

# CURFocus

## The Campus as a Four-Year Undergraduate Learning Laboratory on Sustainability: Linking Facilities, Operations, Curriculum, and Community Engagement

Northern Arizona University (NAU), together with many like-minded universities, is creating a culture of sustainability across campus, from operations to education, research, and community engagement. NAU's efforts reflect nationwide trends of increased numbers of academic programs with a focus on sustainability (Vincent et al. 2013a); campus-wide implementation of learning outcomes related to sustainability (e.g. Chase and Roland 2004; Svanström et al. 2008; Aber et al. 2009); and integration of sustainability education with campus operations. The university's efforts also reflect a critical, nationally recognized need to prepare students for engaged participation in civic and democratic life and the need to address issues of social and environmental justice (U.S. Department of Education 2012). The work recognizes declining civic knowledge and voting by high-school seniors and attempts to better prepare students for 21st century careers (McCormick Tribune Foundation 2007).

With mounting demands to increase campus sustainability activities, there is also a growing need for use-inspired, applied research opportunities to directly address sustainability problems and to engage the rapidly expanding number of students interested in sustainability. In addition, institutions pledged to the American College and University Presidents (ACUP) Climate Commitment must assess their progress toward carbon neutrality. All these needs are best served in a systematic, not ad hoc, way. NAU's strategic plan calls for it to "exemplify a sustainable, innovative, and effective university community." We describe below how NAU uses an "all of the above" strategy—integrating top-down strategic and climate-action plans with many student-driven, grassroots programs—to create a comprehensive approach to sustainability education, operations, and community engagement.

NAU provides a four-year program of community-oriented sustainability education and practice, not just a "one and done" experience. Two key approaches are, first, to link co-curricular and curricular activities such as the First Year Seminar-Action Research Teams (FYSeminar-ARTs) to provide student-driven learning and civic engagement, and, second, to offer opportunities for advanced students to further develop their skills by improving university and community sustainability practices. We provide hands-on experiences with tangible benefits to NAU and to local communities and

encourage continual engagement by students at increasingly sophisticated levels of sustainability practice. Students evolve from novice learners to participants to student mentors and contributing professionals. The campus-wide implementation of this process expands students' research and internship opportunities.

### Coursework and Degree Programs

NAU, along with Arizona State University and the University of Arizona, is overseen by the Arizona Board of Regents. NAU serves 26,000 students, 20,000 of them on the Flagstaff campus where the focus is on a residential undergraduate experience. Its graduate programs focus on global and civic engagement, community building, Native American student success, and sustainability. It offers 87 undergraduate, 45 masters, and 13 doctoral programs. More than 60 percent of our students are over the age of 21, 41 percent are first-generation college students, 18.4 percent are Hispanic, 4 percent are international, 3.3 percent are American Indian/Alaskan Native, and 3.2 percent are African American.

In an academic year, NAU offers approximately 75 undergraduate and 25 graduate courses focused on sustainability issues and another 125 undergraduate and 25 graduate courses that include sustainability topics, out of a total of 2,320 courses. Thus, sustainability or sustainability-related courses account for 11 percent of total course offerings. More than 370 undergraduates are majoring in degree programs in environmental studies or environmental sciences and more than 120 others are enrolled in masters programs focused on sustainable communities, environmental sciences and policy, and climate science and solutions, as well as a PhD program in Earth sciences and environmental sustainability. More than 150 other graduate students are enrolled in degree programs that include substantial content related to sustainability in biological sciences, forestry, and politics and international affairs. Due in part to these academic offerings, NAU earned a gold rating in 2014 from the Sustainability Tracking, Assessment and Rating System of the American Association for Sustainability in Higher Education.

More than 400 undergraduate internships and research projects dealing with the environment or sustainability were

completed for academic credit between 2003 and 2013. Of these, 68 were sponsored by various NAU offices dealing with facilities and operations, residence life, and dining services or by academic units, including 43 between 2011 and 2013.

## Campus-wide and Non-academic Programs

Many components of sustainability education and operations exist to address sustainability at NAU, as is the case at many other institutions. These components are linked to create a stable, long-term program of applied research and internships in sustainability, using the campus as a living laboratory of sustainability. At NAU, top-down initiatives such as the Green NAU Energy Initiative (GNEI), as well as bottom-up, grassroots initiatives such as NAU's Action Research Teams and the Environmental Caucus are critical to the success of these efforts. The wide range of programs and activities engaging students in sustainability learning are outlined in Table 1. Below, we focus in detail on two of these programs, the Global Learning Initiative and the Action Research Teams.

### *The Global Learning Initiative (GLI): Sustainability Learning in Every Major*

The initiative is a campus-wide support structure developed to assist every academic unit with the development and assessment of learning outcomes for their own majors in the

areas of sustainability, global engagement, and diversity. With its pioneering Ponderosa Project (Chase and Rowland 2009), NAU was an early proponent of infusing awareness of environmental and sustainability concerns throughout the curriculum and in the co-curriculum. Over the past several years, NAU has recognized that issues surrounding these topics, and the competencies for dealing with environmental sustainability, are inextricably tied to those of global engagement and diversity. To prepare globally competent graduates, the GLI was developed and adopted university-wide by the NAU Faculty Senate in 2010 (<http://nau.edu/CIE/About/Global-Learning/>).

It focuses on three interdependent core themes long valued at NAU and appearing in its strategic plan. The GLI provides stipends for working groups from each academic unit and technical expertise to assist each degree program in developing student-learning outcomes relating to environmental sustainability, diversity, and global engagement. Regarding environmental sustainability, the desired outcomes are for students "to acquire the skills and knowledge base to understand the importance of and options for environmental sustainability in local and global terms, and also acquire an understanding of the range of ethical perspectives concerning the uses of natural resources and the impact of these perspectives on creating a sustainable relationship of humans to the natural environment."

**Table 1. Major NAU Components Supporting Student-driven Sustainability Activities**

Program	Program objective	Focus/target	Outcomes
<b>Academics</b>			
Global Learning Initiative (GLI), <a href="http://www.nau.edu/CIE/About/Global-Learning/">www.nau.edu/CIE/About/Global-Learning/</a>	Assist all programs in developing and assessing learning outcomes in sustainability	Undergraduate academic-degree programs	75% of undergraduate academic majors now have sustainability learning outcomes
First Year Seminar-Action Research Teams, partnership of ARTs and University College, <a href="http://www.nau.edu/University-College/Your-First-Year/Seminar-Program/">www.nau.edu/University-College/Your-First-Year/Seminar-Program/</a>	Introduce students to just, sustainability concepts and leadership skills through community engagement and democratic action	All 1st and 2nd year students interested in a first-year seminar course	580 students enrolled in 14 sections during 2013-2014
Center for International Education sustainability experiences, <a href="http://www.edabroad.nau.edu/">www.edabroad.nau.edu/</a>	Provide students with sustainability-oriented international experiences	Undergraduate students	Some 50 students participating in programs like Siena Program Sustainable Food Systems
Internship supervisor for environmental, sustainability projects	Assist students in designing and implementing projects for course credit	Environmental, sustainability studies majors and minors, environmental sciences majors	357 internships and research projects in past 10 years; 68 were on-campus sustainability projects
<b>Undergraduate Research</b>			
Hooper Undergraduate Research Awards (HURAs) and Sustainability Prizes, <a href="http://www.nau.edu/hura">www.nau.edu/hura</a>	Support scholarly activities supervised by faculty; prizes recognize student generated projects	Students from all disciplines (HURA); from sustainability studies (prizes)	Each year 2-4 prizes and 20-25 HURAs awarded
Interns to Scholars Program, <a href="http://www.nau.edu/Undergraduate-Research/125/">www.nau.edu/Undergraduate-Research/125/</a>	Undergraduates participate in faculty research as paid interns	1st, 2nd, and 3rd year students	15 sustainability projects each year
Ecological Restoration Institute undergraduate research assistant, <a href="http://www.nau.edu/ERI/Education/">www.nau.edu/ERI/Education/</a>	Engage students in environmental restoration	Undergraduate students	Pay for 12 student designed research projects each year

Facilities and Operations			
Office of Sustainability, <a href="http://www.nau.edu/Green-NAU/Office-of-Sustainability/">www.nau.edu/Green-NAU/Office-of-Sustainability/</a>	Supervise and coordinate campus sustainability operations	Campus facilities operations, capital projects, student education, student groups	Programs in energy, waste and water conservation, student orientation; 25 student internships completed
Green NAU Energy Initiative (GNEI), <a href="http://www.nau.edu/Facility-Services/Energy/GNEI/">www.nau.edu/Facility-Services/Energy/GNEI/</a>	Carbon neutrality by 2020 through reduction of resources waste and promotion of renewable energy; create Sustainable Behaviors Program	Campus facilities and operations, capital improvements, student education, student organizations	\$18 million in energy-efficiency programs, 13 completed student internships; 50 Energy Mentors trained
Campus Climate Action Plan, <a href="http://www.nau.edu/Green-NAU/Climate-Action-Plan/">www.nau.edu/Green-NAU/Climate-Action-Plan/</a>	Meet presidential commitment for carbon neutrality by 2020	Operations, academics, research, student life	Meeting targets for current plan; achieved Gold rating by AASHE STARS*
Residence Life, <a href="http://www2.nau.edu/green-p/index.php/tag/no-impact-jack/">www2.nau.edu/green-p/index.php/tag/no-impact-jack/</a>	Train resident assistants in sustainability education; run No Impact Jacks program	Residence halls assistants	More than 20 RAs in 11 residence halls create education and operations plans
Campus and Community Outreach			
Action Research Teams (ARTs), <a href="http://www.nau.edu/University-College/CRAFTS/Action-Research-Team/">www.nau.edu/University-College/CRAFTS/Action-Research-Team/</a>	Participate in learning, develop understanding of identity within local, national, and global contexts, and gain skills in leadership, critical thinking, and problem solving	All NAU students, faculty, staff, and community partners	580 students, 40 community partners, 27 grad student and 35 undergraduate leaders completing 15 360 hours of civic engagement in addition to course and seminar hours
Student Green Fund, <a href="http://www.nau.edu/Green-NAU/NAU-Green-Fund/">www.nau.edu/Green-NAU/NAU-Green-Fund/</a>	Provides funding for student-designed projects reducing NAU's negative impact on the environment	All NAU students	18 projects completed; 2 interns; student-run committee and student chair
Environmental Caucus and Action Teams: Transportation, Sustainable Landscaping, Waste Minimization, <a href="http://www.nau.edu/Environmental-Caucus/">www.nau.edu/Environmental-Caucus/</a>	Coordinate, collaborate on, communicate, and develop sustainability education and operations	NAU students, faculty, staff, and local community members	Involved 1,000 students, faculty, staff, and community members, 12 student internships; Green NAU website, social media
Green Jacks (student environmental caucus), <a href="http://www.nau.edu/Green-NAU/Green-Jacks/">www.nau.edu/Green-NAU/Green-Jacks/</a>	Informal and hands-on environmental education; coordinate Earth Week, Better World Film Series	NAU students, faculty, staff, and local community members	Over 600 student members; plan and implement Earth Week; film series

\*AASHE STARS is the Sustainability Tracking, Assessment and Rating System of the Association for the Advancement of Sustainability in Higher Education, a self-reporting framework for colleges and universities to assess their progress in improving sustainability performance across their campuses.

Programs revise their curricula to develop and enhance these learning outcomes and to engage students in increasingly sophisticated activities that link global, diversity, and sustainability issues throughout undergraduates' progress through their majors. Through a process of backward design, academic units first identify desired results (outcomes); next they determine acceptable evidence of success (assessment); and then they plan or adapt existing learning experiences and instruction. Sustainability-focused faculty members serve as peer mentors to other academic units and as advisors to GLI administrators. They suggest appropriate materials, case studies, and competencies for units looking to infuse sustainability throughout their programs. Workshops and one-on-one collaborations are used to provide this assistance. Interactions among working groups in several academic units are required, and this cross-fertilization has a profound and positive impact. The process produces finished products that feed into the institution's existing curricular processes, such as the creation of revised syllabi, specific plans for curricular changes, and revised assessment plans.

#### *Campus and Community-Based Action Research Teams*

The NAU Campus and Community-Based Action Research Teams (ARTs) spearhead a movement to actively engage participants in civic engagement and democratic activity. The teams provide an opportunity for all NAU students throughout their college careers to take ownership of their educational growth, develop leadership skills, build meaningful and lasting relationships, and to deeply connect with the essence of public work, environmental stewardship, and social justice. The teams strive to cultivate similar types of deep democratic leadership, skills, relationships, and collaborative networks with community partners throughout the region, in order to advance the interests of our richly diverse area.

The teams create spaces for students and community members to conduct research and engage in grassroots activities as they explore critical issues in the areas of sustainability, as well as social, political, environmental, and economic justice. The latter topics include climate change, inequality, deteriorating education, health care, intolerance, immigration, indigenous rights, sustainable food systems, appropriate tech-

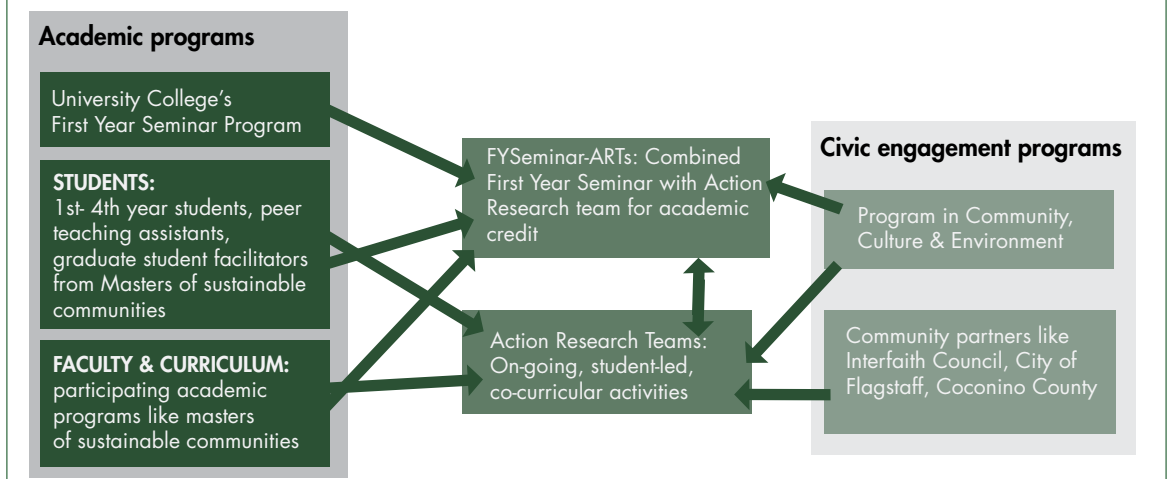
nologies, accessibility to political and community leaders, and more. This program is built on a foundation of student and community partnerships and is linked with existing academic programs, including the master's degree program in sustainable communities, the First Year Seminar, the Program for Community, Culture, and the Environment, and other members of the broader NAU and Flagstaff community. (see Figure 1).

In Figure 1, the faculty and students in academic programs (left side of diagram) combine their academic expertise with professionals in community organizing and sustainability who have expertise in civic engagement (right side of diagram). Two sets of needs (student learning and community sustainability) are combined into two related programs in the middle of the diagram. The First Year Seminar-Action Research Teams combine academic seminars offered in University College with civic-engagement partners.

Based on community conversations in 2008-09 that identified specific problems and areas of interest in our region, community partnerships were formed involving seven action-research teams. In the fall of 2009, students in the First-Year Seminar and a graduate program focused on sustainable communities were connected and asked to choose a research team that interested them. The students were then assigned to develop working relationships with other campus partners and community organizations in order to design, plan, research, and implement community projects. The efforts of the students, faculty, staff, and community partners coalesced as the process of democratic, civic-based organizing took shape. The detailed steps involved in developing, organizing, and implementing this type of research team are detailed in Berutich (2014). As the teams grew, so did the number of projects and participants, and the depth and modes of organizing.

The initiative currently consists of 13 active and growing research teams, made up of 900 freshmen, 30 graduate students, nearly 50 peer teaching assistants, and more than 40 community partners. Examples of the active teams in-

**Figure 1. Ties Among Academic Programs, Research Teams, and Civic-engagement Programs**



clude the Action Group for Water Advocacy, Students for Sustainable Living and Urban Gardening, Weatherization and Community Based Action, and Public Achievement. The teams join theory and critical thinking with on-the-ground practices of civic democratic action aimed at achieving just, sustainable community development and academic-success initiatives. The campus itself serves as a living laboratory for student growth and community changes. As part of this process, students are evaluated on whether they achieve the learning outcomes described in Table 2.

#### *First Year Seminar-ARTs Program (FYSeminar-ARTs)*

A defining aspect of the action-research teams is the FYSeminar-ARTs program, offered to all first- and second-year NAU students. FYSeminar courses, offered with the research-team component, expose students to hands-on, experiential learning. Content, skill-set development, action research, and student engagement are interconnected. Students learn the art of inquiry and self-exploration and are asked to rigorously explore the world around them. "We are the ones we've been waiting for" is the theme that reminds participants that the time to act is now and that the need to inquire and to restore citizens' public roles is urgent.

Mentorship and collaboration form the foundation for the research teams and their successes. Graduate-student facilitators, undergraduate peer teaching assistants, faculty, and FYSeminar-ARTs students all work together both in and out of the seminar, mentoring one another as each person grows into a more activist self. Students learn a tremendous amount just by working with one another in small-group discussions and projects. The peer mentors gain skills in communication and leadership through working with their teams. They have the opportunity to continue this work throughout their college careers and into their professional



**Table 2. Desired Student Learning Outcomes, Skills in First Year Seminars-Action Research Teams (ARTS)**

**FYSeminar-ARTs Program Learning Outcomes:**

Students will actively participate in their own learning process.
Students will develop a greater understanding of their own identity and agency within local, national, and global contexts.
Students will develop leadership skills and capacities as public representatives of the teams.
Students will have a greater awareness of political, social, environmental, and economic challenges in their communities, both locally and globally.
Student success will increase, especially for first-generation, minority, and women students enrolled in FY Seminars.

**Additional Skills Aligned with the National Association of Colleges and Employers Job Outlook Report 2013:**

Ability to verbally communicate with persons inside and outside the organization
Ability to create and/or edit written reports
Ability to plan, organize, and prioritize work
Ability to work in a team structure
Ability to make decisions and solve problems
Ability to obtain and process information
Ability to sell or influence others

lives. The facilitators, faculty, and staff work with community partners to identify needs, establish deep relationships, and develop action plans for implementation, as outlined in Figure 1 above.

In academic 2013-14, the program offered 32 sections. This fall the program planned to expand to 44 sections, enrolling more than 900 first-year students. This student-centered, engaged pedagogical approach challenges each learner to dig deeper and take ownership of his or her education. It requires students to find their voices, explore various models of grassroots organizing, and become agents of change through the democratic process and through real-world applications of research knowledge.

In 2014, as noted above, 41 percent of NAU's students were first-generation college students. Thus the seminars provide a space for these students to experience small class sizes, hands-on learning, and active, experiential pedagogies that speak to student needs and challenges. They provide students, some for the first time, with the opportunity to critically think about the world around them while actively taking ownership of their own learning processes.

Students in the program overwhelmingly report positive perceptions of their increased awareness of local, national, and

global issues, self-confidence, and leadership skills. Eight students in the first cohort of the program remained in leadership positions in it until they graduated. Unpublished data from academic 2012-13 showed a 7-percent-increase in retention of first-year students in the program over students in first-year seminars that did not involve research teams. Even larger differences were reported for female students (9 percent) and minorities (16 percent).

A new way in which students are continuing their involvement in the research teams is through a minor in civic engagement. This program supports continuing student involvement in the research teams and with other programs building the community's capacity for sustainable change. The minor provides curricular and advising support to students as they work in the community, developing skills in peer mentoring and group leadership among diverse constituents and stakeholders. Students build upon their capacities to communicate synthesized knowledge, research, and action; conduct disciplinary research and analysis of real-world issues; and thoughtfully explore the strategies of community-based organizing aimed at creating a more democratic, just, and sustainable community.

## Orienting, Engaging New Undergraduates

To initially engage students in sustainability activities, sections of the FYSeminar-ARTs program offer activities including weatherization of public buildings and private residences, landscaping or gardening, and waste management on campus and in the community. In fall 2013, sixteen sections of the First Year Seminar-ARTs program enrolled 480 students. They worked on topics such as Water in the Southwest; Power-Justice-Freedom; Slam Poetry, Art and Activism; Southwest Sustainable Foods; and Indigenous Environmental Justice. Each section exposed students to assessments of community needs, partnerships with community members, academic best practices in the arts of democracy, and participation in engaged learning.

Through the Global Learning Initiative (GLI) described above, students can also enroll in the first courses in their majors in which learning outcomes related to sustainability are embedded. Students revisit and enhance their learning outcomes in other courses through their major-specific GLI plans. Students majoring in environmental sciences or environmental studies, biological sciences, forestry, geography, planning and recreation, and politics and international affairs also engage in sustainability-focused curricula specific to their majors.

For first-year and returning residential students, the Office of Residence Life has sustainability-outreach programs that include a Sustainable Living (No Impact Jacks) Certificate

and a peer-education program (EcoReps). First-year students also have the opportunity to participate in living/learning communities with a focus on the environment and sustainability through the Sustainable Environments and Engaged Democracy (SEED) and EcoHouse communities.

## Continuing Engagement, Leadership, Professional Development

Undergraduates, regardless of major, remain engaged in sustainability from one semester to the next through both voluntary co-curricular and mandatory curricular activities. This process is illustrated in Figure 2, which demonstrates how students can progress through their academic careers, participating in multiple opportunities for curricular and co-curricular activities involving sustainability.

Figure 2 shows that as undergraduates progress through their curriculum (from top to bottom of diagram), they participate in a range of curricular-based sustainability activities (in italics on right side of diagram) and co-curricular activities (on left side of diagram). Programs spanning both sides of the diagram integrate both curricular and co-curricular activities including new student orientation, FYSeminar'ARTs, and internships and applied research, which maybe co-curricular and/or available for course credit. Specific programs are described in detail in the text. Individual programs are described in more detail above in Table 1.

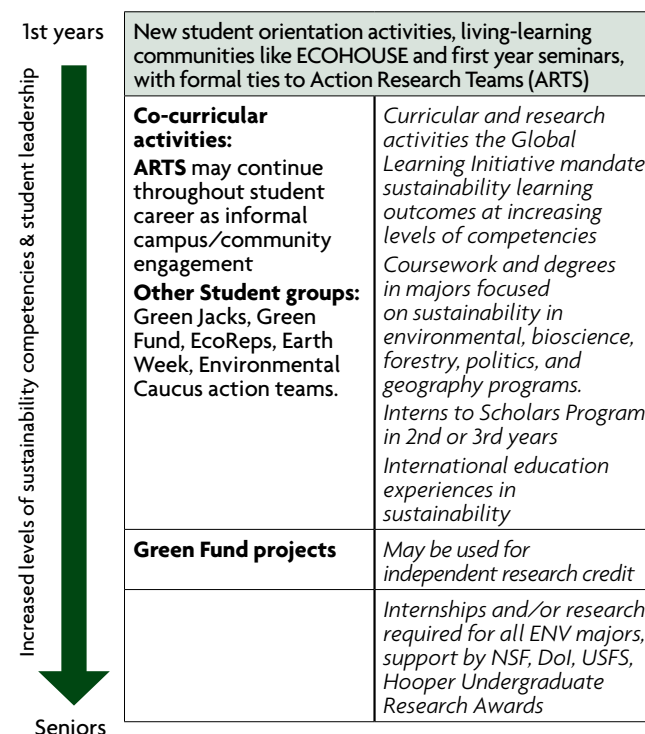
### Co-curricular Activities

The action research teams and the Green Fund, a student-funded and student-run foundation providing funds for student-designed sustainability projects, are structured to provide roles for students with a range of backgrounds and experiences. Thus, students entering these programs through the FYSeminar-ARTs or in other ways see behavior modeled by more-advanced students and frequently choose to stay involved in these programs throughout their academic careers.

Other co-curricular activities include the student section of the campus-wide Environmental Caucus. Also called the "Green Jacks" (after the NAU mascot, the lumberjack), students founded, organized, lead, and run the organization. It holds regular meetings, is registered with the student government, and has officers elected from the membership. The Green Jacks represent the voice of the students in the Environmental Caucus (EC) and share students' interests, concerns, and ideas regarding sustainability efforts on campus not only with each other but also with faculty, staff, and administrators in the caucus. This direct tie to the EC provides students with a voice at the table and allows campus decisions to be informed by students passionate about sustainability.

In addition to hosting and co-hosting smaller events, the

**Figure 2. Co-curricular Activities Paired with Formal Academics**



Green Jacks organize the Better World Film series and campus Earth Week events, which involve a broad coalition of campus groups and departments. Participating students gain valuable experience in event planning, fundraising, and organizing along the way. From event planning to policy conversations, the Green Jacks represent the student body as ambassadors for sustainability. While they suffer the same problems and challenges as any other student-led organization, participants feel a deep sense of ownership of their college experience and develop a sense of their place in the world.

### Required Curricula

As they progress through the mandatory curriculum of their majors, many students advance into courses requiring project design, data gathering, and assessment in order to implement effective changes in resource use on campus. Even in majors without these components, the learning outcomes developed through the Global Learning Initiative in such majors as dental hygiene, philosophy, theater, and art require students to understand how more-sustainable activities can positively impact their disciplines. The GLI learning outcomes for every undergraduate major are listed at <http://nau.edu/CIE/About/Curriculum-and-Resources/>.

Students' learning outcomes are scaled up with increas-

ing levels of professional expectation as students progress through their majors. Junior-level writing courses, required in every major, commonly require students to develop research or community-engagement proposals. The opportunities offered within their major courses and through the action research teams often culminate in individualized study with faculty researchers and staff-sponsored internship experiences (see Table 1).

Both undergraduate and graduate students have access to research opportunities related to sustainability, working with more than 100 faculty members and scores of staff engaged in technical outreach and applied sustainability research. Faculty members support student research and internships through traditional outlets such as the National Science Foundation's Research Experiences for Undergraduates program and NASA's Space Grant Interns and Undergraduate Research Programs, as well as through individual faculty members' federal grants from the Departments of Agriculture and Interior and the Environmental Protection Agency. Other funds supporting internships come from the Ecological Restoration Institute, the Institute for Tribal Environmental Professionals, and other applied-research groups.

Four internal NAU funding sources also support students' sustainability research. The Interns to Scholars program focuses specifically on enlisting sophomores and juniors to assist faculty members' research projects, thus supporting these students' developing interest in research and internships. The Hooper Sustainability Prizes recognize undergraduate and graduate students who design and conduct sustainability projects on campus. The Hooper Undergraduate Research Awards solicit research, scholarly, and creative proposals from undergraduates in all disciplines, allowing recipients to conduct research supervised by a faculty mentor. The Green Fund, developed and funded by students, also provides funding for sustainability-related research projects. All of these opportunities are available to second- and third-year students exploring their first significant opportunity to conduct applied research, as well as to seniors looking for support for their senior research, internship, or other capstone experience.

#### *Center for International Education (CIE)*

CIE offers students structured, volunteer sustainability work, as well as formal internships abroad for course credit. Work sites are both on campus and in the community, and CIE works closely with all leaders at the sites to understand their needs and to place the right student in the right learning environment so that both parties succeed. CIE is also piloting a required sustainability project for students receiving an NAU scholarship for study abroad. Students are required to participate in a campus sustainability project as part of their acceptance of the scholarship.

## Addressing Learning Outcomes

### *Career Preparation*

All NAU undergraduates must demonstrate competence in several learning outcomes related to sustainability. They must be able to articulate the shared and unique contributions that result from diversity in global, social, cultural, and environmental systems through their ability to articulate the importance of, and options for, environmental sustainability locally and globally. They must be able to analyze important local, national, and global issues from multiple viewpoints, demonstrating an understanding of the interdependence of political, economic, environmental, and social systems. They must show that they appreciate the importance of artistic expression in understanding links between social and environmental systems.

Assessment of these learning outcomes is completed by each academic program through a program-specific assessment plan. Faculty in each program agree upon specific learning outcomes related to content and skills, using internal and external resources, such as the National Council for Science and the Environment's Curriculum Design Report (Vincent et al., 2013). Each course in the major is then evaluated to determine how it addresses the skills and content outcomes identified for the program. A matrix is generated to see how students can develop these learning outcomes as students move through the curriculum. Written and oral assessments of students' mastery of the outcomes, based on presentations, project reports, reflective essays, and exams, are performed throughout the students' progression in the major. A primary part of the assessment program in environmental and sustainability programs is through the presentation of a senior project, when students present orally and in writing the results of their internships or research projects. A faculty committee, with assistance from the NAU Office of Assessment, reviews these assessments every two to three years and recommends changes to the program matrix and to major courses.

### *Continuing Professional Development*

More than 400 students majoring in environmental sciences and environmental and sustainability studies are required to complete a 150+ hour internship or research project. Students in other majors, particularly in the natural and social sciences, also chose these options as electives. Dozens of research projects and internships in environmental and sustainability fields arise through interactions between programs on the academic and the facilities sides of NAU. These cooperative efforts have generated research with practical applications at little or no additional expense, as we demonstrate below.

Such cooperation has been facilitated through formal, top-down structures such as the President's Coordinating

Committee on Campus Sustainability and the Green NAU Energy Initiative (GNEI), as well as from bottom-up, informal networks such as the Environmental Caucus. Grassroots networks provide clearinghouses for information about internship and research opportunities, sponsor classroom visits and open houses for prospective campus sponsors of internships (e.g., Facilities Services, the Office of Sustainability, GNEI, Residence Life, Campus Dining) and for local off-campus, non-governmental organizations and local, state, federal, and tribal agencies.

One example of a top-down, centrally planned campus internship program is the Green NAU Energy Initiative (GNEI). As part of NAU's effort to reduce costs and greenhouse-gas emissions associated with energy waste, it has implemented a campus-wide retrofit of its energy systems to improve their efficiency. This project was accomplished through an \$18 million performance contract with an energy services company. The project stands to save NAU \$1.5 million annually and reduce the campus greenhouse-gas emissions to 1990 levels before 2018. GNEI was created as part of the larger retrofitting project.

GNEI has two full-time staff members dedicated to finding ways to conserve energy and water. The efforts include a campus-wide program promoting "sustainable behaviors," development of sources of renewable energy, tracking and minimizing waste, and quantification and management of greenhouse gas emissions. GNEI is uniquely positioned to provide quality research-based internships for students nearing graduation. These internships allow students to gain experience and at the same time fulfill GNEI's research needs for new ways to advance campus sustainability.

One phase of GNEI focuses on behavioral assessments to reduce environmental impacts (and utility costs) through improved awareness of resource use. GNEI undergraduate- research programs include POWER DOWN, a series of building-wide experiments to test ways of encouraging students and faculty to reduce energy usage, including designs for behavioral change and before-and-after assessments of these changes. Other projects assess the impacts of attempts to change behavior in residence halls to reduce resource use, quantify greenhouse gas emissions from mobile sources, and create sustainability plans for units within NAU's Facilities Services division. Another GNEI initiative is the installation of utility meters and a composite reporting database called EnergyCap that will help NAU interns track, audit, process, and manage resource use.

Since the creation of GNEI in 2012, 13 interns with a range of interests have been mentored by GNEI staff members. Nine


conducted research, assessment, or a feasibility study. Two focused on communications and outreach, and two assisted GNEI staff with general program planning and implementation. Ten of the interns enrolled in the 150-hour internship course required as part of their particular degree programs. GNEI staff hold a weekly meeting with each intern to assess progress on tasks, assign new tasks, and provide other support where needed. All internships have specific goals and objectives so students have a clear understanding of expectations and deliverables. Interns work on actual GNEI projects so standards are high, fulfilling GNEI's educational objectives of providing students with valuable insights into the processes, development, operations, and management of sustainability initiatives in large institutions. The internships also provide students with information and skills they may not obtain in the classroom and expose them to a professional, non-academic institutional setting. Examples of interns' projects include:

- researching and creating a methodology for the quantification of scope 3 transportation greenhouse gas emissions from vehicles at NAU, including use of standard reporting protocols and calculators, and the GHG data collection and reporting methods;
- conducting a feasibility study for certifying the Cline Library building under the LEED or Energy Star certification programs;
- organizing and implementing a pilot study to reduce average shower time in residence halls, including coordination with Residence Life, survey design, market research and product selection, and data analysis; and
- creating a sustainability plan for the Facility Services Department.

All NAU opportunities for internships and sustainability research function within the overall context of the sustainability learning available at NAU and are the culmination of students' curricular and co-curricular experiences. These projects are then presented in the context of a senior capstone course required in all majors.

Regardless of the major chosen, students have many options throughout their academic careers to participate in coursework and engaged learning that hone their skills and interests in research and operations related to sustainability. Students at NAU have demonstrated the ability to assume increasingly complex roles, becoming leaders in campus and community sustainability projects, as they progress through their undergraduate careers. They make valuable contribu-



tions to their university and the broader community in the process. 

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## Roderic Parnell

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Roderic Parnell is coordinator of academic sustainability programs, former chair of the campus Environmental Caucus, and professor of Earth sciences and environmental sustainability at Northern Arizona University. His current research focuses on the application of biogeochemistry and geomorphology to the sustainable management of river systems in the Western U.S., and on the transformation of environmental curricula to incorporate more sustainability content. He has received more than \$9 million in research funding from federal and non-governmental organizations in the U.S., Europe, and Latin America, resulting in more than 140 journal articles and papers presented at national and international meetings. As the founding director of the Colorado Plateau Cooperative Ecosystems Studies Unit, Parnell worked to integrate federally funded environmental research across the Colorado Plateau. He has advised 37 graduate students and 24 undergraduate researchers who have successfully completed their degrees. He is currently a member of the executive committee of the National Council on Science and the Environment and President-Elect of its Council of Environmental Deans and Directors. He received a PhD in geology from Dartmouth College, an MS from the University of Massachusetts, Amherst, and a BA from Middlebury College.

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