO 182 . Tina.Ayers@nau.edu

**BIO 408 Field Work Experience** (1-12). Supervised field experience in an appropriate agency or organization. Pass-fail only. Lee.Drickamer@nau.edu

**BIO 409 Bioremediation** (3). Fundamental concepts of bioremediation, including discussion of the following topics: degradation kinetics, bioaugmentation, metal biotransformation, molecular approaches to bioremediation, chlorinated solvents, phytoremediation, petroleum hydrocarbons, and natural attenuation. Prerequisite: CHM 151 and CHM 152 and BIO 205. Maribeth.Watwood@nau.edu

**BIO 410 Phycology** (3). Systematics, structure, reproduction, ecology, and methods of collecting algae; culture and experimental study of selected algae species. Field trips, 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Jane.Marks@nau.edu

**BIO 411 Mycology** (3). Systematics, physiology, ecology, and medical importance of fungi and related forms; field identification and experimental studies. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181 and 182. Pre-biology majors may not take this course. Catherine.Gehring@nau.edu

**BIO 414 Native Plants/Arizona** (3). Field-oriented course emphasizing the recognition of much of the native and naturalized flora of Arizona. Prerequisite: ( BIO 181 or BIO 181H ) and BIO 182. Tina.Ayers@nau.edu

**BIO 435 C Evolutionary Biology** (3). Evolution of organisms, including variability, natural selection speciation, patterns and rates of evolution, and the importance of the fossil record. 2 hrs. lecture. Prerequisite: BIO 340. Philip.Service@nau.edu

**BIO 471 Microbial Ecology** (3). Population, community, and ecosystem ecology of microorganisms emphasizing interactions with plants and animals and the roles of microorganisms in ecosystem processes. Coconvenes with BIO 571. Prerequisite: BIO 205 or 220. Bruce.Hungate@nau.edu, Nancy.Johnson@nau.edu

**BIO 475 Parasitology** (4). Parasites and their life cycles, host injuries, treatment, means of control, and prevention of infection. 3 hrs. lecture, 3 hrs. lab. Prerequisite: Junior Status. Stephen.Shuster@nau.edu

**BIO 476 Higher Aquatic Plants** (3). Ecology and taxonomy of the vascular plants and bryophytes in aquatic and riparian environments. 2 hrs. lecture, 3 hrs. lab. Prerequisite: BIO 431.

**BIO 477 Fish Management** (3). Introduces theory and practice of commercial and sport fish management. Topics include evolution and management of wild and stocked populations; field, lab, and hatchery techniques; aquaculture; exotic species; politics and economic management. 2 hrs. lecture, 3 hrs. lab. Prerequisite: ( BIO 223 or BIO 525 ) and BIO 425C or ( BIO 425 & BIO 425L ). Linn.Montgomery@nau.edu

**BIO 478 Wildlife Management** (3). Surveys concepts and practices employed in the study and management of terrestrial wildlife. Topics include values, habitat requirements, movements, behavior, and dynamics of wildlife populations and the techniques used to ensure their continued survival. 2 hrs. lecture, 3 hrs. lab. Prerequisite: BIO 326 and one of ( BIO 223 or BIO 527 or BIO 528 ). Tad.Theimer@nau.edu

**BIO 479 Ecosystem Ecology: Case Studies on the Colorado Plateau** (3). Principles of ecosystem ecology, including the factors controlling ecosystem structure, productivity, nutrient cycling, and energy balance—with examples from the Colorado Plateau and emphasis on global environmental change. Crosslisted with FOR 479. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181, 182, and 326 or FOR 313, 314, 315, and 316 or instructors' consent. Bruce.Hungate@nau.edu, Nancy.Johnson@nau.edu

**BA 470C Business in Society** (3). Analyzes business and its environment, considering such things as the natural environment, business ethics, governmental policies, the impact of technology, and cultural diversity. This course serves as the capstone for the BAILS emphasis in Enterprise in Society only. Prerequisites: BA 205 and two of FIN 303, MGT 303, and MKT 303. James.Wilson@nau.edu, Lee.Nation@nau.edu

**CENE 150 Introduction to Environmental Engineering** (3). Scientific and technical introduction to contemporary environmental and ecological issues. Pollution prevention, common contaminants, measurements, sources, and regulatory policies. Corequisite: CHM 130 or CHM 151 and MAT 110 or Math Placement 46 or higher. Wilbert.Odem@nau.edu

**CENE 280 Environmental Engineering Fundamentals** (3). A course in environmental engineering fundamentals that applies biological, chemical, and mathematical principles to solve environmental engineering problems using the mass balance approach. Prerequisite: BIO 181 and CENE 150 and CHM 152 and MAT 136 or MAT 136H with C or better or International Student Group.

**CENE 281L Water Quality Lab** (1). Lab and field methods of sampling and measuring water, wastewater, and microbiological parameters. Includes quality assurance and analysis of data. Prerequisite: CHM 151 and CHM 151L and CENE 150 with grades C or better. Corequisite: EGR 225. Terry.Baxter@nau.edu

**CENE 282L Air and Site Investigations Lab** (1). Lab and field methods for measuring parameters in air, soil, and hazardous materials. Includes quality assurance and analysis of data. 2.5 hrs. lab. Prerequisite: CHM 151 and CHM 151L and CENE 150 and EGR 225 with grades C or better or International Student Group. Paul.Gremillion@nau.edu

**CENE 330 Air Quality Engineering** (3). Technical approaches to air quality problems; source identification; acid deposition; ozone; control of primary and toxic air pollutants; indoor air quality. Prerequisites: CENE 280 and MAT 137 with grades greater than or equal to C. Terry.Baxter@nau.edu

**CENE 331 Sanitary Engineering** (3). Water-quality issues affecting water supply and effluent treatment, disposal, and reuse. Design of physical, chemical, and biological treatment facilities. Prerequisite: CENE 333 with grade C or better. Paul.Gremillion@nau.edu

**CENE 332 Solid and Hazardous Waste Management** (3). Waste identification, physicochemical properties, fate and transport in the environment, site characterization and assessment, remediation tools and technologies. Prerequisites: CENE 280 and (CHM 230 or CHM 235 or CHM 440) with grade C or better. Bridget.Bero@nau.edu

**CENE 380 Environmental Transport Process I** (3). Fundamental engineering concepts of momentum balance, with applications for environmental engineering. Prerequisites: CENE 280 and MAT 239.

**CENE 383 Soil Mechanics and Foundations** (4). Soil properties; identification and classification of earth material; subsurface exploration of soil strength, stresses, and settlement; substructure design; computer applications. Prerequisite: CENE 253 with grade C or better.

**CENE 410 Environmental Engineering Design** (3). Design of unit operations in water, wastewater, waste management, and/or air quality engineering. Student-generated data informs and drives the design of relevant processes. Corequisite: CENE 480. Wilbert.Odem@nau.edu

**CENE 418 Highway Engineering** (3). Emphasizes highway geometric design, including capacity, human factors, safety, drainage, and specifications. Introduces highway construction, maintenance, and pavement design; transportation planning; and traffic engineering. 2 hrs. lecture, 3 hrs. lab. Prerequisite: EGR 225 and CENE 270 and CENE 383 with grades C or better. Craig.Roberts@nau.edu

**CENE 430 Air Pollution Controls Design** (3). Design process and procedure for control of particulate and gaseous pollutants. Includes pollution prevention considerations. Prerequisite: CENE 330 and (ME 395 or CENE 380) with grade C or better. Terry.Baxter@nau.edu

**CENE 433 Hydrology and Flood Control** (3). Hydrologic design and analysis of drainage and flood-control systems. Hydrologic cycle components necessary for determining design flows. Computer modeling. Corequisite: CENE 333. Paul.Trotta@nau.edu

**CENE 434 Water and Waste-water Units Design** (3). Design-based environmental engineering course. Unites design of drinking water and waste-water treatment plants. Applies microbiology, water chemistry principles, and units of treatment-plant design techniques. Prerequisites: CENE 280 and CENE 333 with grades C or better. Paul.Gremillion@nau.edu

**CENE 435 Environmental Biotechnology** (3). Presents the engineered application of biological systems for remediation of contaminated environments (land, air, water), and for sustainable development technologies and processes. Prerequisite: CENE 280 and CENE 281L and CENE 282L.

**CENE 440 Environmental Protection: Today and Tomorrow** (3). Explores current legal and regulatory strategies for environmental protection. Examines innovative approaches to environmental management. Group and class projects. Prerequisite: ENV 101 or ENV 101H or CENE 150 or FOR 222 with grade C or better. William.Auberle@nau.edu

**CENE 441 Environmental Protection Case Study** (1). Examines a contemporary and important environmental topic through a real or hypothetical case study. Sample topics include water quality, water resource management, air quality protection, and hazardous waste management. May be repeated for up to 2 hours of credit. Prerequisite: ENV 101 or ENV 101H or CENE 150 or FOR 222 with grade C or better.

**CENE 468 Engineering in Natural Systems: Rivers and Streams** (3). Prepares you for projects involving natural stream systems. Involves stream classification, field data collection, and application of hydrologic and hydraulic models calibrated to natural stream channels. Prerequisites: CENE 333, 383, and 433, with grade C or better..

**CHM 130 Fundamental Chemistry** (4). Principles of chemistry course for students requiring only one semester of chemistry and those proceeding to a one-semester organic ( CHM 230 ) course. Prerequisite: MAT 102X or higher. Hans.Gunderson@nau.edu

**CHM 151 General Chemistry I** (4). Fundamental chemistry principles presented at a level appropriate for preprofessional, science, and engineering majors, including students proceeding to CHM 235 and 238 . Prerequisites: high school chemistry or CHM 100 plus intermediate algebra; recommended: CHM 151L. Prerequisite: MAT 102X or higher. Wayne.Hildebrandt@nau.edu, Douglas.Kolwaite@nau.edu, Wayne.Hildebrandt@nau.edu

**CHM 151L General Chemistry I Lab** (1). Introduces important lab practices, stoichiometry, and the analysis of chemical unknowns. 2 hrs. lab including lecture time when appropriate. Prerequisite or Corequisite: CHM 130 or CHM 151 . Staff

**CHM 152 General Chemistry II** (3). Continuation of CHM 151. recommended: CHM 152L. Prerequisite: CHM 151. John.Wettaw@nau.edu, Brandon.Cruickshank@nau.edu

**CHM 152L General Chemistry II Lab** (3). Continuation of CHM 151 L. Prerequisite: CHM 151. Staff

**CHM 440 Environmental Chemistry** (3). Rigorous introduction to the chemistry of natural systems, including redox properties and complex equilibria, element cycling, and atmospheric chemistry. Prerequisite: CHM 152. Richard.Foust@nau.edu

**CJ 312 Environmental Crime** (3). Examines laws and legal strategies designed to protect environmental quality; explores varieties of environmental crimes and associated problems of control. Raymond.Michalowski@nau.edu

**CM 120 Building Human Environments** (3). Comparative study of humans' efforts to control their environment with constructed shelter and infrastructure on global, regional, and personal levels. Dave.Grider@nau.edu

**COM 150 Environmental Communication** (3). Analytical research and writing skills for public dissemination of environmental information via the media. Lea.Parker@nau.edu

**COM 250 Environmental Perspectives on Communication Arts** (3). Analytical exploration and interpretation of oral, visual, and written artistic and communication works that have influenced public perception and/or policy concerning environmental issues. Lea.Parker@nau.edu

**ECO 325 Environmental Economics** (3). Issues, theories, and policies, including cultural, social, and ethical issues; theories of externalities, property rights, optimal depletion rates and sustainable development; and policy and regulation of environmental economic activity. Prerequisites: ECO 284 and junior status.

**EGR 190 Energy, Ecology, and You** (3). Energy use and the human race; conventional energy sources; social, economic, and environmental impacts; alternative energy sources. Nonmajors only.

**ENG 441: Seminar in American Literature: American Nature Writing (Steven Rosendale).** \*When taught by Steven Rosendale, this course provides an introduction to the history of writing and thought about the environment in the U.S. from its European roots to the present day; explores how the North American environment has exerted an influence on American literature and culture, and conversely, how language and literature have shaped perceptions of the American environment; provides training in critical approaches to nature writing and other literary representations of the environment; provides an introduction to "ecocritical" thought, and examines its implications for the study and criticism of literature. Steven.Rosendale@nau.edu

**ENV 101 Introduction to Environmental Sciences** (3). Studies human impacts on the biosphere, atmosphere, hydrosphere, and lithosphere from a natural sciences perspective. ( Note: This liberal studies course does not meet any requirements for a major or minor in environmental sciences.) Douglas.Hallett@nau.edu, Michael.Ort@nau.edu , cdc22@dana.ucc.nau.edu

**ENV 101L Introduction to Environmental Sciences Lab** (1). Investigates the impacts of humans on the natural world while developing an appreciation of the value of scientific inquiry and the tools for scientific research. 3 hrs. lab.

**ENV 110 Earths Dynamic Atmosphere Environment** (3). Explores basic physical and chemical atmospheric processes and how humans affect, and are affected by, atmospheric conditions. Includes study of thunderstorms, tornadoes, hurricanes, air pollution, ozone depletion, and global warming. Diana.Anderson@nau.edu

**ENV 181 Environmental Challenges** (3). An introduction to the how we perceive the environment: how our environment is structured and functions, how we relate to the environment from humanistic, cultural and political perspectives, and how we identify, approach and resolve major environmental issues. Marcus.Ford@nau.edu, Rod.Parnell@nau.edu, Jacqueline.Vaughn@nau.edu

**ENV 230 Foundations of Environmental Science: Humans and the Environment** (4). Introduces scientific methods of investigating and solving environmental problems. Interdisciplinary analysis of interactions among living and nonliving environmental components, focusing on human interactions. Lab emphasizes experimental design and presentation. Majors only. 3 hrs. lecture, 3 hrs. lab. Prerequisites: CHM 151 and 151L; corequisites: CHM 152 and 152L. Diana.Anderson@nau.edu, Nancy.Johnson@nau.edu

**ENV 280 Physical and Chemical Processes in the Atmosphere and Hydrosphere** (4). Integrated approach to Earth's atmosphere and hydrosphere, emphasizing composition, chemical processing, physical transport, and aspects of human impacts and policy. Lab includes experimental design, statistics, and writing. 3 hrs. lecture, 3 hrs. lab. Prerequisites: ENV 230 plus CHM 151, 151L, 152, and 152L. Diana.Anderson@nau.edu, Roderic.Parnell@nau.edu, Marin.Robinson@nau.edu, Marin.Robinson@nau.edu

**ENV 285 Intermediate Environmental Lab** (1). Lab and field experiences for all of the environmental major fields, demonstrating the interrelationships of the environmental subdisciplines. Prerequisites: ENV 101 or CENE 150 and one additional lab course.

**ENV 300 Problems in Environmental Sciences** (1). Analytical approach to selected problems in the environmental sciences; fieldwork and lab research with selected problems. May be repeated for up to 2 hours of credit.

**ENV 330 Environmental Ecology: Synthesis and Applications** (4). Introduces ecological science and its applications in environmental management. Lab sections focus on land and resource management issues and emphasize hypothesis testing, using data collected in the field. For majors only. 3 hrs. lecture, 3 hrs. lab. Prerequisite: ENV 280. Thomas.Sisk@nau.edu

**ENV 385W Energy, Resources, and Policy** (4). Origins and exploitation of energy and mineral resources, and the policies that control how we obtain and use them. This course fulfills NAU's junior-level writing requirement. 3 hrs. lecture, 3 hrs. lab. Prerequisite: ENV 330; corequisite: POS 359.

**ENV 399 Modular Learning Experience (1-3).** In-depth study of an aspect, concept, or problem within a program of study. May be repeated for up to 6 hours of credit. Michael.Ort@nau.edu

**ENV 408 Field Work Experience (1-12).** Supervised field experience in an appropriate agency or organization. Pass-fail only. Prerequisite: departmental approval. Roderic.Parnell@nau.edu , d.a.o@nau.edu .

**ENV 410 Weather Analysis and Forecasting** (4). Introduces meteorology emphasizing synoptic methods combined with theory to gain practical experience with the behavior of circulation systems and their surface and upper-level analysis. 3 hrs. lecture, 3 hrs. lab.

**ENV 440 Conservation Biology** (3). Scientific basis for conserving and managing biological diversity, emphasizing applications of ecology, drawing on other scientific disciplines, and integrating public policy and sociological issues. Prerequisite: ENV 330 or BIO 326 or all of FOR 413C, 414C, 423C, and 424C, or instructor's consent. Thomas.Sisk@nau.edu

**ENV 440L Conservation Biology Lab** (1). Combines class field studies and independent research investigating the scientific basis for conserving and managing biological diversity. Requires several Saturday field trips. 3 hrs. lab. Prerequisite: ENV 330 or BIO 326 or all of FOR 413C, 414C, 423C, and 424C, or instructor's consent; corequisite: ENV 440.

**ENV 466 Legislative Internship** (1-12). Supervised internship in the Arizona Legislature during spring semester. Students are selected on a competitive basis, and you must apply during the fall semester. (To be eligible, you must be a candidate for a bachelor's degree and have completed all lower-division requirements and attained senior status at the end of the fall semester preceding the internship.) Registration is handled by the associate provost for academic administration after the legislature has made its final selection. Pass-fail only. Roderic.Parnell@nau.edu

**ENV 490C Senior Seminar in Environmental Sciences** (3). Presentation of internship results in scientific meeting format. Participation in weekly seminar and cooperative project with a team of student colleagues is required. You must receive a 70% grade to be awarded the B.S. in environmental sciences. Prerequisite or corequisite: completion of 3 hours in ENV 485. Richard.Foust@nau.edu

**ENV 495 Global Environmental and Climate Change** (3). Characteristics of the global climate system, estimating past and predicting future impacts of human activities on climate and environmental systems, and policy implications. Prerequisites: CENE 150, one statistics and one computer course, and junior status. Scott.Anderson@nau.edu

**FOR 101 Forestry Intro** (3). Introduces the subject areas and career opportunities in forestry. Required of lower-division forestry students currently enrolled at NAU. Robert.Larson@nau.edu, Margaret.Moore@nau.edu, Bruce.Fox@nau.edu

**FOR 211 Forest Measurements** (3). Fundamentals of measuring forest ecosystems and resources, land surveying, mapping, and orienteering. 2 hrs. lecture, 3 hrs. lab. Prerequisite: MAT 125 or MAT 125H or higher and Prerequisite or Corequisite: STA 270. Denver.Hospodarsky@nau.edu

**FOR 212 Trees & Forests: North America** (2). Introduces important forest trees and forest types in North America . Tom.Kolb@nau.edu

**FOR 213 Ecology & Management Forest Soils** (3). Introduces soil science, with special emphasis on forest soils. Topics include soil formation and classification; the physical, chemical, and biological properties of soil; and impacts of human-based activities on soils. Prerequisite: ( BIO 181 or BIO 181H ) and BIO 182 and CHM 130 and CHM 151L. Steve.Hart@nau.edu

**FOR 220 Introduction to Forest and Range Plants** (2). Field identification, ecology, and uses of common forest and range plants in northern Arizona. 1 hr. lecture, 3 hrs. lab. Letter grade or pass-fail. Janice.Busco@nau.edu, Margaret.Moore@nau.edu

**FOR 222 Environmental Conservation** (3). Environmental quality problems in natural and human-made environments. Robert.Larson@nau.edu

**FOR 230 Multicultural Perspectives on Environmental Management** (3). Introduces the effects of culture on attitudes, institutions, and environmental management from a multicultural perspective. Martha.Lee@nau.edu

**FOR 240 Intro Conservation Biology** (3). Explores the practical issues related to people and society in maintaining the earth's biological diversity. Discusses the social environment and how to implement successful conservation of biodiversity. Paul.Beier@nau.edu

**FOR 250 Arizona Forests and Wildlife** (3). Overview of fundamental ecology and management of major forest types and wildlife of Arizona. Relationship of Arizona 's forests and wildlife to North America. Thom.Alcoze@nau.edu, Robert.Mathiasen@nau.edu

**FOR 255 International Wildlife Issues** (3). This course will provides a survey of current issues in wildlife conservation and management from around the globe. Carol.Chambers@nau.edu

**FOR 270 Native American Ecology** (3). Uses introductory ecology and natural science principles to critically review literature and information about the geographic distribution, traditional land use, and conservation knowledge of indigenous peoples in North America. Letter grade or pass-fail. Thom.Alcoze@nau.edu

**FOR 313 Forest Ecology I** (4). Studies abiotic and biotic components affecting the structure, composition, and function of forests: individuals, populations, and communities. 3 hrs. lecture, 1 hr. lab. Prerequisite: Admission to BS in Forestry Plan. Paul.Beier@nau.edu

**FOR 314 Forest Ecology II** (3). Studies abiotic and biotic components affecting the structure, composition, and function of forests: landscapes and ecosystems. Prerequisite: Admission to BS in Forestry Plan and Corequisite: FOR 313. Paul.Beier@nau.edu

**FOR 315 Silviculture Principles** (3). Art and science of growing trees in forested stand: principles. Corequisite: FOR 314. Paul.Beier@nau.edu

**FOR 316 Silviculture Applications** (3). Art and science of growing trees in forested stands: applications. 2 hrs. lecture, 1 hr. lab. Corequisite: FOR 315. Paul.Beier@nau.edu

**FOR 323W Forest Management I** (3). Studies techniques and skills needed to manage complex forested ecosystems for the generation of goods and services. This course fulfills NAU's junior-level writing requirement. Prerequisite: FOR 313 , 314 , 315 and 316 with grades greater than or equal to C. Don.Arganbright@nau.edu

**FOR 324W Forest Management II** (3). Studies role of human needs and values in the management of forested ecosystems. This course fulfills NAU's junior-level writing requirement. Prerequisite: ( FOR 313 - 316 with grade greater than or equal to C) Corequisite: FOR 323W. Don.Arganbright@nau.edu

**FOR 325W Forest Management III** (3). Evaluates interactions between and among competing and complementary uses of forested ecosystems within a human context. This course fulfills NAU's junior-level writing requirement. Prerequisite: ( FOR 313 - 316 with grades greater than or equal to C) Corequisite: FOR 324W. Don.Arganbright@nau.edu

**FOR 326W Forest Management IV** (4). Integrates principles of forest ecosystem management across spatial, temporal, and geopolitical scales. This course fulfills NAU's junior-level writing requirement. Prerequisite: ( FOR 313 - 316 with grade greater than or equal to C) Corequisite: FOR 326W. Don.Arganbright@nau.edu

**FOR 340 Environmental Hydrology** (3). Introduces environmental implications of extreme hydrological processes, the effects of natural and human activities on the hydrology and water resources of an area, and related problems and solutions. Crosslisted as GGR 340. Prerequisite: MAT 125 and (GLG 100 or GLG 101 or ENV 101 or GGR 250 or FOR 101). Aregai.Tecl@nau.edu

**FOR 340L Environmental Hydrology Lab** (1). Practical lab and field measurement and evaluation for FOR 340 . Crosslisted as GGR 340L. 3 hrs. lab. Prerequisite: MAT 125 and ( GLG 100 or GLG 101 or ENV 101 or GGR 250 or FOR 101 ) Aregai.Tecl@nau.edu

**FOR 340H Environmental Hydrology-Honors** (3). Introduces environmental implications of extreme hydrological processes, the effects of natural and human activities on the hydrology and water resources of an area, and related problems and solutions. Crosslisted as GGR 340. Prerequisite: MAT 125 and ( GLG 100 or GLG 101 or ENV 101 or GGR 250 or FOR 101 ) and in honors student group. Aregai.Tecl@nau.edu

**FOR 340HL Environmental Hydrology Lab-Honors** (1). Practical lab and field measurement and evaluation for FOR 340 H. Crosslisted as GGR 340L . 3 hrs. lab. Prerequisite: MAT 125 and ( GLG 100 or GLG 101 or ENV 101 or GGR 250 or FOR 101 ) Aregai.Tecl@nau.edu

**FOR 370 Indigenous Knowledge: Ecological Implications** (3). Uses advanced ecology and natural science principles to critically review literature and information about the ecological implications of indigenous people's resource use strategies. Letter grade or pass-fail. Prerequisites: FOR 270 and ENV 230. Thom.Alcoze@nau.edu

**FOR 380 Ecological Restoration Principles** (3). Concepts and theories of ecological science related to restoring natural structures and processes of ecosystems. Coconvenes with FOR 580. Letter grade or pass-fail. Prerequisite: instructor's consent. Pete.Fule@nau.edu, Max.Oelschlaeger@nau.edu

**FOR 381 Forest Ecosystem Management** (3). Explores the tools and practices for mimicking natural patterns of variation in forest ecosystems and for adaptive management over time and space. 2 hrs. lecture, 3 hrs. lab. Prerequisite: ENV 330 . Paul.Beier@nau.edu

**FOR 382 Ecological Restoration Applications** (3). Examples and applications of ecological science related to restoring natural structures and processes of ecosystems. Coconvenes with FOR 582. Letter grade or pass-fail. Prerequisite: instructor's consent. Pete.Fule@nau.edu

**FOR 382H Ecological Restoration Applications-Honors** (3). Examples and applications of ecological science related to restoring natural structures and processes of ecosystems. Coconvenes with FOR 582. Letter grade or pass-fail. Prerequisite: Honors Student Group. Pete.Fule@nau.edu

**FOR 403 Project Learning Tree** (1). Set of supplemental, interdisciplinary materials dealing with the forest environment that can be used for environmental education. Jillian.Worssam@nau.edu

**FOR 404 Project Wild** (1). Set of supplemental, interdisciplinary materials dealing with wildlife management concepts and issues that can be used for environmental education. Jillian.Worssam@nau.edu

**FOR 405 Project Wild Aquatic** (1). Set of supplemental, interdisciplinary materials dealing with aquatic ecosystems in natural environments that can be used for environmental education. Jillian.Worssam@nau.edu

**FOR 413C Forest Ecosystem Assessment I** (3). Studies principles and foundations of the techniques and practices required to characterize forest conditions. 2 hrs. lecture, 1 hr. lab. Prerequisite: FOR 323W, 324W, 325W and 326W with grades greater than or equal to C. Pablo.Parysow@nau.edu, Stephen.Dewhurst@nau.edu

**FOR 414C Forest Ecosystem Assessment II** (3). Applies techniques and practices required to characterize forest conditions. 2 hrs. lecture, 1 hr. lab. Prerequisite: ( FOR 323W - 326W with grade greater than or equal to C) Corequisite: FOR 413C. Pablo.Parysow@nau.edu, Stephen.Dewhurst@nau.edu

**FOR 415 Developing World Forests** (2). Ecology, management, and policy issues related to tropical and arid-land forests in developing countries. Coconvenes with FOR 515. Prerequisite: 3 hours FOR or BIO coursework. Mike.Wagner@nau.edu

**FOR 423C Forest Ecosystem Planning I** (3). Understanding of tools, techniques, and approaches for developing short- and long-term landscape-level forest management plans. 2 hrs. lecture, 1 hr. lab. Prerequisite: ( FOR 413C and FOR 414C with grades greater than or equal to C) Corequisite: FOR 424C and ( POS 344 or POS 359 ). Yeon-Su.Kim@nau.edu

**FOR 424C Forest Ecosystem Planning II** (3). Applies planning tools for the development of landscape-level forest management plans. 2 hrs. lecture, 1 hr. lab. Corequisite: ( FOR 413C and FOR 414C with grades greater than or equal to C) Corequisite: FOR 423C and ( POS 334 or POS 359 ). Yeon-Su.Kim@nau.edu

**FOR 430 Environmental Leadership** (3). Development of knowledge and expertise in leading the decision-making process regarding environmental or resource issues. Spring Prerequisite: Junior Status. Denver.Hospodarsky@nau.edu

**FOR 445 Wilderness Management** (3). Examines the philosophical, historical, legal, ecological, social, and cultural aspects of lands managed under the Wilderness Act. Prerequisite: upper-division coursework in areas related to natural resources management or science. Martha.Lee@nau.edu

**FOR 452 Forest Pathology** (3) Important forest tree diseases, their identification, ecology, and management. Coconvenes with FOR 552. 2 hrs. lecture, 3 hrs. lab. Letter grade or pass-fail. Prerequisites: FOR 313, 314, 315, and 316, or one course in biology or ecology. Robert.Mathiasen@nau.edu

**FOR 453 Forest Insects** (3). Identification, biology, population dynamics, ecological role, and management of forest insects in western forests. Coconvenes with FOR 553. Prerequisites: FOR 313, 314, 315, and 316, or one course in biology or ecology. Mike.Wagner@nau.edu

**FOR 465: Watershed Restoration** (3). Students will explore the effects of natural and anthropogenic activities on watershed conditions, and learn various approaches of restoring or handling any adverse effects of such disturbances on watershed ecosystems. The course is co-convened with FOR 565. Aregai.Tecle@nau.edu

**FOR 479 Ecosystem Ecology: Case Studies on the Colorado Plateau** (3). Principles of ecosystem ecology, including the factors controlling ecosystem structure, productivity, nutrient cycling, and energy balance—with examples from the Colorado Plateau and emphasis on global environmental change. Crosslisted with BIO 479. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 181, 182, and 326 or FOR 313, 314, 315, and 316 or instructors' consent. Steve.Hart@nau.edu

**FOR 498 Soil Ecology and Nutrient Cycling** (1). Integrates theory and practice, with emphasis on historical, contemporary, and future issues. Steve.Hart@nau.edu

**FOR 499 Contemporary Developments** (1). Examines recent trends and investigations in a selected area. Jillian.Worssam@nau.edu

**GGR 240 World Geography West** (3). Physical and cultural elements of Europe, Russia, and North and South America; areal distributions and factors influencing location, development, global processes, and international issues. Robert.Clark@nau.edu

**GGR 241 World Geography East** (3). Physical and cultural elements of Africa, the Middle East, Asia, and the Pacific regions; areal distributions and factors influencing location, development, global processes, and international issues. Robert.Clark@nau.edu, Duane.Marshall@nau.edu

**GGR 250 Physical Geography** (4). Studies the physical elements of the environment. 3 hrs. lecture, 3 hrs. lab. Robert.Clark@nau.edu, Ruihong.Huang@nau.edu, Thomas.Paradis@nau.edu

**GGR 340 Environmental Hydrology** (3). Introduces environmental implications of extreme hydrological processes, the effects of natural and human activities on the hydrology and water resources of an area, and related problems and solutions. Crosslisted with FOR 340. Prerequisites: MAT 125 and one of GLG 100 or 101, ENV 101, GGR 250, or FOR 101. Aregai.Tecle@nau.edu

**GGR 340L Environmental Hydrology Lab** (1). Practical lab and field measurement and evaluation for FOR 340. Crosslisted as FOR 340L. 3 hrs. lab. Prerequisite: MAT 125 and ( GLG 100 or GLG 101 or ENV 101 or GGR 250 or FOR 101 ).  
Aregai.Tecl@nau.edu

**GGR 346 United States** (3). Analyzes the relationships between physical and cultural aspects of the United States with an emphasis on contemporary geographic trends. Lori.Couture@nau.edu , Alan.Lew@nau.edu

**GGR 361 Weather & Climate I** (3). Fundamental properties and processes of the atmosphere. Lee.Dexter@nau.edu

**GGR 453 Quaternary Environments** (3). Multidisciplinary methods of studying Quaternary environments with an emphasis on the timing, magnitude, and causes of climatic change.

**GGR 451 Snow and Ice in our Environment** (3). Geographic treatment of earth's high elevation and high relief landscapes. Topics include the physical environment of, and human interaction with, mountains. Prerequisites: any introductory course in natural science and in social science. Lee.Dexter@nau.edu

**GLG 100 Introductory Geology** (3). Fundamental physical and historical concepts in geology, including dynamics of the earth. You may take either GLG 100 and 100L or GLG 101 and 103 or GLG 110 and 110L or GLG 112 and 112L for credit. Corequisite: GLG 100L. Paul.Morgan@nau.edu, David.Best@nau.edu, Peter.Koehler@nau.edu

**GLG 100L Intro Geology Lab** (1). Must be taken concurrently with GLG 100. 2 hrs. lab plus field trips. You may take either GLG 100 and 100L or GLG 101 and 103 for credit. Corequisite: GLG 100. Corequisite: GLG 100 Staff.

**GLG 101 Physical Geology** (3). Fundamental physical aspects of the earth's crust; rocks and minerals, structures, landforms and their origin. Corequisite: GLG 103. Thomas.Hoisch@nau.edu

**GLG 102 Historical Geology** (3). Chronological sequence of events in the history of the earth and its inhabitants. Corequisite: GLG 104. Ronald.Blakey@nau.edu

**GLG 103 Physical Geology Lab** (1). 3 hrs. lab plus field trips. Corequisite: GLG 101. Christina.Jan@nau.edu

**GLG 104 Historical Geology Lab** (1). Must be taken concurrently with GLG 102. 3 hrs. lab plus field trips. Prerequisite: ( GLG 101 and GLG 103 ) or GLG 110 or GLG 112. Ronald.Blakey@nau.edu

**GLG 110 Environmental Geology** (3). Relationship between humans and the Earth, including geological processes, pollution, natural hazards, and earth systems science. Corequisite: GLG 110L .

**GLG 110L Environmental Geology Lab** (1). Must be taken concurrently with GLG 110 .

**GLG 112 Geologic Disasters** (3). Geologic processes and hazards affecting humans. Topics include earthquakes, volcanic eruptions, tsunamis, landslides, floods, subsidence, meteorite impacts, and climate changes. Corequisite: GLG 112L .  
David.Brumbaugh@nau.edu

**GLG 112L Geologic Disasters Lab** (1). Must be taken concurrently with GLG 112.

**GLG 190 The Planets** (3). Outline of the current understanding of the planets, emphasizing their geology and the processes involved in their formation and evolution. Corequisite: GLG 190L. James.Wittke@nau.edu

**GLG 190L The Planets Lab** (1). Must be taken concurrently with GLG 190. 3 hrs. lab plus field trips. Prerequisite: MAT 110. James.Wittke@nau.edu

**GLG 201 Ancient Life** (4). Changing environments and the development of life through past ages as revealed by the study of fossil remains of the animal and plant kingdoms. 3 hrs. lecture plus lab experience, which includes field investigations and observation of fossils. David.Elliott@nau.edu

**GLG 225 Paleontology** (4). Principles and methods of invertebrate paleontology including classification, morphology, evolution, and distribution in time and space of fossil organisms. 3 hrs. lecture, 3 hrs. lab, plus field trips. Prerequisite: GLG 100 or GLG 101 or GLG 110 or GLG 112 or BIO 100. David.Elliott@nau.edu

**GLG 240 Intro Field Methods** (2). Introduces geological field methods; emphasis on sedimentary and volcanic rocks, faults, and folds through lectures, labs, and field trips. Prerequisite: GLG 101 or (a grade greater than or equal to B in GLG 100 or GLG 110 or GLG 112 ). Nancy.Riggs@nau.edu

**GLG 265 Earthquakes** (3). Introductory survey of the development of thought about earthquakes. Includes early ideas as well as modern scientific techniques applied to study earthquakes. David.Brumbaugh@nau.edu

**GLG 301 Advanced Environmental Geology** (4). Process-oriented models and case studies of geologic hazards, environmental pollution, and effect of geologic environment on society. 3 hrs. lecture, 3 hrs. lab. Prerequisite: GLG 101 or (a grade greater than or equal to B in GLG 100 or GLG 110 or GLG 112 ) and GLG 103 or (a grade greater than or equal to B in GLG 100L or GLG 110L or GLG 112L ) and CHM 151 and CHM 151L and MAT 125 . Abe.Springer@nau.edu

**GLG 304 Geology of Arizona** (4). Geologic evolution of Arizona is interpreted from its rocks, structural features, fossils, and landforms, including natural resources and environmental geology. 3 hrs. lecture plus lab/field trips. Prerequisite: GLG 100 or 101 or 201. David.Best@nau.edu

**GLG 307 Oceanography** (3). Geologic, chemical, physical, and biologic properties of the marine environment and the description and origin of ocean basins. Prerequisites: GLG 100, 101, 110, and 112. Ronald.Blakey@nau.edu

**GLG 430 Geomorphology** (3). Interpretation of the development, history, and significance of landforms. 3 hrs. lecture, 3 hrs. lab, plus field trips. Prerequisite: (GLG 101 or a grade greater than or equal to B in GLG 100, GLG 110, OR GLG 112 ) and ( GLG 103 or a grade greater than or equal to B in GLG 100L, GLG 110L, OR GLG 112L ).

**GLG 451 Hydrogeology** (4). Aquifer types and hydrologic properties; physical laws and mathematical equations of subsurface flow; recharge and discharge; analyses of groundwater flow systems. An emphasis will be placed on the hydrogeology of the Southwest and sustainability of water resources 3 hrs. lecture, 3 hrs. lab, plus field trips. Prerequisites: GLG 101 and MAT 137. Abe.Springer@nau.edu

**HA 284 International Travel and Tourism** (3). This course examines the effects of international tourism on the social and economic well being of host populations and develops sensitivity to responsible travel in relation to the natural environment. Claudia.Jurowski@nau.edu

**HA 390 International Hospitality Management** (3). Along with other topics, this course addresses sustainable facilities management and design as well as sustainable management practices in general. Claudia.Jurowski@nau.edu

**HA 384 Destination Development** (3). Development of the destination tourist attraction with an emphasis on economic, environmental, and sociological factors. Prerequisite: HA 284. Claudia.Jurowski@nau.edu

**HIS 100 World History I** (3). Exploration of humankind through a detailed analysis of materials from the world's major ancient and early medieval civilizations, paying particular attention to their intellectual, religious, political, and social traditions. Scott.Reese@nau.edu

**HIS 102 World History II** (3). Evolution of the world from a constellation of relatively isolated regions in 1200 to global interdependence of the present day. Special emphasis on the interaction between Western and non-Western civilizations. Sanjam.Ahluwalia@nau.edu

**HIS 240 Western Civilization I** (3). Topics related to the ancient Middle East, Greeks and Romans, the medieval world, the Renaissance, and the Reformation. aem39@dana.ucc.nau.edu

**HIS 241 Western Civilization II** (3). Topics related to Europe in the ages of absolutism, reason, revolution, Napoleon, nationalism, and the world wars, and the social and cultural background of our own age. cv39@dana.ucc.nau.edu

**HIS 280 Colonial Latin America** (3). Surveys Iberian exploration and colonization of the New World, emphasizing the mutual acculturation with Indian civilizations and the political, social, economic, religious, and cultural development in the colonial period. Susan.Deeds@nau.edu

**HIS 281 Latin America : Independ-Pres** (3). Struggles for independence and the problems of national development from 1810 to the present. Lance.Blyth@nau.edu

**HIS 291 U. S. History To 1865** (3). Colonial period and national development to the close of the Civil War. dhd@dana.ucc.nau.edu

**HIS 292 U. S. History Since 1865** (3). Social, economic, and political developments since the Civil War. Valeen.Avery@nau.edu, Margaret.Morley@nau.edu

**HIS 340 Renaissance and Reform** (3). Cultural, political, religious, and social development of Europe from the end of the Middle Ages to the Thirty Years War. HIS 240 or HIS 241 is recommended before taking HIS 340 . Laurence.Boles@nau.edu

**HIS 381 U. S.-Mexico Borderlands** (3). Cultural, political, socioeconomic, and ethnic evolution of the border region from the late pre-Hispanic period to the present. Eric.Meeks@nau.edu

**HIS 394 Recent America** (3). Political, economic, and cultural history of the United States since 1919. Dudley.Acker@nau.edu

**HIS 397 Survey of American Environmental History** (3). Introduces American environmental history from the colonial era to the present: intellectual-cultural context, major writers, policies and legislation, ecofeminism, and environmental justice. HIS 291 or 292 is recommended before taking HIS 397. George.Lubick@nau.edu

**HIS 405 Topics in American Environmental History** (3). Topics in American Environmental History include: wilderness and national parks, conservation and reclamation, environmental justice, ecofeminism, ecological ideas (science, culture, and nature), and the global environmental context. Prerequisite: none (if you have trouble registering because of a prerequisite please contact George Lubick at (928) 523-6211, George.Lubick@nau.edu or Cynthia Kosso at (928) 523-9305)

**HUM 130 Introduction to Southwest Humanities** (3). Explores how the social, political, economic, environmental, technological, and cultural mores of a diversity of Southwestern peoples have found expression in arts and literature. Gioia.Woods@nau.edu

**HUM 175 Environmental Humanities** (3). Introduces and examines arts and ideas that reflect the relationship between nature and culture. Gioia.Woods@nau.edu

**HUM 371 Humanistic Values in a Technological Society** (3). Examines the meaning and role of humanistic values (e.g., tolerance and freedom) in relation to our technological society. Prerequisite: sophomore status or higher or instructor's consent. Marcus.Ford@nau.edu, Donald.Davison@nau.edu, Alison.Brown@nau.edu

**HUM 373 Nature And Values** (3) Critical examination of Western beliefs about the natural world and the proper relationship between humankind and nature. Prerequisite: Sophomore Status. Judith.Stiers@nau.edu, Max.Oelschlaeger@nau.edu

**HUM 395 Public Humanities** (3). Examines the roots of our humanity, sources of the self and community, collective goods issues, possibilities for intentional cultural change, and the practical dimensions of building good and sustainable communities. Prerequisites: admission into public humanities program and junior status.

**HUM 475 Human Nature and Values** (3). Examines selected views of human nature and of their moral implications as these are expressed in artistic and written works. Prerequisite: junior status or higher or instructor's consent. Alison.Brown@nau.edu

**JLS 440C Environmental Research and Reporting** (3). Researching, reporting on, and publishing articles about environmental issues for a variety of media. Prerequisite: junior status or instructor's consent.

**MAT 368 Mathematics Modeling** (3). Concept of a mathematical model; construction and application of deterministic and probabilistic models. Prerequisite: MAT 239 with grade greater than or equal to C. This course is currently utilizes environmental applications of mathematical modeling, such as ground water and air quality. Terence.Blows@nau.edu

**MS 204 Winter Skills and Military Survival Techniques** (1). Helps develop skills necessary to successfully navigate in diverse terrain and to survive cold weather situations and other adverse conditions with map and compass, military equipment, and natural resources. Taught in classroom and outdoor environment.

**NAV 405 Navajo Culture and Civilization** (3). Important issues in the culture, history, physical environment, and social institutions, of the Navajo people from 1500 to 1923. Prerequisite: NAV 101 or basic knowledge of the Navajo sound system (or, for Navajo minors, NAV 201, 202, 303, and 304). Evangeline.Parsons-Yazzie@nau.edu

**NAV 406 Navajo Culture and Civilization** (3). Important issues in the culture, history, physical environment, and social institutions of the Navajo people from 1923 to the present. Letter grade or pass-fail. Evangeline.Parsons-Yazzie@nau.edu, J.Collentine@nau.edu

**NTS 300 International Studies in Nutrition** (3). Cultural, economic, and environmental perspectives on world hunger; prevalence and causes of malnutrition; comparison of approaches to fighting world hunger. Prerequisite: grade of C or better in NTS 156.

**PHI 223 Argument Analysis** (3). Systematic study of arguments, emphasizing analysis and evaluation of arguments as they occur in everyday life. Letter grade or pass-fail. (We encourage you to take either PHI 203 or 223 but not both.). Michael.Malone@nau.edu

**PHI 331 Environmental Ethics** (3). Critical examination of the moral reasons for protecting and preserving the environment: ethics, aesthetics, and the scientific study of nature. Letter grade or pass-fail. Recommended: 3 hrs. of philosophy coursework. Jeffrey.Downard@nau.edu

**PHS 101 Physical Science of Everyday Life** (3). Physical science concepts encountered daily: motions of the sun, earth, and moon; motions and forces; electricity; heat and the conservation of energy; the nature of matter. Corequisite: PHS 101L. Mark.James@nau.edu

**PHS 101L Physical Science of Everyday Life Lab** (3). Corequisite: must be taken concurrently with PHS 101.  
pjr8@dana.ucc.nau.edu

**PHY 111 General Physics** (3). First course in the two-semester, algebra-based, introductory physics sequence. Classical mechanics, heat, and sound. Prerequisite or Corequisite: MAT125 or MAT125H or higher and Corequisite: PHY 111L.  
David.Cole@nau.edu

**PHY 111L General Physics Lab** (1). Must be taken concurrently with PHY 111. Prerequisite or Corequisite: MAT 125 or MAT 125H or higher and PHY 111. David.Cole@nau.edu, rml54@dana.ucc.nau.edu

**PHY 112 General Physics II** (3). Second course in the two-semester, algebra-based, introductory physics sequence. Electricity, magnetism, and optics. Prerequisite: PHY 111 and PHY 111L and Corequisite: PHY 112L. David.Cole@nau.edu

**PHY 112L General Physics II Lab** (1). Prerequisite: PHY 111 and PHY 111L. Barry.Lutz@nau.edu, Gary.Bowman@nau.edu, Randy.Dillingham@nau.edu .

**PHY 161 University Physics I** (3). First course in the three-semester, calculus-based, introductory physics sequence. Classical mechanics. Prerequisite or Corequisite: MAT 136 or MAT 136H or higher and Corequisite: PHY161L. William.Delinger@nau.edu

**PHY 161L University Physics I Lab** (1). Must be taken concurrently with PHY 161 . Prerequisite or Corequisite: MAT 136 or MAT 136H or higher and PHY 161. William.Delinger@nau.edu, pr36@dana.ucc.nau.edu, mpj5@dana.ucc.nau.edu, David.Cornelison@nau.edu

**PHY 262 University Physics II** (3). Second course in the three-semester, calculus-based, introductory physics sequence. Electricity, magnetism, and thermodynamics. Prerequisite: ( PHY 161 and PHY 161L ) and Prerequisite or Corequisite: MAT 137 or higher and PHY 262L. Stephen.Tegler@nau.edu

**PHY 262L University Physics II Lab** (1). Prerequisite:(PHY 161 and 161L) and Prerequisite or Corequisite: MAT 137 or higher and PHY 262. Stephen.Tegler@nau.edu

**PL 201 Introduction to Planning and Land-Use Principles** (3). Underlying principles for orderly environmental change in dynamic communities, zoning regulations, and landuse planning functions. Carolyn.Daugherty@nau.edu

**PL 302 Environmental Planning** (2). Planning for the implementation of environmental regulations and quality-of-life standards. Staff.

**PL 308W Land Use Policy** (3). Land-use priority, development, and strategic planning; includes a fieldwork component. This course fulfills NAU's junior-level writing requirement. Carolyn.Daugherty@nau.edu

**PL 376 Planning for Sustainable Tourism** (3). Issues and methods in planning for tourism development from a sustainability perspective.

**PL 402W Environmental Impact Statements** (2). Requirements and implementation of the National Environmental Policy Act, with emphasis on writing environmental assessments and impact statements. This course fulfills NAU's junior-level writing requirement. Prerequisite: PL 302 or POS 359. Carolyn.Daugherty@nau.edu

**PL 407 Planning On Public Lands** (2). History and process of planning as it applies to various public lands in the United States. Prerequisite: PL 302 . Watson, Kim William

**POS 110 American Politics** (3). Basic introduction to American national government; constitutional foundations, the structures of government, courts, Congress, the presidency, interest groups, political parties, and major political issues facing the American people. This course satisfies state teacher certification for teachers in Arizona for federal constitution only. Katie.Desmond@nau.edu, Glenn.Phelps@nau.edu, Thomas.Brunell@nau.edu

**POS 159 Introduction to Environmental Inquiry** (3). Introduces major issues and controversies in environmental policy and politics, focusing on Western natural resources and land use from local, tribal, regional, national, and global perspectives. David.Ostergren@nau.edu

**POS 254 Political Ideologies** (3). Political ideas and belief systems in theory and practice. Includes democracy, liberalism, conservatism, Marxism, democratic socialism, liberation, and green ideologies. Joel.Olson@nau.edu  
**POS 344 Environmental Movements** (3). Examines the broad range of environmentalisms existing in the United States today. Covers varied experiences, motivations, social and political critiques, organizational models, and political tactics.

**POS 345 Environmental Law** (3). Role of law in environmental management. Discusses major federal regulatory actions by examining legal cases. Nancy.Nelson@nau.edu

**POS 359 Environmental Policy** (3). Political aspects of environmental problems, policy responses to those issues, and their impact on the human and natural environment. Zachary.Smith@nau.edu, Grenetta.Fink@nau.edu

**POS 455 Political Ecology** (3). Analyzes various green political theories and their positions on the nature of the ecological crisis, environmental ethics, ideology, policies, institutions, and political culture Prerequisite: POS 344 or 359 or instructor's consent.

**PRM 210 Basic River Skills** (1). Experientially based course providing basic skills and techniques for water sports (rafting, kayaking, or canoeing). Emphasizes skill development. 6 hrs. lecture total; 30 hrs. outdoor application total. May be repeated for up to 2 hours of credit. Pam.Foti@nau.edu

**PRM 211 Leave No Trace** (1). Technical skills, appropriate curricula, and practices for minimum impact camping and exploration of wilderness ethics. Pam.Foti@nau.edu

**PRM 212 Basic Safety Systems** (1). Technical skills related to setting protection for ascending and descending in canyon environments. Focuses on knots, anchors, and ascending and descending techniques. 12 hrs. lecture total; 20 hrs. outdoor application total. Pam.Foti@nau.edu

**PRM 213 Introduction To Mountain Biking** (1). An experimentally-based course in the basic principles of mountain biking theory and practice including safety, technical skills, and trail etiquette and protection. Emphasis will be placed on development of skills and proper application. Pam.Foti@nau.edu

**PRM 216 Wilderness First Responders** (3). Eighty-hour national curriculum leading to three-year certification as a wilderness first responder. Specific skills and techniques for outdoor emergencies in backcountry and remote settings. 40 hrs. lecture total; 40 hrs. skill application total. Staff

**PRM 217 Basic Mountaineering** (1). Technical skills, appropriate curricula, and practices in safe glacier and alpine travel. Pam.Foti@nau.edu

**PRM 218 Outdoor Survival Skills** (1). Technical skills, appropriate curricula, and practices in outdoor survival. Pam.Foti@nau.edu

**PRM 219 Primitive Living Skills** (1). Technical skills, appropriate curricula, and practices in primitive living skills. Pam.Foti@nau.edu

**PRM 220 Intro/Parks & Recreation** (3). History, philosophy, scope, and value of park and recreation services; their organization and relationship to other social institutions. ( [www.for.nau.edu/prm/PRM220](http://www.for.nau.edu/prm/PRM220) ). Judith.Hammersley@nau.edu

**PRM 300 Ecotourism** (3). Introduces the history, concepts, principles, marketing, planning, and management of ecotourism activities and development. Charles.Hammersley@nau.edu

**PRM 310 Park Protection I** (4). Detailed instruction in the fundamentals of park law enforcement. 3 hrs. lecture, 3 hrs. lab. Prerequisite: Junior Status. Steve.Dodd@nau.edu

**PRM 311 Park Protection II** (4). Provides additional instruction in the fundamentals of park law enforcement. 3 hrs. lecture, 3 hrs. lab. Corequisite: PRM 310. Steve.Dodd@nau.edu

**PRM 331 Outdoor Leadership Cert I** (3). First of two courses required to train outdoor leaders who may then be certified through the Wilderness Education Association. Outdoor leadership theories, techniques, and outdoor pursuit administration. Includes six days of fieldwork. Marieke.Taney@nau.edu

**PRM 346W Wildland Recreation Management** (3). Overview of wildland recreation management principles, practices, and current issues. This course fulfills NAU's junior-level writing requirement. Prerequisite: ( ENG 105 or HON 190 or HON 191 ) or 6 hours ENG. Pam.Foti@nau.edu

**PRM 360 Interpretation/Parks & Recreation** (3). Theory, techniques, and applications of oral and written interpretation for parks and recreation management. Spring. Pam.Foti@nau.edu

**PRM 408 Intern/Parks & Recreation Management** (12). Directed, full-time, professional work experience in a qualified parks and recreation management agency. You take this course during the last semester before graduation. Pass-fail only. Pam.Foti@nau.edu

**PRM 423 Recreation Facility & Area Planning** (3). Planning, design, and operation of recreation facilities and adjoining areas. On-site visits supplement classroom principles. Spring. Charles.Hammersley@nau.edu

**PRM 430 Environmental Leadership** (3). Development of knowledge and expertise in leading the decision-making process regarding environmental or resource issues. Prerequisite: junior or senior status.

**PRM 431 Outdoor Lead Cert II** (3). Second of a two-course series to train outdoor leaders who may then be certified through the Wilderness Education Association. Advanced outdoor pursuit planning and administration. Includes fourteen days of fieldwork. Prerequisite: PRM 331 Pam.Foti@nau.edu

**PRM 452 Outdoor Recreation Program Administration** (3). Management issues and techniques of outdoor programs. Pam.Foti@nau.edu, Andrew.Bourget@nau.edu

**PSY 494 Ecological Approaches to Perception and Action** (3). Theory and research in human and animal environment systems. Topics include perception, action, learning, communication, and development. Prerequisites: PSY 101, 230, and 302W.

**PSY 495 Animal Intelligence** (3). Research and theory of animal intelligence. Topics include concept learning, tool use, imitation, self-recognition, numerical competence, and language acquisition. Prerequisite: PSY 101 and Jr Status. Lester.Hunt@nau.edu

**REL 322 Christian Thought** (3). Studies contemporary Christian thinkers on topics of perennial and current interest. Prerequisite: Sophomore Status. Arne.Hassing@nau.edu

**SC 365 Communication Contemporary Affairs** (3). Examines the effect of communication on historical and contemporary events. Particular attention given to how communication has been employed as an instrument of social change, order, and control. Prerequisite: Sophomore Status. Brant.Short@nau.edu

**SOC 101 Intro To Sociology** (3). Basic concepts and interpretations of human action; significance of a sociological perspective on the human experience. James.Reed@nau.edu, Kooros.Mahmoudi@nau.edu

**SOC 210 Social Problems** (3). Selected social problems in contemporary American society. Douglas.Degher@nau.edu, Doreen.Martinez@nau.edu

**SOC 301 Top Cont Soc Issues** (3). Examines selected social issues in contemporary societies. May be repeated for credit for up to 9 hours with different content. Kathleen.Ferraro@nau.edu, Gerald.Hughes@nau.edu, Jennifer.Hoefle@nau.edu

**SOC 319 Population and Environment** (3). Studies population growth as it relates to the social and natural environment. History of the emergence, growth, and organization of human populations. Examines contemporary population growth and distribution patterns in relation to natural resources and environmental stress. Kooros.Mahmoudi@nau.edu

**SOC 319W Population and Environment** (3). Human population dynamics in relation to the social and natural environment. Contemporary population patterns in relation to resources and environment. This course fulfills NAU's junior-level writing requirement. Prerequisites: SOC 101 and 201.

**SOC 333 Environment And Society** (3). This course explores the social construction of nature and the growth of an environmental consciousness. Students will explore the cultural and structural roots of human-produced ecological problems. Janine.Minkler@nau.edu

**SOC 334 Sociology of Community** (3). Examines community from a number of perspectives, including social system, normative, human ecological, and social constructionist models. Images of ideal communities are contrasted with existing community forms.

**SOC 334W Sociology of Community** (3). Examines community using social system, normative, human ecological, and social constructionist perspectives. Contrasts images of ideal communities with existing community forms. This course fulfills NAU's junior level writing requirement. Prerequisites: SOC 101 and 201. Richard.Fernandez@nau.edu

**SOC 339 Crime Law & Society** (3). Analyzes the origins and development of law and social control agencies; structural theory of the origins of crime and criminality. James.Reed@nau.edu

**STA 270 Applied Statistics** (3). Graphical and quantitative description of data; binomial, normal, and t distributions; one- and two-sample hypothesis tests and confidence intervals; simple linear regression and correlation. Prerequisite: MAT 102X grade greater than or equal to C or MATPLC 40 or MATPLC 46 or higher. Jin.Wang@nau.edu, Michael.Ratliff@nau.edu, Brook.Russell@nau.edu, Kellee.Williams@nau.edu

**SWS 250 Southwest Studies** (3). An introductory interdisciplinary course which brings together faculty from varied disciplines to explore the physical, sociocultural, and humanities. Miguel.Vasquez@nau.edu

**WST 300W Feminist Theories** (3). Foundational overviews of the history of feminist theory. Also addresses contemporary ethnic minority and international theorists. This course fulfills NAU's junior-level writing requirement. Prerequisite: WST 291. Kym.Maclaren@nau.edu

## Graduate Courses

*This information courtesy of Merriam-Powell Center for Environmental Research and the Ponderosa Project.*

**ANT 554 Paleoethnobotany** (3). Archaeological analysis of the interrelationships between people and plants in prehistory through the study of archaeobotanical macroremains, phytoliths, and pollen. Andrea.Hunter@nau.edu

**BIO 522 Advanced Entomology** (3). Evolution, behavior, ecology, systematics, and recognition of insects. 3 hrs. lecture. Prerequisite: BIO 322. Neil.Cobb@nau.edu

**BIO 525 Ichthyology** (3). Evolution, systematics, anatomy, physiology, ecology, and identification of fishes. Prerequisites: BIO 223 and 425C or instructor's consent; recommended: weekend field trips. Linn.Montgomery@nau.edu

**BIO 526 Herpetology** (3). Classification, distribution, ecology, and identification of amphibians and reptiles. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 182 and 223. Kiisa.Nishikawa@nau.edu

**BIO 527 Ornithology** (3). Classification, anatomy, physiology, ecology, behavior, distribution, and field identification of birds. 2 hrs. lecture, 4 hrs. lab. Prerequisites: BIO 182 and 223 or instructor's consent. Tad.Theimer@nau.edu

**BIO 528 Mammalogy** (3). Survey of functional morphology, classification, behavior, and ecology of mammals. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 223 and 424 or instructor's consent. Tad.Theimer@nau.edu

**BIO 570 Plant Ecology** (3). Surveys theories that explore the dynamic nature of plants. Uses examples from population-level and community-level studies to demonstrate current problems in plant ecology, emphasizing paradigms unique to plants. 2 hrs. lecture, 3 hrs. lab. Prerequisite: 15 hours of biology.

**BIO 571 Field Biology** (3). Natural history of organisms common to Arizona. Coconvenes with BIO 471. 1-2 hrs. lecture, 3 hrs. lab. Prerequisite: instructor's consent. May be repeated as needed for credit.

**BIO 572 Limnology** (3). Ecology of inland waters; examination of structural, physical, and chemical influences on biotic communities. 2 hrs. lecture, 3 hrs. lab, field trips. Prerequisites: BIO 182 and 221. Jane.Marks@nau.edu

**BIO 573 Field Ecology** (3). Emphasizes identification of original field research problems in diverse habitats, experimentation, data analyses, oral presentation of findings, and writing in journal format. Thomas.Whitham@nau.edu

**BIO 574 Experimental Marine Ecology** (6). Summer field studies of marine organisms in the Gulf of California, emphasizing observational and experimental tests of behavioral, ecological, and evolutionary theory. 2 hrs. lecture, 6 hrs. lab daily. Prerequisites: instructor's consent and BIO 326 and 340; recommended: one of BIO 221, 223, 410, or 525.

**BIO 575 Plant Pathology** (3). Causes, environmental relations, and control of major plant diseases. 2 hrs. lecture, 3 hrs. lab. Prerequisite: one of BIO 220, 284 or equivalent, or 411.

**BIO 577 Concepts in Ecology** (3). Theoretical and applied concepts in ecology, such as evolutionary ecology, population and community ecology, ecosystem ecology and behavioral ecology. 3 hrs. lecture. Prerequisite: BIO 326.

**BIO 580 Population and Quantitative Genetics** (3). Mendelian and quantitative approaches to understanding population and evolutionary genetics; inference concerning natural lab populations. 3 hrs. lecture. Prerequisite: BIO 340 and MAT 119 and STA 270. Philip.Service@nau.edu

**BIO 599 Bioremediation** (3). Fundamental concepts of bioremediation, including discussion of the following topics: degradation kinetics, bioaugmentation, metal biotransformation, molecular approaches to bioremediation, chlorinated solvents, phytoremediation, petroleum hydrocarbons, and natural attenuation. We will address these and related issues from a biological and biochemical perspective, emphasizing the roles of microorganisms in bioremediation and carefully examining the current status of bioremediation efforts in the field. Maribeth.Watwood@nau.edu

**BIO 608 Field Work Experience** (1-12). Supervised field experience in an appropriate agency, organization, or situation. May not exceed 12 hours of credit. Pass-fail only. Lee.Drickamer@nau.edu

**Bio 660 Organic Evolution** (3). Modern theory of evolution and developing conceptual issues, patterns, and mechanisms of evolution. Prerequisite: undergraduate degree in biology. Philip.Service@nau.edu

**BIO 644 Applied Microbiology** (4). Theoretical considerations and practical application in using microbes for producing specific products and for solving environmental, industrial, and medical problems. 3 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 220 and one of CHM 360, 460, or 560.

**BIO 663 Biogeography** (3). Reviews factors governing the patterns of organism distribution, including biotic and physical relationships, evolutionary history, dispersal mechanisms, paleoecology, continental drift, and insular phenomena. Prerequisites: undergraduate degree in biology or related field plus knowledge of basic ecological concepts.

**BIO 670 Advanced Ecology** (3). Contemporary theories on various ecological phenomena including ecological systems theory, species diversity, competition, predation, habitat selection, dispersal, co-evolution, and population regulation. Prerequisite: BIO 326. Thomas.Whitham@nau.edu

**BIO 673 Physiological Ecology** (4). Biophysical analysis of organism interaction with environment. Major topics include energy balance, gas exchange, and water relations of animals and plants. Prerequisites: introductory courses in ecology, physiology, chemistry, and physics.

**BIO 680 Biologic Techniques** (3). Selected topics on techniques used in modern field and lab research. May be repeated for up to 6 hours of credit. 2 hrs. lecture (3 hrs. lab at instructor's option). Prerequisite: instructor's consent. Stephen.Beckstrom-Sternberg@nau.edu, Marilee.Sellers@nau.edu, Richard.Shand@nau.edu

**BIO 682 Quantitative Biology** (3). Introduces quantitative analysis of biological data, including the treatment of field and lab data by computer statistical packages and mathematical models of biological and ecological processes. Prerequisite: STA 570. Philip.Service@nau.edu

**CENE 502 Principles of Environmental Transport Processes** (3). Development of the balance laws for chemical species and application of these laws to describe mass transport processes in engineered and natural environmental systems. Prerequisite: MAT 239 and CHM 152 and (ME 395 or ME 291). Bridget.Bero@nau.edu

**CENE 540 Environmental Protection: Today and Tomorrow** (3). Explores current legal and regulatory strategies for environmental protection. Examines innovative approaches to environmental management. Group and class projects. Prerequisite: CENE 150 or ENV 230 or FOR 222. William.Auberle@nau.edu

**ENG 644: Countertraditions in American Literature: American Literature and the Environment.** An introduction to advanced study in the field of environmental literatures, with special attention to American texts. The course 1) introduces major currents in literary-environmental theory and criticism, along with relevant philosophical background, 2) surveys American nature writing as a distinct literary tradition in the United States, and 3) provides students with opportunities to develop ecocritical perspectives on a variety American literary texts. Tara.Green@nau.edu

**ENV 530 Arid Land Geomorphology** (3). Analyzes arid to semiarid landforms, geomorphic processes involved in their formation and evolution, and human impact in arid to semiarid terrains. Lab emphasizes standard geomorphic techniques. 2 hrs. lecture, 3 hrs. lab. Letter grade or pass-fail. Prerequisite: GLG 430. Diana.Anderson@nau.edu

**ENV 540 Conservation Biology** (3). Scientific basis for conserving and managing biological diversity, emphasizing applications of ecology and genetics, drawing on other scientific disciplines, and integrating public policy and sociological analyses. Letter grade or pass-fail. Prerequisites: graduate status plus ENV 380 or BIO 326, or instructor's consent. Thomas.Sisk@nau.edu

**ENV 540L Conservation Biology Laboratory** (1). Combines class field studies and independent research investigating the scientific basis for conserving and managing biological diversity. Requires several all-day Saturday field trips. Letter grade or passfail. Coconvenes with ENV 440L. Prerequisites: graduate status and concurrent enrollment in ENV 540, or instructor's consent.

**ENV 544 Landscape Ecology** (3). Theory and application of landscape ecology, an emerging discipline focusing on spatial patterns in natural and human-dominated landscapes and their role in determining the structure and function of ecological systems. Crosslisted with FOR 544. Prerequisite: one of ENV 380, BIO 326, and FOR 311, or instructor's consent. Margaret.Moore@nau.edu

**ENV 555 The Environmental Science-Policy Interface** (3). Seminar examines the generation of scientific knowledge and how that knowledge is presented, evaluated, manipulated, and applied as political forces shape environmental policy. Crosslisted with POS 555. Prerequisite: graduate status or instructor's consent. Thomas.Sisk@nau.edu

**ENV 580 Atmospheric Change** (3). Focuses on impact of human behavior on air quality—locally, regionally, and globally—by examining Earth's radiation budget, circulation models, and chemical processing in the atmosphere. Prerequisite: CHM 151 and 152 plus one 200- or 300-level CHM course.

**ENV 595 Global Environmental and Climate Change** (3). Characteristics of global climate system, estimating past and predicting future impacts of human activities on climate and environmental systems, and policy implications. Prerequisite: ENV 230 plus one statistics and one computer course, or instructor's consent. Scott.Anderson@nau.edu

**ENV 596 Quaternary Climate Change** (3). Analyzes the causes and effects of climate change during the Quaternary Period and methods used to reconstruct past climates from marine and terrestrial sediments, ice cores, and biological records. Crosslisted with GLG 596 and QS 596. Prerequisite: graduate status or instructor's consent.

**FOR 500 Ecosystem Science and Management Principles** (3). General systems overview of biophysical, social, and political factors associated with forestry. Emphasizes wildlife, recreation, and other noncommodity resources. P.J.Daugherty@nau.edu , W.Wallace.Covington@nau.edu

**FOR 504 Forest Wildlife Ecology and Management** (3). After brief overview of theory and practice, course involves critically evaluating current literature on a specific management concern, such as migratory birds, predators, or endangered species. Prerequisite: one course in general biology or ecology. Paul.Beier@nau.edu

**FOR 506 Special Studies in Forestry** (1-4). Individual investigation of a specially assigned topic. Carol.Chambers@nau.edu, Yeon-Su.Kim@nau.edu.

**FOR 514 Field Identification of Birds** (1). This course will teach students how to identify common forest birds of northern Arizona by sight and sound and provide an overview of sampling techniques used for monitoring forest-dwelling birds. Carol.Chambers@nau.edu, Paul.Beier@nau.edu.

**FOR 515 Forestry in Developing Countries** (2). Ecology, management, and policy issues of tropical and arid land forests in developing countries. Coconvenes with FOR 415. Prerequisite: one course in forestry or biology. Mike.Wagner@nau.edu

**FOR 521 Forest Soils** (3). Forest Soils. Development; morphology; and physical, chemical, biological, and engineering properties, with emphasis on forest management. Prerequisite: FOR 213 or FOR 479 or BIO 479 or equivalent. steve.hart@nau.edu

**FOR 524 Aerial Photo Interpretation** (3). Basic photogrammetric principles; uses of aerial photographs to identify and map vegetation, physiography, and cultural features. Pablo.Parysow@nau.edu

**FOR 525 GIS And Spatial Techniques In Forestry** (3). Application of geographic and spatial techniques to research and management in forestry, wildland management, and conservation planning. Seminar format may include analysis of data provided by instructor or students. Crosslisted with GGR 525. 3 hrs. lecture, 3 hrs. lab. Scott.Walker@nau.edu

**FOR 544 Landscape Ecology** (3). Theory and application of landscape ecology, an emerging discipline focusing on spatial patterns in natural and human-dominated landscapes and their role in determining the structure and function of ecological systems. Crosslisted with ENV 544. Prerequisite: one of FOR 311, ENV 330, and BIO 326, or instructor's consent. Margaret.Moore@nau.edu

**FOR 550 Forest Tree Ecophysiology** (3). Effects of environment on physiological processes in forest trees. Prerequisites: college chemistry (including organic) and general or forest ecology. Tom.Kolb@nau.edu

**FOR 551 Fire Ecology and Management** (3). Ecological effects of wildland fires, fire regimes, fire management, prescribed fire, and the application of fire science to restoring and managing ecosystems. Letter grade or pass-fail. Pete.Fule@nau.edu

**FOR 551L Fire Ecology and Management Lab** (1). Field and computer lab applications in wildland fire: fuel sampling, fire behavior prediction, modeling fire effects, and prescribed burning. 3 hrs. lab. Letter grade or pass-fail. Corequisite: FOR 551. Pete.Fule@nau.edu

**FOR 552 Forest Tree Diseases** (3). Important forest tree diseases: their identification, ecology, and management. Coconvenes with FOR 452. Letter grade or pass-fail. Robert.Mathiasen@nau.edu

**FOR 553 Forest Entomology** (3). Important forest insects, their ecology and control. Coconvenes with FOR 453. Mike.Wagner@nau.edu

**FOR 563 Watershed Hydrology** (3). Hydrologic principles and practices related to the land-water system; emphasis on the effects of climate, soils, vegetation, and land-use factors on the quantity and quality of runoff. Aregai.Tecle@nau.edu

**FOR 565 Watershed Restoration** (3). Students will explore the effects of natural and anthropogenic activities on watershed conditions, and learn various approaches of restoring or handling any adverse effects of such disturbances on watershed ecosystems. Aregai.Tecle@nau.edu

**FOR 579 Terrestrial Ecosystem Ecology** (3). Principles of terrestrial ecosystem ecology with an emphasis on southwestern ecosystems and global environmental change. Crosslisted as BIO 579. Coconvenes with BIO 479 and FOR 479. 2 hrs. lecture, 3 hrs. lab. Prerequisites: BIO 326 or FOR 313 AND FOR 314 or equivalents.

**FOR 582 Ecological Restoration Applications** (3). Examples and applications of ecological science related to restoring natural structures and processes of ecosystems. Coconvenes with FOR 382. Letter grade or pass-fail. Pete.Fule@nau.edu

**FOR 593 Natural Resource Economics** (3). This class will explore applied microeconomic theories and current issues in natural resource management. The key emphasis of the course is to be familiar with the basic economic concepts and to develop one's own point of view in applying economic principles to problems associated with natural resource management. Yeon-Su.Kim@nau.edu

**FOR 599 Contemporary Developments** (1-3). Steve.Hart@nau.edu

**FOR 604 Wildlife Habitat Relationships** (3). Systems approach to comprehending the associations with and uses of habitat by wildlife. Carol.Chambers@nau.edu

**FOR 605 Policy Process, Multi-resource Management** (3). Policy process and substance. Interest groups. Multi-resource history, philosophy, laws and regulations. Products and services, current and potential. Prerequisite: POS 671. David.Ostergren@nau.edu

**FOR 625 Forest Conservation Biology** (3). Theory and practice of conserving biodiversity in forested ecosystems; relationship with forest ecosystem management objectives. Letter grade or pass-fail. May be repeated for up to 6 hours of credit. Paul.Beier@nau.edu

**FOR 633 Ecological Economics** (3). Theory of ecological economics, which is the union of ecology and economics, and its application to natural resource management. Addresses both micro and macro aspects of ecological economics. Prerequisite: FOR 593 or instructor's consent. Ronald.Trosper@nau.edu

**FOR 698 Soil Ecology and Nutrient Cycling** (1). Integrates theory and practice, with emphasis on historical, contemporary, and future issues. Steve.Hart@nau.edu

**GGR 546 Arizona and the Southwest** (3). Regional analysis of the southwestern United States. Tina.Kennedy@nau.edu

**GGR 547 Mountain and Highland Geography** (3). Geographic treatment of earth's high elevation and high relief landscapes. Topics include the physical environment of, and human interaction with, mountains. Prerequisites: any introductory course in natural science and in social science. Lee.Dexter@nau.edu

**GGR 574 Rural Economic Geography** (3). Examines the relationships between economic theory and rural spatial patterns, including agriculture, small towns, resources, and environmental issues. Thomas.Paradis@nau.edu

**GGR 642 Rural Spatial Patterns** (3). Spatial characteristics, relationships, and systems that are unique to the rural environment. Tina.Kennedy@nau.edu

**GGR 655 Advanced Physical Geography** (3). Landforms, climates, hydrology, soils, vegetation, and animal life, emphasizing the interaction of these phenomena in the rural setting. Prerequisite: GGR 250. Staff

**GLG 530 Vertebrate Paleontology** (3). History of vertebrate organisms from the earliest fish to birds and mammal-like reptiles. Prerequisite: GLG 225 or BIO 223. David.Elliott@nau.edu

**GLG 535 Paleocology** (3). Interprets ancient environments and the adaptation of organisms to those environments. 2 hrs. lecture, 3 hrs. lab. Prerequisite sites: BIO 221 and GLG 102 or 225.

**GLG 536 Vertebrate Paleobiology** (3). Detailed examination of osteology and paleobiology of Cenozoic animals, with separate emphases in amphibians, reptiles, and mammals. 2 hrs. lecture, 3 hrs. lab. Field trip possible. May be repeated for up to 6 hours of credit. Jim.I.Mead@nau.edu

**GLG 542 Advanced Structural Geology** (3). Advanced study of deformation of Earth's crust. Stress and strain theory, deformation mechanisms, geometry, kinematics, and dynamics of orogenic belts. Prerequisite: GLG 315 and 435. Ernie.D@nau.edu

**GLG 561 Regional Tectonics** (3). Geologic principles, plate tectonic theory applied to the interpretation of geologic history on a regional scale. 3 hrs. lecture, field trips. Prerequisite: graduate status in geology or instructor's consent. Paul.Umhoefer@nau.edu

**GLG 575, Geochemistry of Natural Waters** (4). Covers environmentally relevant aspects of water chemistry, including pollutant characterization and remediation. James.Sample@nau.edu, Roderic.Parnell@nau.edu

**GLG 602 Topics/Earth Science** (3). Education or earth science majors only. Fundamentals of a selected earth-science topic. 3 hrs. lecture or 2 hrs. lecture and 2 hrs. lab. Field trips. Prerequisite: 8 hours of earth science or geology. May be repeated for credit, with the exception that the same topic may not be repeated for credit. Paul.Morgan@nau.edu

**GLG 610 Volcanology** (4). Volcanic eruption and depositional mechanisms, origin of volcanic features, and research methods in volcanology. 3 hrs. lecture, 3 hrs. lab. Prerequisite: GLG 315. Nancy.Riggs@nau.edu

**GLG 637 Geochronology/Quaternary Depositional Systems** (3). Chronological, geologic, stratigraphic, paleoecologic investigation, analysis, and interpretation of Quaternary depositional systems. 3 hrs. lecture, field trips. Prerequisite: GLG 101 or GLG 101H. Darrell.Kaufman@nau.edu

**GLG 670, Advanced Hydrogeology** (4). Covers groundwater hydrology, both theory and application, as it relates to environmental issues such as groundwater contamination and transport. Abe.Springer@nau.edu

**GLG 675 Shale Petrology** (4). Detailed investigation of the crystal chemistry of the clay minerals, their geologic distribution through time; space; their origin and alteration by geologic processes; and their significance in environmental and pedogenic processes. 3 hrs. lecture; 3 hrs. lab. Prerequisites: GLG 310 and 324.

**HIS 560 Readings in World History** (3). Specific topics in world history, such as general developments, colonialism, environmental, economic, social, political, and military issues. May be repeated for up to 9 hours of credit.

**HIS 568 Readings in Environment and Economy** (3). Readings in environmental and economic history that cuts across more than one region. Possible themes are nature and society, climate, water rights, ecofeminism, resource preservation, ecotourism, capitalist development, modernization, and globalization. May be coconvened with HIS 668. May be repeated for up to 6 hours of credit. George.Lubick@nau.edu

**HIS 590 Readings in United States History** (3). Directed readings and critical analysis to develop historiographical competence in a variety of areas, such as cultural, intellectual, social, environmental, ethnic, gender, diplomatic, and economic history of the United States. May be coconvened with HIS 690. May be repeated for up to 9 hours of credit.

**HIS 592 Readings in American West, Southwest, and Borderlands** (3). Directed readings and critical analysis to develop historiographical competence in the American West, the Southwest, and the borderlands. Possible themes are gender, environment, frontier theory, Native American history, and Chicana/o history. May be coconvened with HIS 692. May be repeated for up to 12 hours of credit. Eric.Meeks@nau.edu

**HIS 650 Research in Comparative History** (3). Specific topics in comparative historical methods, regions, and themes, such as comparative methodologies, colonization, modernization, gender systems, nationalism, ethnogenesis among indigenous peoples, environment, and identity and class formation. Coconvenes with HIS 550. May be repeated for up to 6 hours of credit. Prerequisite: HIS 550 or instructor's consent.

**HIS 668 Research in Environment and Economy** (3). Research in environmental and economic history that cuts across more than one region. Possible themes are nature and society, climate, water rights, ecofeminism, resource preservation, ecotourism, capitalist development, modernization, and globalization. May be coconvened with HIS 568. May be repeated for up to 6 hours of credit. Prerequisite: HIS 568 or instructor's consent. George.Lubick@nau.edu

**HIS 690 Research in United States History** (3). Research in archival, primary, and secondary sources in regions and topics of U.S. history. Possible themes include cultural, intellectual, social, environmental, ethnic, gender, diplomatic, and economic history. May be coconvened with HIS 590. May be repeated for up to 9 hours of credit. Prerequisite: HIS 590 or instructor's consent.

**HIS 692 Research in American West, Southwest, and Borderlands** (3). Research in archival, primary, and secondary sources in regions and topics of in the American West, the Southwest and the borderlands. Possible themes are gender, environment, frontier theory, Native American history, and Chicana/o history. Coconvenes with HIS 592. May be repeated for up to 12 hours of credit. Prerequisite: HIS 592 or instructor's consent. Eric.Meeks@nau.edu

**MAT 542 Wildlife Population Modeling** (3). Application and analysis of deterministic and simulation models in ecology, emphasizing conservation and management of wildlife. Co-taught by a mathematician and an ecologist. Letter grade or pass-fail. Prerequisite: one course in calculus or matrix algebra, or instructor's consent; corequisite: MAT 543; can only be taken concurrently with MAT 543. Terence.Blows@nau.edu

**MAT 543 Population Ecology Lab** (1-2). Building and using population models using calculus and matrix algebra. Letter grade or pass-fail. Prerequisite: instructor's consent; corequisite: MAT 542; can only be taken concurrently with MAT 542. Terence.Blows@nau.edu

**MLS 599 Contemporary Developments** (1-3). Examines recent trends and investigations in a selected area of a particular field of study. Recent course topics have included spirituality, community, and health; alternatives to environmental conflict; and ecological design. Letter grade or pass-fail. Sandra.Lubarsky@nau.edu

**MLS 601 Visions of Good and Sustainable Societies: Self, Other, and Community.** (3) Included in the examination of the relationship between the self and "other" is an examination of the human self in relation to the more-than-human world. Sandra.Lubarsky@nau.edu

**MLS 602 Visions of Good and Sustainable Societies: Community, Technology and Values** (3) As part of the discussion of technology and values, students look at the effect of technology on the human relationship with the natural world. Topics have included biopiracy, sustainable agriculture, eco-economics, and green history. Michael.Vasquez@nau.edu , Marcus.Ford@nau.edu

**MLS 695 Elements of Sustainable Communities** (3) Students explore aspects of "reenchanting" the world, including attention to issues of sustainability and stewardship. Sandra.Lubarsky@nau.edu

**POS 555 Science, Politics, and the Environment** (3). Examines the generation of scientific knowledge and how that knowledge is presented, evaluated, manipulated, and applied as political forces that shape environmental policy. Crosslisted with ENV 555. Prerequisite: graduate status or instructor's consent. David.Schlosberg@nau.edu

**POS 621 Topics in American Public Law** (3). Specialized study of such subjects as civil rights and liberties, constitutional law, environmental law, legal theory, and law of race and gender. May be repeated for up to 6 hours of credit.

**POS 648 Comparative Policy and Administration** (3). Comparative perspectives of substantive policy areas (such as health, education, environmental, and economic policies), examining policy making and implementation in different regional or national settings. Dan.Cothran@nau.edu

**POS 658 Topics in Environmental Politics** (3). Examines a variety of specific issues and topics in environmental politics and policy, such as environmental political theory, natural resource policy, and global environmental politics. May be repeated for up to 9 hours of credit.

**POS 659 Environmental Policy** (3). Examines environmental policy in the United States. Topics include air and water policy, energy production and regulation, federal land policy, and problems associated with food and agricultural production.

**POS 683 Topics in International Policy Studies** (3). Explores state policies on major international issues, such as trade, security, environment, resources, and international organizations. May be repeated for up to 6 hours of credit. Sheila.Nair@nau.edu

**POS 698 Environmental Science and Policy Case Studies** (1). Applying science to federal lands management policy. The course investigates the challenges and successes of utilizing science to inform and implement policy on public lands. Case study examples focus on biodiversity and the human component of protected areas. David.ostergren@nau.edu

**PRM 531 Recreation Ecology** (3). Exploration of recreation ecology of the southwest with a focus on physical impact analysis for managing recreation areas. Includes 3 weekends of work and 5 days of application. Prerequisite: permission of instructor. Pam.Foti@nau.edu

**PSY 694 Ecological Psychology** (3). Examines ecological aspects of various psychological phenomena, with particular attention to the areas of perception, learning, and memory.

**QS 502 Quaternary Pedology** (3). Includes historical and conceptual developments in pedology; soil morphology, field descriptions, chronosequences, soil-forming factors; weathering products, processes, horizonation; soil-landform relationships, landscape evolution, and soil taxonomy. 2 hrs. lecture, 3 hrs. lab. Prerequisite: graduate status or instructor's consent.

**QS 596 Quaternary Climate Change** (3). Analysis of the causes and effects of climate change during the Quaternary Period; methods used to reconstruct past climates from marine and terrestrial sediments, ice cores, and biological records. Crosslisted with GLG 596 and ENV 596. Prerequisite: graduate status or instructor's consent.

**QS 671 Quaternary Paleoecology** (3). Theories and methods in reconstructing terrestrial and aquatic biotic communities affected by climate and anthropogenic change. Techniques include palynology, paleobotany, lake levels, charcoal particles, sediments, packrat middens, and special topics. Cross-listed with BIO 671. 3 hrs. lecture, field trips. Prerequisite: graduate status or instructor's consent. Scott.Anderson@nau.edu

**QS 672 Quaternary Pollen Analysis** (4). Analyzes pollen and spore morphology, use of pollen assemblages to deduce vegetation and climate change. 3 hrs. lecture, 3 hrs. lab. Prerequisite: coursework in ecology, plant taxonomy, or Quaternary geology or instructor's consent.

# Student Environmental ASSOCIATIONS

For an up-to-date list of registered clubs at NAU, please visit the Student Life website at <http://www4.nau.edu/stulife/clubs.htm>

## **Alpha Chi Sigma**

Promotes chemistry in local schools and assists the Chemistry Department's outreach activities in the greater community. The club also gives students the opportunity to network with other chemistry students.  
Online: [www.chemgeek.net/axe](http://www.chemgeek.net/axe)

## **Ambassadors for the College of Engineers and Natural Sciences (ACENS)**

Represents the student body of the CENS to the Dean and industry.

## **American Indian Science and Engineering Society**

Promotes excellence, leadership and opportunities in education and professional development for American Indians and Alaska Natives. Enriches the fields of science and engineering with Native traditions and strengthen communities with knowledge, resources and innovation.  
Online: <http://www.cet.nau.edu/Orgs/AISES/index.htm>

## **Anthropology Club**

Enhances anthropology students' university experience and provides a forum to network among students and professionals in the anthropology field.

## **Black Mesa Water Coalition**

Dedicated to empowering youth for a more sustainable future and preserving the integrity of Native American culture. Main focus has been on the Peabody Coal Slurry on Black Mesa and a transition to more sustainable energy practices and economic sources.  
Online: [www.blackmesawatercoalition.org](http://www.blackmesawatercoalition.org)

## **Botany Club**

Assists in the maintenance of the teaching collection of live plants in the Biology Greenhouse and acquires new plants for the greenhouse by fundraising and traveling to special collections.  
Online: <http://jan.ucc.nau.edu/~plants-c/BotanyClub/>

## **Engineers Without Borders**

Partners with developing communities to improve the quality of life through the implementation of environmentally sustainable, equitable, and economical engineering projects while fostering the development of internationally responsible engineers.

## **Environmental Science and Policy Graduate Student Organization**

Provides a graduate student contact with the Center for Environmental Sciences and Education and the Graduate College. Promotes bi-directional communication between Chair of Graduate Coordination and students.

## **Forestry Club**

Promote the professional, academic, and social development of its members as related to forestry.

## **Geology Graduate Student Organization**

Aims to create a social and professional network of graduate geology students at the university.

## **Graduate Association of Political Science**

Serves as a bridge between graduate students and faculty by representing students' interests and offers profession development opportunities for political science graduates.

## **Graduate Student History Association**

Creates a stronger community of history graduate students through symposiums, research funding and access to academic resources.

**Northern Arizona Astrobiology Club**

Fosters interest in the origin, character, and future of life in the Universe.

Online: <http://www.astrobio.nau.edu>

**Northern Arizona Astronomy Association**

Increases public interest in astronomy by providing free astronomical viewing and information. Operates the NAU Atmospheric Observatory for public viewing every Friday night.

Online: [www.physics.nau.edu/~naaa](http://www.physics.nau.edu/~naaa)

**Society of Environmental Communicators**

Enhances community environmental awareness and provides a multi-disciplinary forum for environmentally conscious NAU students to express and apply their ideas.

Online: <http://dana.ucc.nau.edu/~sec-p>

**Society of Physics Students**

Academic club that focuses on the field of physics; offers outreach, tutoring, and physics related trips.

Online: [www.physics.nau.edu/~sps](http://www.physics.nau.edu/~sps)

**Student Action Network**

Non-hierarchical, consensus-based group that seeks to educate the Flagstaff community on the issues of social, environmental and economic justice.

**The Wildlife Society: NAU Student Chapter**

Dedicated to volunteer opportunities to further student's interest and involvement in the sustainable stewardships of wildlife, their habitats, and the environment.

Online: <http://dana.ucc.nau.edu/~wild-soc/>

# Campus MAP



## Greening the CAMPUS

The faculty, staff, students, and administrators at Northern Arizona University have played a significant role in the long-term planning and the extensive new construction on campus. Their contributions continue to be instrumental in reshaping the campus philosophy to focus on a more sustainable university community.

Several factors have already contributed to “greening the campus”. In 2000, NAU received a grant for a green building design resulting in the Applied Research and Development (ARD) Facility (page 8). A university-wide sustainability program was launched to conserve natural resources and reduce expenses. In 2005, Arizona Governor Janet Napolitano signed an executive order requiring all state-funded buildings to achieve LEED Silver Certification and all newly constructed state buildings to incorporate renewable energy.

LEED, Leadership in Energy and Environmental Design, is a nationally accepted Green Building Rating System developed by the U.S. Green Building Council for constructing high-performance sustainable buildings. The newly completed College of Business Administration and Engineering and Technology buildings are seeking LEED certification, and the ARD Facility seeks a Platinum LEED Certification—the highest such recognition. The construction of this facility is expected to be completed in early 2007.

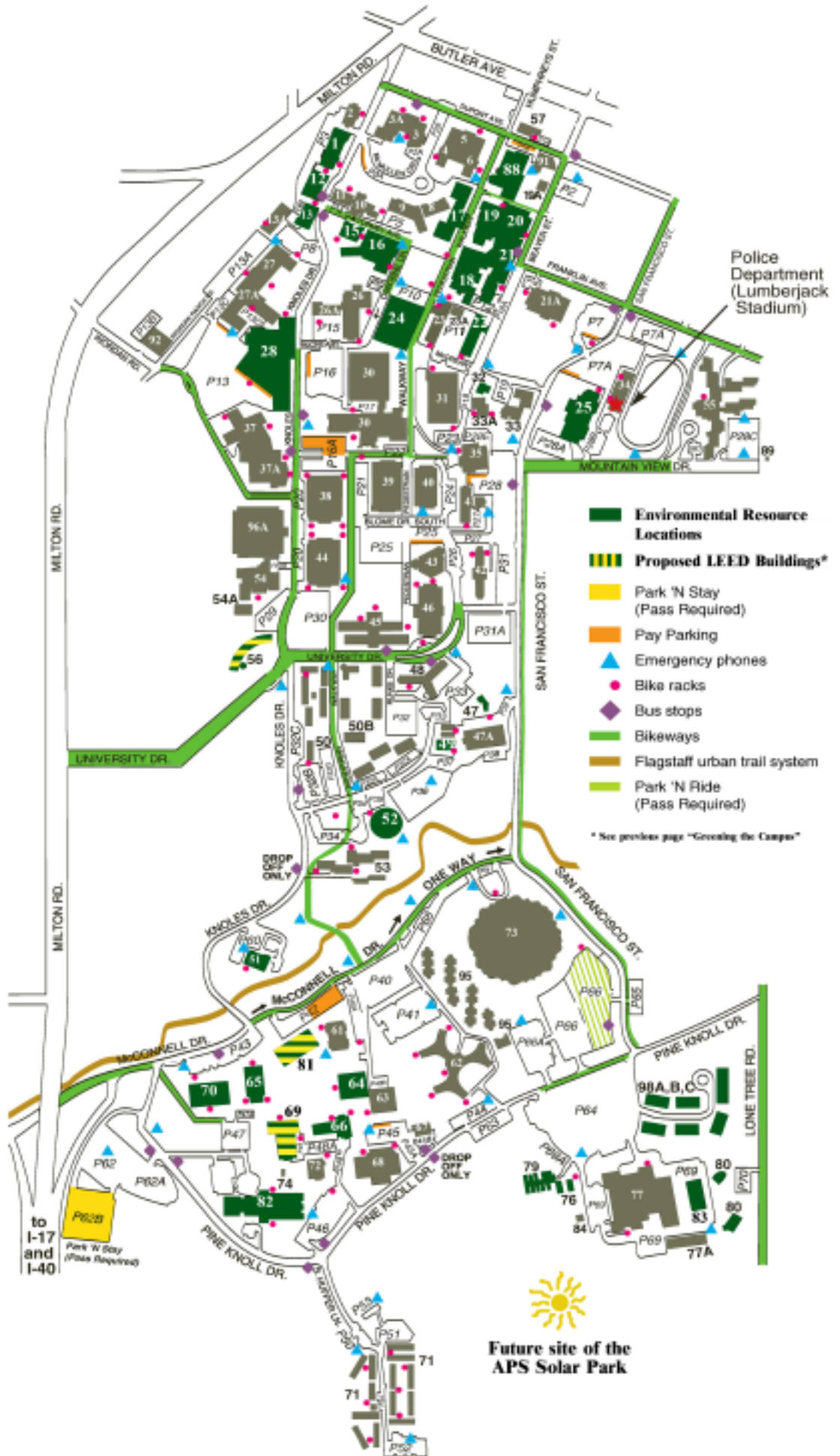
The following map illustrates several “green” programs that reflect aspects of our transformation. Research and degree programs, laboratories and environmental associations are located in all areas of campus. NAU also has started to reform transportation systems to decrease the use of vehicles and reduce greenhouse gases. Bike paths, pedestrian pathways, and new parking options reflect the University’s sustainable plan.

As our country moves into a new era, NAU’s programs, courses and research facilities provide students with research opportunities, skills to meet future workforce demands, and scientific information for the public. Our University’s integrated approach provides a model for future generations.

I hope you find this environmental guide useful in locating our green resources.

Richard Bowen  
Associate Vice President of Administration and Finance

- 1 **Gammage Building**
- 2 Blome Building
- 3 North Union
- 3A Prochnow Auditorium
- 4 North Morton Hall
- 5 North Morton Hall
- 6 Campbell Hall
- 8 Bury Hall
- 9 Taylor Hall
- 10 Old Main
- 11 Ashurst Building
- 12 **Geology**
- 13 **Geology Annex**
- 13A Roseberry Apartments
- 15 **Riles Building**
- 16 **Communication Building**
- 17 **Science Lab Facility**
- 18 **Liberal Arts**
- 18A **Biology Greenhouse**
- 19 **Physical Sciences**
- 19A Employee Assistance and Wellness Office
- 20 **Chemistry**
- 21 **Biological Sciences**
- 21A Wall Aquatic Center
- 21B **Biological Sciences Annex**
- 22 **Peterson Hall**
- 23 Babbitt Academic Annex
- 23A Education Annex
- 24 **Plateau Center**
- 25 **Recreation Center**
- 26 Adel Mathematics
- 26A Counseling and Testing Center
- 27 Eastburn Education Center
- 27A Institute for Human Development
- 28 **Cline Library**
- 30 University Union
- 31 Gillenwater Hall
- 32 **Hospitality Resource and Research Center**
- 33 The Inn at NAU
- 33A Eugene M. Hughes Hotel and Restaurant Management Building
- 34 Lumberjack Stadium
- 34 Police Department
- 35 Bookstore Building
- 37 Performing and Fine Arts
- 37A Ardey Auditorium
- 38 Cowden Learning Community
- 39 Raymond Hall
- 40 McDonald Hall
- 41 Fronske Health Center
- 42 Sechrist Hall
- 43 Gateway Student Success Center
- 44 Tinsley Hall
- 45 Wilson Hall
- 46 Allen Hall
- 47 **Astronomic Research Observatory**
- 47A ROTC/Property Control
- 48 Reilly Hall
- 49 **Anthropology Laboratory**
- 50 Campus Heights Apartments
- 50B McKay Village
- 51 **Babbitt Administrative Center**
- 52 **Bilby Research Center**
- 53 Gabaldon Hall
- 54 Information Systems Building
- 54A Information Systems Building Annex
- 55 Mountain View Hall
- 56 **Applied Research and Development**
- 57 Printing Services
- 61 Learning Resource Center
- 62 McConnell Hall
- 63 South Dining
- 64 **du Bois Center**
- 65 **Social and Behavioral Sciences**
- 66 **Health Professions**
- 67 Heating Plant Annex
- 68 Rolle Activity Center
- 69 **Engineering and Technology**
- 70 **Social and Behavioral Sciences West (SBS West)**
- 71 South Apartments
- 72 Nursing
- 73 Walkup Skydome
- 74 Anechoic Chamber
- 76 **Avian Cognition Laboratory**
- 77 Capital Assets and Services
- 77A Capital Assets and Services Annex
- 79 **Greenhouse Annex**
- 80 **Ceramics Complex**
- 81 **College of Business Administration**
- 82 **Southwest Forest Science Complex**
- 83 **KNAU and Bus Barn**
- 84 Recycling Building
- 88 **John F. Wettaw Biology and Biochemistry Building**
- 89 Fountaine Apartments
- 91 Centennial Building
- 91 Human Resources/Payroll
- 91 Parking Services
- 92 Ponderosa Building
- 95 Pine Ridge Village
- 96A Parking Garage
- 98 **Emerald (98A, B, C)**



NORTHERN  
ARIZONA  
UNIVERSITY



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**Ecological Monitoring  
& Assessment  
Program & Foundation**

[www.EMaprogram.com](http://www.EMaprogram.com)