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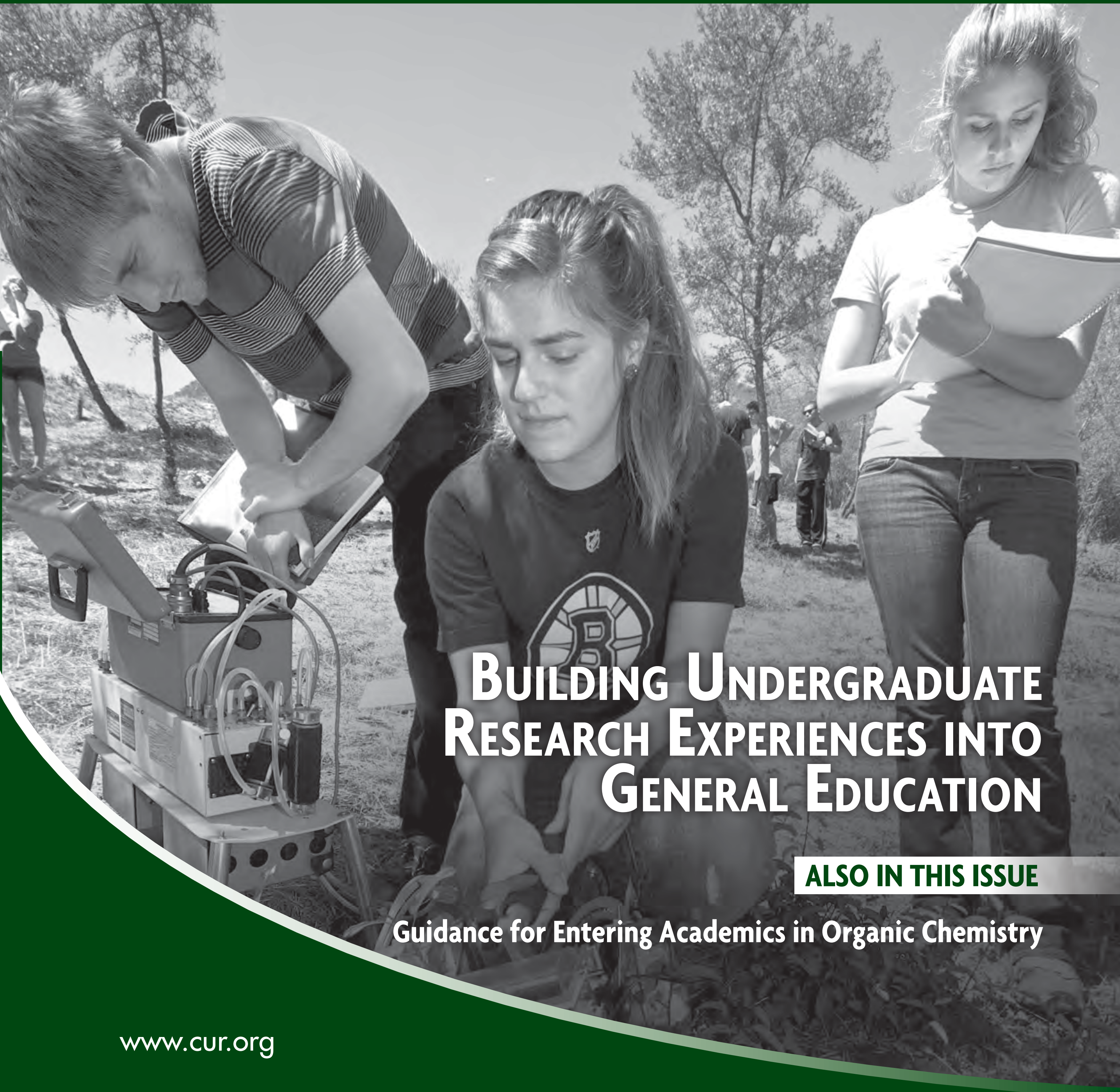

# Building Undergraduate Research Experiences into General Education

**ALSO IN THIS ISSUE**

Guidance for Entering Academics in Organic Chemistry

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Council on Undergraduate Research
734 15th Street NW, Suite 550
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*Cover Photo:*
*First-year students at Pepperdine University who are investigating the biological mechanism of plant adaptation to wildfire in the Santa Monica Mountains. Students shown are measuring enhanced photosynthesis and transpiration characteristic of fire-adapted plants after shoot removal by wildfire. (Photo credit: Stephen D. Davis)*



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# From CUR's President

*"An ounce of practice is worth more than tons of preaching"*
*—Mahatma Gandhi*

Over the course of the past nine months in my new role at Florida Southern College and as CUR President, I have been engaged in a wide variety of conversations related to the role and purpose of general education. A haphazard survey of college websites indicates institutions vary dramatically with respect to the number of general education courses students complete as part of a degree program. Colleges and universities are less varied, though, with respect to the goals of these requirements. The goals often refer to preparing students for citizenship, providing an appreciation for diversity, helping students integrate ideas from across disciplines to illuminate interdisciplinary themes, and improving thinking, reasoning, and communication skills.

Given the goals of general education and the percentage of these courses that make up a student's educational experience, it behooves us to find ways to integrate undergraduate research. Weaving undergraduate research/scholarship into and across general education courses is an effective way to achieve educational coherence and provides a framework for intentional scaffolding of intellectual and communication skills. When successful, we will solve two of today's most vexing challenges—supporting research opportunities for all students and involving students in research early in their college careers.

An analogy that might help us think of ways to use these courses to create undergraduate researchers is to think about how we create musicians or athletes. Mastery of a sport or musical instrument requires practice and the mastery of different skill sets. Think about a softball player who works on hitting, fielding, and pitching skills. Countless hours are spent improving these skills, as well as general skills related to movement such as balance, flexibility, agility, and speed. A campus might approach the design of general education as building a specific skill set for student scholars. Many faculty members assign readings for students to complete out of class and then are disappointed when their analysis of the readings is superficial. When was the last time you took time in class to break down a research article (or book or poem) paragraph by paragraph (or stanza by stanza)? When have you spent time in class to help students create an annotated bibliography? How can we expect students to effectively build analytical skills if we do not model the behavior and devote class time for this process? Think about how our method might work (or not) for a coach. How effective would it be for a coach to tell an athlete to work on improving his or her swing but not be present to help guide that process?

If a campus chooses to use its general education courses to develop a given skill set (writing, critical thinking, analysis), a process for communication among faculty members in disparate departments needs to be developed and implemented; doing so would allow for general education courses to be modified to ensure that courses appropriately scaffold and build upon skills from one course to the next. I understand this is easily said but difficult to implement. Yet I would argue the benefits of good interdisciplinary communication and assessment are critical to our success. We have the opportunity to thread, and then use the needle to weave, undergraduate research into a coherent framework within our general education courses.

Another way that undergraduate research in general education courses can foster coherence is by drawing attention to both the common ground and the differences among disciplines with respect to ways of knowing. Break the research/scholarship cycle into different steps—asking and imagining questions, understanding one's place in the field, effectively using the methods of a discipline to answer a question, communication, analysis, and dissemination. By breaking the "research/scholarship/creative work" cycle into distinct stages, one gains a clearer understanding of how general education courses can provide us the means to introduce students to the commonalities and differences among disciplines. For the past five years, my institution has been using a common theme in its general education courses to help students learn how different disciplines approach a given issue (poverty and hunger; environment and sustainability). Students are learning how simple issues can suddenly become complex when disciplines and individuals differ in their value systems. This reminds me of Herb Childress's address at the 2012 biennual CUR conference about "wicked" problems and how they cannot be solved with the lens of a single academic discipline.

The examples in this issue show that our general education courses offer a ready mechanism for us to provide early and sustained research experiences for all students. We cannot predict in advance who will be the next generation's greatest humanitarians or thinkers- all we can do is provide time and guidance as they practice in our the classrooms. I hope the articles inspire you to incorporate undergraduate research into your general education classes.

**Mary Crowe**
*Associate Provost of Experiential Education*
*Florida Southern College*
*CUR President*



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## IN THIS ISSUE OF CURQ on the Web

**CURQ on the Web, Summer 2013 Edition -**
**http://www.cur.org/publications/curq_on_the_web/**

# From CUR's Executive Officer

As a student attending a private liberal arts institution in the 70's, and aspiring to "live my life in widening circles that reach out across the world" (Rainer Maria Rilke), I found general education to be a welcome feast. As a faculty member teaching in a highly structured and "silo-ed" general education program at a large public comprehensive institution in the 90's, I vacillated between a sense of mission to continue the liberal arts tradition, and a stultifying sense of despair that the students in my classes seemed to have little interest in the sweeping overview of Earth's processes and history I presented in prescribed, thrice-weekly, 50-minute lecture doses. From colleagues in the science education department, I did learn to infuse some inquiry-based elements into the large lecture setting, but didn't have a smidgen of a vision about restructuring the course to emphasize research.

The articles in the Summer 2013 *CUR Quarterly* provide insights on how to turn general education environments into laboratories of practice for "Students as Scholars." The five contributions (four print, and one web-based) share common themes: inter (and multi) disciplinarity, creative deconstruction of the standard lecture environment, and an emphasis on assessing outcomes of the (re)created general education curriculum. Several of the articles, for example Pukkila et al. and Carr et al., provide innovative models for cost-effective ways to expand the numbers of mentors engaged in research-based learning environments, through empowerment of near-peer (graduate and/or upper division) students to help lead course-related research projects and processes.

Revitalization of general education to inculcate high-impact practices such as undergraduate research is receiving a lot of attention in higher-education circles, as well it should. CUR is an important force in the movement to expand undergraduate research fully into the curriculum. In 2007, CUR published *Developing & Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices* (edited by Kerry K. Karukstis and Timothy E. Elgren), which serves as a primary source of curricular innovations that can be adapted and implemented in a variety of educational settings. In the half-decade since the publication of this substantial contribution to the national teaching-and-learning literature, the urgency to "grow" research into the curriculum has increased.

The February 2013 CUR Dialogues conference featured back-to-back plenary presentations by Jane Wellman, executive director of the National Association of System Heads, followed by Rebecca Martin, vice president of the Education Delivery Institute. The first presentation highlighted pressing issues in higher education, including the systematic disinvestment in higher education (for all but a few well-endowed private institutions) that's taken place over the last few decades, the seemingly inexorable rise in tuitions, and the sickening crunch between students' expectations for affordable, accessible, and high-quality education, and what many domains of the educational marketplace are offering right now. The second presentation focused on strategies to connect high-impact practices such as undergraduate research with the national dialogue on improvements in student success and degree quality, and engaged several hundred CUR Dialogues participants in focus-group discussions on the challenges and opportunities to systematically expand undergraduate research on their campuses.

Both plenaries called for leadership from faculty and administrators to build more connections between research programs and classroom practice, and, quite specifically, to expand undergraduate research into the lower-division curricula and campus-wide general education infrastructure. The Summer *CUR Quarterly* special issue showcases the vitality and diversity of the faculty and students who are doing just that.

Allied to the expansion of undergraduate research into the general education curriculum, we see growth in other aspects of undergraduate research culture and practice. In this 35th year of CUR as an organization, we are witnessing significant growth in the National Conference on Undergraduate Research (NCUR). The April 11-13 NCUR at the University of Wisconsin, La Crosse was the largest conference in the event's 27-year history, with the number of abstracts submitted up more than 12 percent. The CUR Biennial Conference in June 2014 will be held in Washington, D.C., and will focus on the "Democratization of Undergraduate Research." One of the main strands of the meeting will be the embedding of undergraduate research into the curriculum. If one democratic ideal is the widespread empowerment and engagement of a broadly diverse community of faculty, students, and staff in undergraduate research, can there be a better way of achieving this goal than by focusing more of our efforts on the general education curriculum?

**Elizabeth Ambos**
*Executive Officer*





# From the Issue Editor

## Building Undergraduate Research Experiences into General Education

The competition has never been fiercer in the delivery of general education courses. MOOCs (Massive Open Online Courses) from the nation's top universities offer general education courses free of charge to more than 100,000 students in some classes. MOOCs will soon come with academic credit for students who wish to transfer the coursework across the country or globe. For-profit institutions continue to offer a myriad of core curriculum courses, and technical colleges in many states now offer general education courses at significantly cheaper tuition rates. In this increasingly competitive marketplace, many colleges and universities are asking how they can stand out. The focus of our Summer 2013 *CUR Quarterly* on the integration of undergraduate research experiences into general education courses provides an answer to that question. For institutions of higher education to not only survive but also to prosper in this hyper-competitive environment, the best practices highlighted in the focus articles and vignettes of this issue provide a path forward.

Katy Carr and colleagues from Pepperdine University describe the powerful combination of undergraduate research and first-year seminars. The Keck Scholars Program enrolls between 140 and 160 first-year students in seminars that span diverse academic disciplines with fellow students serving as peer mentors. The article provides particularly valuable assessment data on student research skills and abilities. Marina Cetkovic-Cvrlje and colleagues at St. Cloud State University illustrate the value of interdisciplinary faculty learning communities. The authors highlight a learning community of faculty in anthropology, chemistry, english, and biology (immunology) that reached across disciplinary silos and engaged undergraduates in research through courses that are part of the university's general education requirement. The article provides an analysis of the quantitative and qualitative results of a Common Classroom Assessment Tool (CCAT). The CCAT reveals student attitudinal shifts concerning the research process, research skills, collaboration skills, and attitudes toward the discipline.

Susan Hirsch and colleagues provide an intriguing look at how research through focus groups can meet disciplinary and general education goals at George Mason University's School for Conflict Analysis and Resolution. In a capstone course in which students are required to synthesize knowledge gained through their general education courses, the authors describe how a focus group exercise is a particularly positive experiential learning project. Our final focus article describes the novel Graduate Research Consultant (GRC) program at the University of North Carolina at Chapel Hill. The program provides faculty with advanced graduate students who are instrumental in turning general education course assignments into robust research projects. Consistent with the other thematic articles in this issue, an internal assessment of the GRC program through surveys and focus groups notes the desirable results of the initiative.

I also encourage you to explore the insightful print vignettes in the Summer 2013 *CUR Quarterly*. C. Wesley Walter describes a general education first-year seminar in which students at Denison University perform home energy assessments using the homes of volunteers as a "research lab." Robert Zeidel and Kate Kramschuster of the University of Wisconsin-Stout report how students in a general education U.S. History course can access primary sources to investigate their "historical birthday." Amy Peeler of Wheaton College reveals that undergraduates can engage in Biblical exegesis in a general education course.

Finally, our Summer 2013 *CUR Quarterly on the Web* provides additional and valuable examples of undergraduate research in general education courses. The article by Ardi Kveven and Josh Searle outlines Everett Community College's Ocean Research College Academy (ORCA). ORCA involves an interdisciplinary learning community that is cohort-based with student-led research at the heart of the initiative. Our web vignettes describe innovative models of incorporating undergraduate research into general education courses ranging from biology to Japanese culture as well as first-year experiences from the Earth sciences to nursing.

The intense competition that will continue to unfold in the delivery of general education courses creates a tremendous challenge for colleges and universities, but it also provides valuable opportunities. The collection of articles and vignettes in this issue, from private to public institutions,

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can serve as a clarion call for how to incorporate undergraduate research experiences into general education courses. Institutions of higher education that incorporate these best practices can thrive in a marketplace of growing competition. Fundamentally, our authors teach us that undergraduate research is not reserved for upper-level students but rather should be a key and dynamic element in how we provide the core curriculum.

**James T. LaPlant**
*Valdosta State University*
*CURQ Issue Editor*

## CUR Calendar

### SEPTEMBER 2013

| | |
|---|---|
| 2 | Registration Opens for Applications to Posters on the Hill |
| 9 | CUR Councilor Nominations Open |
| 16 | CUR Officer Nominations Open |
| 30 | Registration Opens for Applications to the National Conference on Undergraduate Research |

### OCTOBER 2013

| | |
|---|---|
| 2 | Pre-International Society for the Scholarship of Teaching and Learning (ISSOTL) Conference, Raleigh, North Carolina |
| 26 - 28 | Conference of Research Experiences for Undergraduates (REU) Student Scholarship & National Science Foundation (NSF) Social, Behavioral & Economic Sciences (SBE) REU Pre-Conference, Arlington, VA |

### NOVEMBER 2013

| | |
|---|---|
| 4 | Deadline for Applications to Posters on the Hill |
| 8 - 10 | Creative Inquiry in the Arts and Humanities Institute, California State University-Sacramento |
| 12 | CUR Councilor Nominations Due |
| 25 | CUR Officer Nominations Due |

### DECEMBER 2013

| | |
|---|---|
| 6 | Deadline for Applications to the National Conference on Undergraduate Research |

### FEBRUARY 2014

| | |
|---|---|
| 20 - 22 | CUR Dialogues, Arlington, VA, Renaissance Arlington Capital View |

## MEET THE EXECUTIVE OFFICER

Elizabeth (Beth) L. Ambos became CUR's fourth Executive Officer in May 2012. As an undergraduate student, she found the undergraduate research paradigm one of the best ways to learn, and when she became a professor at California State University, Long Beach, she actively sought ways to establish and expand undergraduate research opportunities. She was attracted to CUR first as a faculty member, because of the opportunity to interact with like-minded faculty who were passionate and practiced undergraduate research mentors. As she transitioned to administrative positions, she deepened her relationship to CUR through connections to CUR's NSF-funded programs for STEM faculty. Now, as Executive Officer, her deep commitment to and appreciation of CUR has grown substantially. She believes the people involved in CUR, the past accomplishments of the organization, and the opportunity to significantly expand undergraduate research in its manifold forms are amazing and set CUR apart from other organizations.

Prior to becoming CUR's Executive Officer, from 2006 to 2012 Ambos served as assistant vice chancellor for research initiatives and partnerships in the California State University System office. Before taking that position Ambos held several administrative appointments at California State University, Long Beach, including associate vice president for research and external support, graduate dean, and associate dean of the College of Natural Sciences and Mathematics. She has helped obtain or manage more than $60 million in grant and contract funds over the past two decades. One of the grants she led and managed was the Geosciences Diversity Enhancement Program (GDEP), which supported summer undergraduate research experiences for students and faculty at Long Beach-area community colleges and high schools.

Ambos received her AB in geology from Smith College (magna cum laude), and her master's and doctoral degrees in marine geology and geophysics from the University of Hawaii at Manoa.

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Katy S. Carr, Stephen D. Davis, Stella Erbes, Constance M. Fulmer,
Lee B. Kats, Melissa Umbro Teetzel, *Pepperdine University*

CUR Focus

# Developing First-Year Students as Scholars

Two of the challenges of increasing undergraduates' participation in research are supporting research opportunities for students from all disciplines and involving students in research early in their college careers. Pepperdine University's Seaver College has sought ways to engage first-year students in research with the expectation of tremendous benefits for students' academic development. Three years ago when we embarked on creating and implementing what is now called the Keck Scholars Program (KSP) in honor of the W. M. Keck Foundation's support for the program, we pondered, as have others, the question: "What would happen if teachers in all disciplines allowed their students to seize the creative work right from the beginning, trusting that the important fundamentals would emerge? What would change for us, and for our students?" (Blackmer 2008, 10).

KSP introduces undergraduates to research through first-year seminar courses, which are part of the general-education curriculum. The program was built upon our belief, which the program has reaffirmed, that first-year students can make important contributions to their disciplines, even in the absence of extended exposure to discipline-specific methods. Students are not only learners; they are also developing scholars (Hodge, Pasquesi, Hirsh 2007). We seek to accelerate the shift from learner to scholar by introducing research in the first year and allowing that formative experience to shape students' undergraduate careers.

The inclusion of first-year seminars in the college curriculum aligns with best practices in higher education, including those recommended by the National Leadership Council for Liberal Education and America's Promise, sponsored by the Association of American Colleges and Universities. Among the effective educational practices cited in its 2007 report are first-year seminar courses that bring small groups of students together with faculty. First-year seminars often emphasize "critical inquiry, frequent writing, information literacy, collaborative learning, and other skills that develop students' intellectual and practical competencies," according to the National Leadership Council (2007, 53). First-year seminars at Pepperdine University meet several desired learning outcomes, two of which align closely with the outcomes of undergraduate research. In the first-year seminar, students sharpen their critical-thinking and problem-solving skills through study within a specific academic discipline, and they use written assignments and oral presentations to become more effective communicators.

*First-year students visit the Frederick R. Weisman Museum of Art at Pepperdine University during the Pop Culture exhibit for their KSP course entitled "Art and Faith in Asia," an interdisciplinary approach to key artworks, rituals, and practices associated with the religions of Asia. (Photo credit: Stephen D. Davis)*

Since the first-year seminar is the only course that is required for all first-year students and since it is offered across all disciplines, it provides the perfect platform to integrate intensive research into the general-education curriculum. Designed to connect students from all disciplines to scholarship early in their undergraduate careers, the KSP has already produced a significant change in the first-year seminar landscape. Implementing this change required careful planning and coordination among faculty, administration, and support staff.

In its second full year, academic 2012-13, Pepperdine's KSP enrolled 162 first-year students, roughly one fifth of the incoming class, in research-based courses during their first semester in college. The goal is to transform the beginning of a student's four-year college experience from a tourist's gaze (Woodiwiss 2011) to deep learning and personal scholarship (Blackmer 2008). The students in the program also realize the benefits of teamwork and collaboration (Barkley 2009) and have the opportunity to receive funding for continued research as the seminar draws to a close.

## The Keck Scholars Program Model

Six key objectives guide the vision for KSP. The program aims to:

1) engage students in research through first-year seminars;
2) encourage faculty development through instructors sharing their scholarship with first-year students through learner-centered and discovery-based practices;
3) create a learning environment in which peers serve as role models of scholarship;
4) empower students by allowing them to take ownership of their creative, original ideas;
5) foster an environment in which students are encouraged to continue scholarly contributions to their disciplines; and
6) integrate research with existing curricular and co-curricular endeavors.

An overarching framework unifies KSP seminars, even as they span diverse academic disciplines. Each major component within the seminar revolves around conducting and presenting research (Figure 1). Utilizing this framework, faculty participants introduce students to an aspect of their own scholarly research and invite students to engage with them in thinking about research possibilities. Next, student teams in each seminar formulate research questions. KSP faculty have found team membership essential to developing collaborative skills among students, refining and perfecting students' ideas, and realizing the full benefits of a learning community. These research teams are also a key component of the seminars, allowing faculty to spend sufficient time working with each group on their hypotheses, research methods, and presentations.

To ensure a sustained impact, programmatic components of KSP extend beyond the first-year seminar course and link students to subsequent research opportunities (McKillip 2009). All participants in KSP write an individual mini-grant proposal as a final academic exercise in their seminars. Within each seminar, the emphasis given to the group and individual projects varies at the faculty member's discretion and is generally influenced by his or her specific discipline. Regardless, the students are all eligible to receive mini-grant funding to conduct the proposed projects over the following term or the summer if they choose to submit their proposals for review by a committee. Ultimately, students who successfully integrate revisions suggested by the committee into their proposals receive funding for their research projects. Similar to standard grant-acceptance protocol, students are designated as principal investigators (PIs) on their grant awards. KSP alumni may seek additional funding for travel to attend academic conferences and may choose to participate in one of Pepperdine's other undergraduate research programs. Thus, the program is designed to equip KSP alumni to pursue further research opportunities after their first experience.

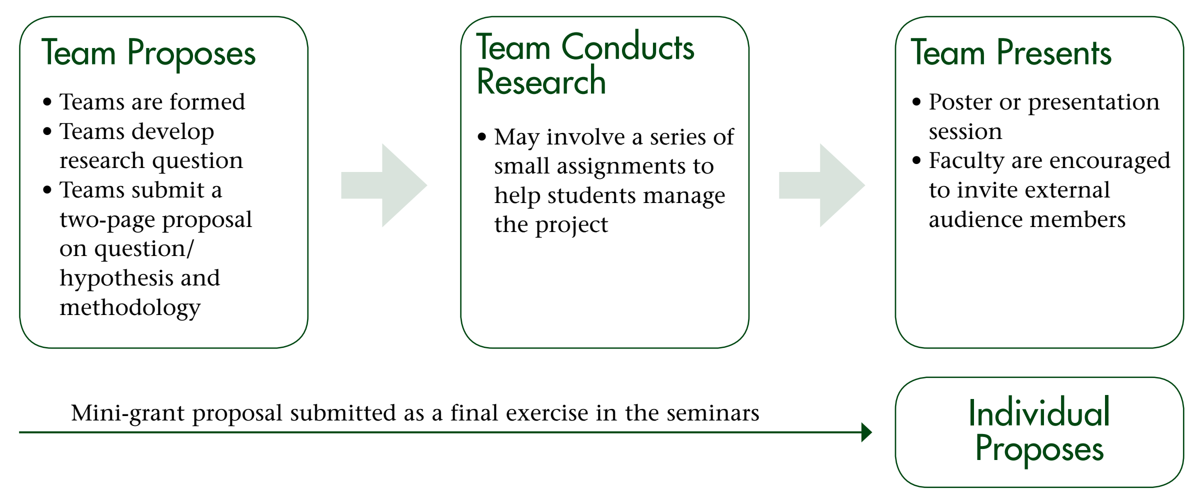
## Program Components and Populations

*Students*. Enrollment in first-year seminars occurs during the summer prior to the start of the academic year. At Pepperdine, students rank their top three seminar choices, selected from offerings in three categories: first-year seminars on a variety of topics, colloquia that would extend beyond the first term (e.g., seminars titled Great Books, or Social Action and Justice), or KSP seminars. None of the offerings in the first two categories include research as a central component. In the first year of the Keck Scholars Program, 142 students enrolled in KSP first-year seminars, and in the second year 162 students enrolled.

Early in the fall term, faculty form, or allow students to form, research teams of three to four researchers. Content introduced early in the term situates students in a particular subdiscipline in which they are free to explore potential research topics. Students in the seminars learn to investigate a topic of interest, to develop research projects, and finally to present results to one another and to a broader university audience. The format for the presentations varies according to the particular disciplines and is intended to replicate what one might find at a national or regional academic conference.

In preparation for their final presentations, students now are required to attend the Southern California Conferences for Undergraduate Research (SCCUR) held annually in November. This one-day, regional conference welcomes all disciplines, is appropriate for entry-level presentations and first-year stu-

**Figure 1 – The Keck Scholars Program Seminar Framework**



dents, and provides peer-reviewed feedback on abstract submissions prior to final abstract acceptance (Swift et al. 2012). By attending, KSP students are exposed to an academic conference and can witness their peers disseminating the products of their research. In the subsequent fall semester, KSP alumni are encouraged to present their research at SCCUR either in the form of an oral seminar, poster presentation, artistic performance, or artistic display.

As mentioned above, along with their team's research project, as a final assignment each student crafts a mini-grant proposal for a hypothetical project. Students apply the knowledge they have gained and demonstrate mastery of the thought processes necessary to formulate a research question. The mini-grant proposal includes methods, a timeline, a budget, and the significance of the project to the discipline and the student's scholarly career. Students who are interested in conducting their proposed research the following term or summer have the option of submitting their proposals for consideration for funding. In the first year, more than 50 of the 142 KSP students submitted mini-grant proposals, all of which were offered funding. A selection of project titles appears in Table 1.

**Table 1. Selected Keck Mini-Grant Research Project Titles**

| Student Proposes |
|---|
| Nixon/Boone: The Unlikely Friendship of Two Icons |
| What You Don't Know Will Certainly Hurt You: A Study into the Impact of Early Financial Education on Financial Behavior and Dispositions |
| A Study of Arch Height in Shod Versus Unshod Runners |
| How International Students React to Common U.S. College Social-Cultural Situations |
| iPads and Group Work: Exploring how the Integration of the Apple iPad into Cooperative Learning Affects Student Comprehension and Retention of Curriculum |
| The Set Point Theory and Subjective Well-Being of College Students |
| Athletic Body Image: Comparing Body Image Between Social and Sport Settings in Water Athletes |
| Michaëlle de Verteuil: Altering Her Life to Change Others |
| Effects of the Presence of UV Radiation on Feeding Behavior of Dendrobatidae Frogs |
| Forgive Me, I'm Fat: The Relationship Between Sympathy and Physical Appearance Stereotypes |

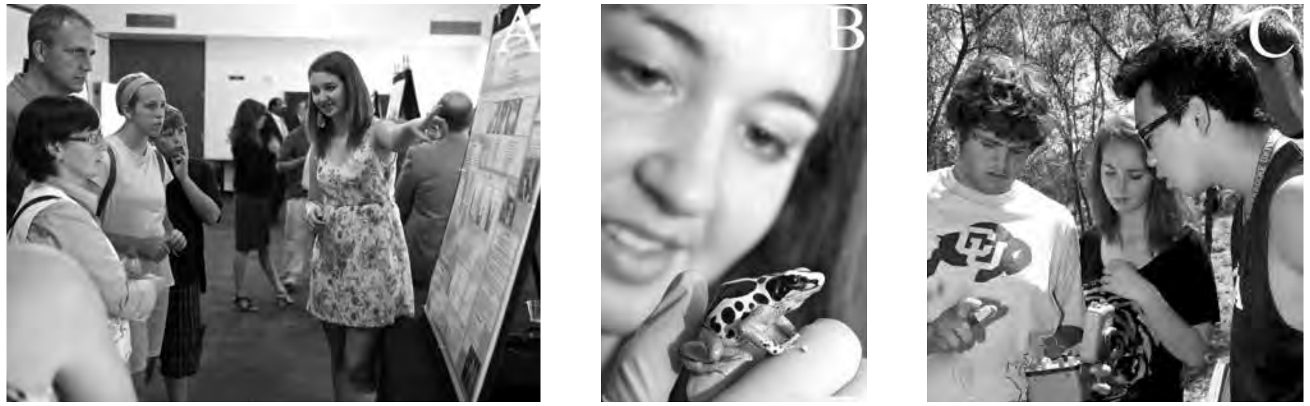
*Faculty*. KSP faculty attempt to replace the traditional wedge driven between faculty research and teaching with a new bridge that unites their research with their students' learning. This occurs at the most impressionable moment of a student's four-year experience, his or her first semester in college. Faculty mentors bring emerging issues to the attention of students, thereby increasing the potential to advance current knowledge. Students benefit from an early introduction to the rigor of academic scholarship; faculty benefit from devising innovative methods that engage first-year students in original, creative research. By working collaboratively and consistently throughout the semester with the undergraduate researchers, faculty members have the opportunity to stay abreast of the current literature in their discipline, which can, in turn, help to advance their own scholarship.

For example, the KSP seminar in plant biology, entitled "Plant Adaptations to Wildfires," focused on the mechanical adaptations of plants to water stress because water is the factor most restricting plant survival in arid landscapes in California. Mechanical resistance of native plants to water stress is an emerging field of investigation and is of particular interest to Stephen Davis, the seminar's instructor. Another example was the KSP seminar in teacher education entitled "Discovering the Secret to Inspirational Teaching." In this seminar, one research team chose to investigate an emerging issue in educational technology, titling their project "Teachers' Perceptions of Integrating iPads into their Middle School and High School Classrooms." This topic complemented the research efforts and interests of their faculty mentor, Stella Erbes. These two examples, from very different KSP seminars, serve to illustrate the common elements of research and how scholarship can be shared by faculty.

Up to ten faculty members, drawn from eight divisions, are recruited for KSP each year. Besides broad disciplinary representation, selection of faculty is based upon: 1) faculty aptitude and willingness to adapt professional approaches to scholarship for first-year students; 2) faculty willingness to provide guidance while encouraging student ownership of original research ideas; and 3) personal engagement and scholarly activity of faculty within their discipline. Further, faculty participants are expected to exemplify teamwork and interdependence within and across sub-disciplines.

Before the first year of the program, participating faculty attended five teaching seminars organized by the project's directors. These seminars included discussions on assigned readings about collaborative undergraduate research and development of shared learning outcomes, as well as dialogue on how to organize and facilitate a research course. Since the program was launched, KSP faculty have met regularly to compare notes and to share best practices across disciplines. Participating faculty are also encouraged to share their best practices and pedagogical outcomes with other academics beyond Seaver College, either at educational workshops or in the educational section of academic conferences.

*Peer Mentors*. The role played by peer mentors in KSP is also critical to the program's success. Two peer mentors are selected by each participating faculty member on the basis of the peer mentor's prior research or teaching experience in the discipline. Mentors receive a modest stipend to attend every class session, provide advice and feedback on research ideas,




*Taylor Stucky is an example of both a first-year student and a subsequent peer mentor in KSP. In the fall of 2011 she was a participant in KSP as a first-year student and, A) reported on her research findings during a poster session; B) she was awarded a mini-grant to continue her research on poison dart frogs; and C) served as a peer mentor to guide a new cadre of KSP-students during the fall semester of 2012. (Photo credit: Stephen D. Davis)*

help with methods and logistics, and attend SCCUR and the seminar's final poster or oral presentation session. In the second year of the program, peer mentors could be drawn from sophomores who participated in KSP as first-year students. In addition to bringing first-hand familiarity with KSP, they are also able to empathize and provide advice to first-year students newly immersed in research, scholarship, and creative activity. Our experience suggests that an ideal combination of mentors would be one junior or senior and one sophomore who had participated in KSP.

## Assessment Overview

KSP students, peer mentors, and faculty complete mid-program and post-program surveys in which they are asked to report on their experiences in the seminar by rating items on Likert scales and responding to ranking and open-ended questions.

The survey questions for students are grounded in the works of Kardash (2000) and Erbes (2008) and ask respondents to report their abilities for planning, analyzing, and communicating research before and after their undergraduate research experience. Assessment data based on survey results after the first year of the program (Table 2) indicate that in eight out of nine sections of the KSP seminar students reported, a significant increase in growth in their abilities to design an original research study (N=124). In six out of nine sections they also reported significant growth in their perceived abilities to locate current research studies relevant to any research topic (N=124). On the other hand, the data did not demonstrate a statistically significant growth in students' perceptions of their abilities to analyze or communicate research. In eight out of nine sections of the seminar, the results did not show a statistically significant increase in students' perceived abilities to demonstrate problem-solving or critical thinking skills when carrying out a research project. Similarly, in seven out of nine sections, no statistically significant increase was reported in students' perceptions of their ability to interpret research findings appropriate to a research topic.

This minimal growth in students' perceptions of their abilities to analyze research may be attributed to the challenges created from a combination of factors in the first year of the Keck Scholars Program. These challenges included professors learning how to plan and pace the activities effectively for this research-intensive course, the limited time that students have to invest in the research during the semester while managing the responsibilities of their regular course loads, and the students' inabilities to dig deep into their research given the time restrictions of one semester.

Eight out of nine sections also did not report statistically significant growth in students' perceived ability to communicate clearly in oral presentations, and seven out of nine sections did not report statistically significant growth in perceived ability to communicate effectively in written discourse. These findings prompted us to look at how communicating research is formally taught in the KSP seminars and to investigate what prior experiences or training can be attributed to students' perceptions of their abilities to communicate research. Post-surveys revealed that 90 percent of students found the mini-grant proposal assignment to be somewhat or extremely useful. The number of students who are interested in attending graduate school remained constant in both mid-program and post-program surveys, with 72 percent showing interest in continuing their education.

At the faculty level, three program components were helpful to faculty teaching KSP seminars: participation in faculty workshops, collaboration among KSP faculty members, and the participation of peer mentors (eight of nine faculty members reported that each of these aspects was helpful) after the first year of the program. The Likert-scale questions for faculty asked them to rate how important the research experience was in helping students develop the skills for planning, analyzing,

**Table 2. Self-perceptions of Student Research Abilities (n=124)**

**Table 2: Self-Perceptions of Student Research Abilities (n=124)**
Scale: Exceptionally Capable (5); Considerably Capable (4); Adequately Capable (3); Relatively Capable (2); Slightly Capable (1); Not applicable (0)

| | To what extent do you feel capable of: | Section | N | Mid-Average | Mid SD | Post-Average | Post SD | p value < .05 | Statistically Significant |
|---|---|---|---|---|---|---|---|---|---|
| Planning Research | ***1. Designing*** an original research study? | 1 | 13 | 2.92 | 0.86 | 3.92 | 0.76 | 0.001 | * |
| | | 2 | 10 | 2.9 | 1.29 | 3.3 | 0.823 | 0.309 | |
| | | 3 | 13 | 2.54 | 0.88 | 3.46 | 1.05 | 0.021 | * |
| | | 4 | 14 | 3.29 | 0.99 | 4.07 | 0.475 | 0.035 | * |
| | | 5 | 15 | 3.07 | 1.1 | 4.13 | 0.743 | 0.001 | * |
| | | 6 | 14 | 2.29 | 1.07 | 3.5 | 1.019 | 0.001 | * |
| | | 7 | 15 | 3 | 0.93 | 3.93 | 0.704 | 0.002 | * |
| | | 8 | 16 | 2.25 | 0.93 | 3.69 | 0.479 | 0.000 | * |
| | | 9 | 14 | 2.64 | 0.84 | 3.71 | 0.726 | 0.001 | * |
| | ***2. Locating current research*** studies relevant to any research topic? | 1 | 13 | 3.54 | 0.78 | 3.92 | 0.641 | 0.175 | |
| | | 2 | 10 | 2.9 | 1.1 | 3.5 | 1.08 | 0.024 | * |
| | | 3 | 13 | 3.08 | 0.86 | 3.85 | 0.899 | 0.054 | |
| | | 4 | 14 | 3.64 | 0.63 | 4.29 | 0.726 | 0.013 | * |
| | | 5 | 15 | 4 | 0.93 | 4.47 | 0.516 | 0.029 | * |
| | | 6 | 14 | 2.71 | 1.07 | 3.64 | 1.216 | 0.001 | * |
| | | 7 | 15 | 3.8 | 0.86 | 4.27 | 0.961 | 0.11 | |
| | | 8 | 16 | 3.69 | 0.87 | 4.25 | 0.683 | 0.014 | * |
| | | 9 | 14 | 3 | 0.88 | 4.07 | 0.917 | 0.002 | * |
| Analyzing Research | ***3. Demonstrating problem-solving or critical thinking skills*** when carrying out a research project? | 1 | 13 | 3.46 | 0.78 | 3.85 | 0.801 | 0.24 | |
| | | 2 | 10 | 3.6 | 0.84 | 3.6 | 0.843 | 1 | |
| | | 3 | 13 | 3.38 | 0.96 | 3.62 | 0.87 | 0.427 | |
| | | 4 | 14 | 3.79 | 0.7 | 4 | 0.679 | 0.336 | |
| | | 5 | 15 | 3.6 | 0.51 | 3.93 | 0.704 | 0.136 | |
| | | 6 | 14 | 3.43 | 0.94 | 3.64 | 1.008 | 0.426 | |
| | | 7 | 15 | 3.67 | 1.05 | 3.73 | 0.799 | 0.806 | |
| | | 8 | 16 | 3.19 | 0.83 | 3.62 | 0.719 | 0.048 | * |
| | | 9 | 14 | 3.43 | 0.65 | 3.86 | 0.663 | 0.054 | |
| | ***4. Interpreting research*** findings appropriate to a research topic? | 1 | 13 | 3.23 | 0.73 | 4 | 0.913 | 0.026 | * |
| | | 2 | 10 | 3.5 | 1.08 | 3.7 | 0.823 | 0.555 | |
| | | 3 | 13 | 2.92 | 1.04 | 3.46 | 0.877 | 0.11 | |
| | | 4 | 14 | 3.36 | 0.75 | 4 | 0.555 | 0.033 | * |
| | | 5 | 15 | 3.93 | 0.7 | 3.87 | 0.834 | 0.774 | |
| | | 6 | 14 | 3.21 | 0.8 | 3.79 | 0.975 | 0.071 | |
| | | 7 | 15 | 3.8 | 1.01 | 3.93 | 0.594 | 0.634 | |
| | | 8 | 16 | 3.38 | 0.81 | 3.81 | 0.655 | 0.11 | |
| | | 9 | 14 | 3.07 | 0.62 | 3.64 | 1.008 | 0.088 | |
| Communicating Research | ***5. Communicating*** clearly in well-organized and persuasive ***oral*** presentations? | 1 | 13 | 3.31 | 1.03 | 4 | 0.913 | 0.006 | * |
| | | 2 | 10 | 3.3 | 1.16 | 3.8 | 0.919 | 0.096 | |
| | | 3 | 13 | 3.15 | 0.8 | 3.62 | 0.65 | 0.082 | |
| | | 4 | 14 | 3.71 | 0.73 | 4.14 | 0.535 | 0.082 | |
| | | 5 | 15 | 3.2 | 0.94 | 3.53 | 0.743 | 0.29 | |
| | | 6 | 14 | 3.36 | 1.01 | 3.57 | 1.089 | 0.189 | |
| | | 7 | 15 | 3.87 | 0.99 | 4 | 0.926 | 0.61 | |
| | | 8 | 16 | 3.75 | 0.93 | 4.12 | 0.719 | 0.054 | |
| | | 9 | 14 | 3.71 | 0.99 | 4 | 0.877 | 0.365 | |
| | ***6. Communicating*** effectively in well-organized and clear ***written*** discourse? | 1 | 13 | 3.15 | 0.9 | 4.08 | 0.76 | 0.004 | * |
| | | 2 | 10 | 3.3 | 1.06 | 3.7 | 0.949 | 0.223 | |
| | | 3 | 13 | 3.38 | 0.65 | 3.77 | 0.832 | 0.096 | |
| | | 4 | 14 | 3.5 | 0.65 | 3.79 | 0.893 | 0.365 | |
| | | 5 | 15 | 3.6 | 0.91 | 3.93 | 0.594 | 0.096 | |
| | | 6 | 14 | 3.21 | 0.89 | 3.86 | 0.949 | 0.045 | * |
| | | 7 | 15 | 4 | 0.66 | 4.33 | 0.724 | 0.136 | |
| | | 8 | 16 | 3.44 | 0.73 | 3.69 | 0.479 | 0.164 | |
| | | 9 | 14 | 3.14 | 0.77 | 3.71 | 1.069 | 0.15 | |

*First-year students in a KSP course who are investigating the biological mechanism of plant adaptation to wildfire in the Santa Monica Mountains. Students shown are measuring enhanced photosynthesis and transpiration characteristic of fire-adapted plants after shoot removal by wildfire. (Photo credit: Stephen D. Davis)*

and communicating research. Six out of nine faculty said that designing an original research study was very important, and eight out of nine (88 percent) said they felt having students locate current research studies was moderately to very important. Faculty were also asked to rank the outcomes of undergraduate research in order of importance (choices included participating in the research process, contributing to the field of study, and motivating students to attain a higher level of education or commit to a research-related career).

All 17 peer mentors completed surveys in the first year of the program, and the data reveal they were extremely satisfied (4.5 on a 5-point scale) and had their expectations met from their participation in the program. This was the only Likert-scale question on the surveys of peer mentors. Most of the questions for mentors addressed their prior experiences and future goals. Ten out of 17 mentors (59 percent) reported that their participation as a research mentor reinforced their decision to attend graduate school. Interestingly, the stipend promised to peer mentors was the least important factor in determining their participation. Peer mentors reported that gaining teaching experience and enhancing their résumés were the primary reasons they decided to participate.

## Post-Implementation Insights

Based on experience with the program, some unexpected benefits, unforeseen challenges, and best practices for future implementation have emerged. Project directors found debriefing sessions with faculty participants to be beneficial and plan to continue these meetings in subsequent years. Especially helpful during these sessions were collegial discussions about the nature of research within diverse disciplines. Faculty shared their processes for determining what the products of student research should look like in their respective disciplines. For example, this year's art history students curated museum exhibits, while history students developed outlines of the biographies they hypothetically would write. KSP has deepened mutual respect among faculty across disciplines as they wrestle with pedagogical decisions and share outcomes with one another.

In teaching the seminars, faculty had to learn to balance the research-intensive elements of the course and the generic first-year seminar requirements that orient students to college life. Faculty benefited from sharing syllabi with one another prior to the first year, which allowed them to conceive of how best to incorporate the traditional first-year seminar's learning outcomes with the desired research learning outcomes. At the beginning of the semester, faculty needed to be organized so that research skills were clearly introduced early in the semester, helping prepare students for the workload ahead.

Faculty initially were unsure of how to include peer mentors effectively in their plans for the seminars. They questioned how they could utilize peer mentors during and outside of class and what responsibilities the mentors should be given. Through trial and error and conversations with one another,

**Table 3. Peer mentor activities and the corresponding percentages of the 17 mentors' participation.**

| Activity | # participate | % participate |
|---|---|---|
| Met individually with research groups | 15 | 88% |
| Assisted groups with formulating a research question | 16 | 94% |
| Assisted with finding resources | 14 | 82% |
| Assisted groups with research designs | 15 | 88% |
| Helped groups with problem-solving as it related to the research process | 15 | 88% |
| Assisted groups with oral presentation skills | 8 | 47% |
| Assisted groups with written presentation skills | 9 | 53% |
| Reviewed research proposals along with the seminar professor | 15 | 88% |
| Taught the whole group | 9 | 53% |
| Graded papers | 11 | 65% |

Other:
Reviewed journals weekly (2); developed grading rubrics (1); reviewed games for exams, tips of the week, review sheets (2); helped with SPSS and Excel (1).

*While on a field trip to the San Onofre Nuclear Power Generating Station in San Onofre, CA, first-year students in a KSP course entitled "Communication Meltdown? Exploring the Challenges of Nuclear Discourse" learn about the challenges and possibilities associated with communication about nuclear issues.*

faculty developed best practices for involving peer mentors (Table 3). Nearly all peer mentors were involved in assisting student research groups with formulating a research question. At least 15 out of the 17 peer mentors reviewed research proposals with the seminar professor and assisted student research groups with problem-solving and developing research designs.

## Sustainability, Transferability

Sustainability of KSP, funded in part by a three-year grant from the W. M. Keck Foundation, was always at the forefront of the program's design. Pepperdine's commitment to broadening support for a research-rich culture provides the institutional commitment to implement a program of this scope and nature. This is central to sustaining the program in the future. Project directors cultivated "buy-in," not only from faculty who were both willing and interested in teaching a new first-year, research-intensive course, but also from representatives from academic divisions, the dean, and other key stakeholders. Each year KSP will continue to incorporate the faculty expertise that has developed in the earlier years. With this significant investment of personnel, we anticipate that this program will become an established part of the institution's first-year seminar curriculum.

First-year seminars are common among colleges and universities in the United States; 95 percent of four-year institutions have them (Goodman and Pascarella 2006, 26). The KSP should be transferable to almost any institution that has first-year seminars. While the goals of first-year seminars may vary across institutions, one common shared goal is increasing students' academic performance. Students currently enrolled in KSP may or may not have chosen to participate in a research-intensive course as a first choice for their first-year seminar. It might have been their second or third choice. As a result, this may impact the extent of their subsequent engagement in research, and it creates a potential challenge for faculty. Yet even if students do not choose to pursue research opportunities after their first-year seminar, current literature indicates that participating in research helps students become better students (Lopatto 2010). Nonetheless, other institutions may want to consider creating seminars on the basis of demand for the seminars.

## Conclusions

KSP both enhances and complements the general-education requirements in the context of a liberal arts education. When students are challenged to engage in personal research, scholarly work, and creative activity, they actively make use of all resources available to them in order to test hypotheses, answer questions, defend theses, and/or create artistic expression. Because students experience this process first-hand in KSP, we are now convinced of the importance of offering first-year research-intensive seminar courses within the general-education curriculum. Regardless of a student's discipline, scholarly work requires astute reasoning ability, clarity of oral and written communication, critical thinking and problem solving skills, quantitative ability, and creative, original expression. KSP students quickly realize that these broad skills complement the technical and theoretical training they receive in their specialized majors.

Through the assistance of KSP faculty, the scholarly contributions of first-year students can eventually lead to transformative ideas, paradigm shifts, and a distinctive advancement of new knowledge. A few examples of 19-year-olds who have made a significant impact in the past are Charles Darwin, Richard Henry Dana, Jr., Bill Gates, and Mark Zuckerberg (Darwin 1887; Dana 1840). The benefit of KSP for faculty participants is an added dimension to their research, scholarly work, or creative activity. This is accomplished by involving inexperienced students who often bring fresh perspectives, without preconceived notions, to pressing needs and emerging issues. The ideas of first-year students are often more creative, novel, adventuresome, and far less constrained than those of professionals.

The full benefits of KSP may not be realized until the students who have participated in the program reach their senior year. For our first cohort of KSP students, this remains two years in the future. At the time of their graduation, we anticipate greater student satisfaction with their undergraduate experiences and a significant increase in their scholarly productivity, measured by research conference presentations, visual and performing art expressions, publications in refereed journals, applications for graduate fellowships, and receipt of Fulbright awards or acceptance to prestigious internship programs. Because KSP students have started their scholarly activity in their first year of college, they will certainly have more experience and a longer track record to reference in their applications for grant awards, fellowships, and competitive positions in graduate and professional schools. Evidence thus far indicates that through integrating research into the first-year general-education curriculum, KSP provides a viable model for increasing scholarship activity among undergraduates.

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**Katy S. Carr**
Pepperdine University, katy.carr@pepperdine.edu

*Katy Carr is the assistant director for research, grants, and events at Seaver College of Pepperdine University. She earned her MA in clinical psychology from the Graduate School of Education and Psychology at Pepperdine University.*

*Stephen D. Davis is Distinguished Professor of Biology at Pepperdine University. He has served as coordinator of Pepperdine's summer undergraduate research program in biology, has served as a member of the board of directors of the Southern California Conferences for Undergraduate Research (SCCUR), and has been a Harriet and Charles Luckman Distinguished Teaching Fellow, as well as Teacher of the Year, at Pepperdine University. In 2008 he received the Robert Foster Cherry Award for Great Teaching, from Baylor University. Davis has co-authored journal articles with more than 44 undergraduate students and has directed 22 undergraduate students in their honors theses in biology. Much of Davis's research centers on the physiological ecology of chaparral shrubs and their adaptations to wildfire, drought, and freezing.*

*Stella Erbes is an assistant professor of teacher education at Pepperdine University. She earned her PhD in educational psychology from the University of California at Santa Barbara, and her research interests focus on teaching methods, educational technology, and undergraduate research experiences.*

*Constance M. Fulmer is associate dean for teaching and assessment at Seaver College of Pepperdine University. She holds the Blanche E. Seaver Chair of English Literature and is director of the Center for Teaching and Learning. She previously served as chair of Seaver College's Humanities and Teacher Education Division and as coordinator of the First-Year Seminar Program. She works regularly with undergraduate English majors in conducting summer research and writing articles based on their research.*

*Lee B. Kats is vice provost for research and strategic initiatives at Pepperdine University. His primary research interests include conservation, amphibian ecology, and stream ecology. He works with his undergraduate research students in the Santa Monica Mountains of southern California and in Costa Rica and Argentina.*

*Melissa Umbro Teetzel is a sponsored-programs officer in the Office of Research and Sponsored Programs at Pepperdine University. She was previously the coordinator for national scholarships and awards at Seaver College of Pepperdine University, where she recruited and assisted high-achieving students in applying for nationally competitive, merit-based scholarships and fellowships.*

Marina Cetkovic-Cvrlje, Latha Ramakrishnan, Shumona Dasgupta, Kelly Branam, Lalita Subrahmanyan, *St. Cloud State University*

CUR Focus

# A Multi-disciplinary Analysis of Intensive Undergraduate Research

Undergraduate research as a "high impact practice" has attracted a great deal of attention in the last several years, thanks to the emphasis placed on it by the Association of American Colleges and Universities (AAC&U) within its Liberal Education and America's Promise (LEAP) initiative. Complementing that emphasis has been the support provided by the Council on Undergraduate Research since 1978 to undergraduate institutions beyond the large, elite, research universities. These efforts, stimulated by the influential Boyer Commission's (1998) criticism of the elite research-oriented universities' lack of focus on teaching have resulted in the creation and implementation of a number of university-wide undergraduate research programs and the introduction of research and inquiry into individual courses, classified by Seymour et al. (2004) as the "Research-Based-Learning" model. Our present study, which involves pedagogical changes to incorporate research and inquiry processes into a course at any time during the student's undergraduate education, fits best with the latter model. (The term "research" is unfortunately often used to mean the method of experimental research used primarily in the sciences. In this article we have used both "research" and "inquiry," to be mindful of the breadth of the processes of inquiry across the disciplines.)

Undergraduate research as a learning process has the potential to be used in general education to help students achieve some of the key outcomes that the LEAP initiative recommends for liberal education. Scholars across the disciplines (Behling 2010; Ishiyama 2002; Lopatto 2004, 2010a) agree that to a greater or lesser degree, benefits occur over four or five broad areas: (1) personal and professional gains such as an increase in students' confidence in establishing collegial working relationships with faculty and peers; (2) increased knowledge of the various aspects of the research process; (3) gains in research, communication and collaboration skills; and (4) clarification or confirmation of a career or education path.

No matter the nature of undergraduate research practices, there are few, if any, standardized assessment tools that help evaluate its impact across the disciplines. Assessments of some intense undergraduate research programs have been published (Weight 2010; Lopatto 2010a; Kierniesky 2005), but as Seymour et al.'s (2004) review showed, not many scholarly research studies examine the impact of research-based courses on students' perceptions of their learning in general education or in their majors. Surveying students' perceptions of undergraduate research appears to be an effective way of assessing this impact, as seen in Lopatto's (2010b) Summer Undergraduate Research Experience (SURE) and Classroom Undergraduate Research Experiences (CURE) surveys, and in Hunter et al.'s (2009) web-based Undergraduate Research Student Self-Assessment (URSSA) survey.

In recent years, as interdisciplinary studies have begun to take shape and be strengthened, the need for implementation of cross-disciplinary approaches to teaching and learning has gained further recognition (Klein 2010). Establishment of "faculty learning communities" (FLC) has been acknowledged as an avenue for building cross-disciplinarity (Cox and Richlin 2004) and enhancing student learning (Cox 2009).

## Methodology of Our Project

In response to the recognized need for greater cross-disciplinarity and to discuss students' early involvement in undergraduate research, for the first time at St. Cloud State University (SCSU), a regional comprehensive institution, four faculty (in anthropology, chemistry, English, and immunology), encouraged by the director of the Center for Excellence in Teaching and Learning, reached across disciplinary silos and formed a faculty learning community. Below we discuss how the FLC balanced the objectives for involving undergraduates in research with the existing content objectives in courses that were part of the university's general education requirement (anthropology and chemistry) and those that were program electives (English and immunology).

In August 2011, the faculty members in our FLC each began redesigning one of their courses to include research/inquiry-based learning, to be implemented and evaluated in spring 2012. At our working sessions, held every three weeks, besides discussion about the instructional techniques and assessment procedures common and specific to our courses, we developed a Common Classroom Assessment Tool (CCAT) to evaluate students' perceptions of their learning in light of the learning community's goals for the project. The first goal was to introduce and guide students to successfully complete the research process and acquire research skills in the respective disciplines. Our second goal was to ensure student success in collaboration in a research project, and the third was to create positive attitudes toward inquiry-based learning in the respective disciplines. No changes were made to the content of the courses or to the course outcomes. Instead we used a different pedagogical approach by designing research and inquiry experiences for students to more effectively learn existing content and achieve course objectives. Our FLC project was approved by the university's institutional review board (IRB) for research with human subjects.

*Anthropology*. At SCSU Introduction to Anthropology is one of many 100-level courses students may choose from to satisfy the history, social, and behavioural sciences area in the general education program. This course introduces students to the discipline, and students who take this course are often in their first or second year of college. It draws just a handful of students who decide to major in anthropology.

As a result of the instructor's participation in this FLC, a group-research project utilizing ethnographic methods was incorporated into a section of the course in which 50 students were enrolled. In a revised instructional design, the instructor replaced the ethnographic reading, writing, and quiz with ethnographic research exercises and the group project. Students were placed in groups and were guided in formulating a research question that they then answered ethnographically—through fieldwork involving participant-observation.

*Chemistry*. Students enroll in General Chemistry I to satisfy the university requirement for a four-credit science course with a laboratory component in the natural sciences area for general education or to fulfil a pre-requisite for majoring in science or engineering. Of the 72 students enrolled in the course in the spring of 2012, a majority of them were freshmen and sophomores who aspired to major in engineering; a handful intended to major in chemistry or biochemistry.

The instructor adapted the " Process Oriented Guided Inquiry Learning" (POGIL) (Moog and Farrell 2011) and the case study approach in science teaching (Herreid 2006) in the redesigned class, where students worked in groups of four to six participants. The students spent the class time working collaboratively on inquiry-based learning activities, guided by the instructor and a learning assistant who occasionally helped them navigate the inquiry process. In this class, students had access to pre-recorded lectures through our university's online course-management system. The inquiry-based collaborative case study exercise required students to perform a literature search, design and conduct simple experiments, collect data and analyze the results, and write a report during the last two laboratory meetings of the course.

*English*. At SCSU, Modern and Contemporary British Literature is taught as a traditional survey of the 20th-century British literary canon. Approximately 30 students were enrolled in the course during this study—an even mix of juniors and seniors and a few sophomores and freshmen. Half of the students were English majors.

As a consequence of the instructor's participation in this FLC, active reading strategies were foregrounded through an introduction of concepts from literary and critical theory, using a practical, application-oriented approach. The final research paper for the class required a theoretical interpretive grid for textual analysis. Aligned with CUR recommendations that student research be "an original, intellectual, or creative contribution" and "distinct from the ubiquitous research paper" (Grobman and Kincaid 2010), students also worked on collaborative projects researching the literary impact in Britain of any 20th-century socio-historical/cultural event. Identifying and analysing a range of primary and secondary literature, students created PowerPoint presentations for a mini in-class conference and responded to questions from their peers.

*Immunology*. Research in Immunology is an elective, upper-level course in the biomedical sciences major. It has been offered since 2006 as a conventional undergraduate, faculty-mentored, research "course" taken by juniors and seniors outside of class work (Cetkovic-Cvrlje 2011). To align with the objectives of our FLC to involve undergraduate students in research early on, Research in Immunology was modified to make it suitable for freshman and sophomore students in the spring 2012 class. The instructor chose nine students based on their successful completion of Cell Function and Inheritance, an introductory biology course, in fall 2011 and their stated intention to major in the biomedical sciences.

In addition to simplifying the course content from the complex immunology of autoimmune type I diabetes to basic fish immunology, the instructor revised the steps in the research process to include greater scaffolding of material. For instance, unlike the previous offerings of this course, the revised class incorporated regular group meetings, and more importantly, the instructor emphasized the why and the how during each step of the research process the students performed, from acquisition of fundamental theoretical knowledge, laboratory skills, data collection, analysis, and interpretation, to presentation of results in the written and oral formats. In the context of collaborative learning, students worked collaboratively in two groups (with four and five students in each) during all steps of the research process.

## Developing a Common Classroom Assessment Tool (CCAT)

In addition to the usual discipline-based assessments, such as quizzes, exams, journals, oral presentations, papers, etc., we decided as a group to develop a CCAT on four broad areas that we determined were important outcomes of any research or inquiry-based learning experience: knowledge of the research processes, knowledge of research skills, experience with collaborative learning, and attitudinal shifts toward their respective disciplines. Within these broad areas, each of us developed survey questions specific to, and using the language of, each of our disciplines.

Upon a cursory examination of the results of our pre-course survey of student knowledge/attitudes in the four areas, it appeared to us that the students had overrated themselves in almost all areas surveyed (their average Likert scores were >3, on a scale of 1-4). We then decided to modify our survey following the course to include a Retrospective Post-then-Pre (RPTP) design to avoid the response shift bias that results from pre-survey overestimation (Howard 1980). Accordingly, students were called upon to complete a survey at the end of the semester in which, using a Likert scale, they not only rated their learning in each category after course completion but also reflected back to their knowledge and skills at the beginning of the semester, in addition to answering a limited number of open-ended prompts.

What made our assessment tool unique was the differentiated manner in which we formulated the questions on the survey. Unlike the sections on collaborative learning and attitudinal shift toward research in the discipline, in the section of the survey related to research processes and skills, each of us asked questions specific to the discipline using language that best reflected disciplinary approaches, such as the experimental approach in the sciences, the ethnographic approach in anthropology, and theoretical textual analysis in English. The specific questions or prompts used in our surveys, as well as the method of statistical analysis of the data, are briefly described in Figures 1, 2, and 3.

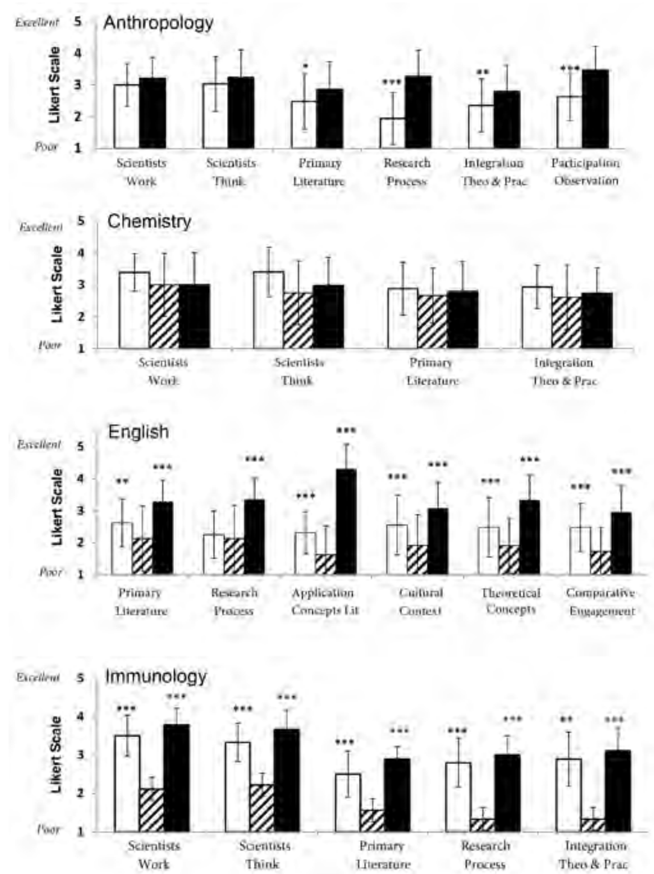
## Comparative Analysis and Results

In this section we focus on an analysis of the quantitative (Figures 1, 2, and 3) and qualitative results (Tables 1, 2, and 3) from surveying students' perceptions about their learning in the three goal areas: research process and skills (Figures 1 and 2, Tables 1 and 2), collaborative learning (Figure 3, Table 3), and attitudinal shift toward the respective disciplines, obtained through our pre-course, RPTP, and post-course surveys. First, we discuss the differences between the results from the pre-course and the RPTP surveys, and second, we present a comparative analysis of the post-course and RPTP survey findings.

Figure 1 shows that in some categories students had overrated themselves as we had mentioned in the methodology section; however, the occurrence and extent of overrating were not the same in all four courses. The anthropology instructor opted out of the RPTP survey at the end of the semester as the overrating was not apparent in the pre-survey section evaluating knowledge of the research process. Very few studies exist of the pre-conceptions students bring regarding the research process, the skills needed, and the learning they can expect in a research experience; more studies are needed so as to understand the role of developing student self-efficacy in learning. Adedokun and Burgess (2011) have attempted to draw some conclusions regarding research internships in chemistry, but few scholars have examined research and inquiry embedded within courses.

*Findings on research skills.* Figure 1 displays the occurrence and extent of the students' overrating of their prior knowledge of the research process in the four disciplinary courses. Interestingly, the highest level of student overrating (average Likert score >3) was observed in chemistry and immunology, compared to anthropology and English, (Figure 1), raising an interesting question as to whether students in general feel that they "know" the research process in the sciences better than the processes of inquiry in the humanities and social sciences. Research in chemistry general education courses seems

**Figure 1. Student Survey Responses Regarding the Research Process**



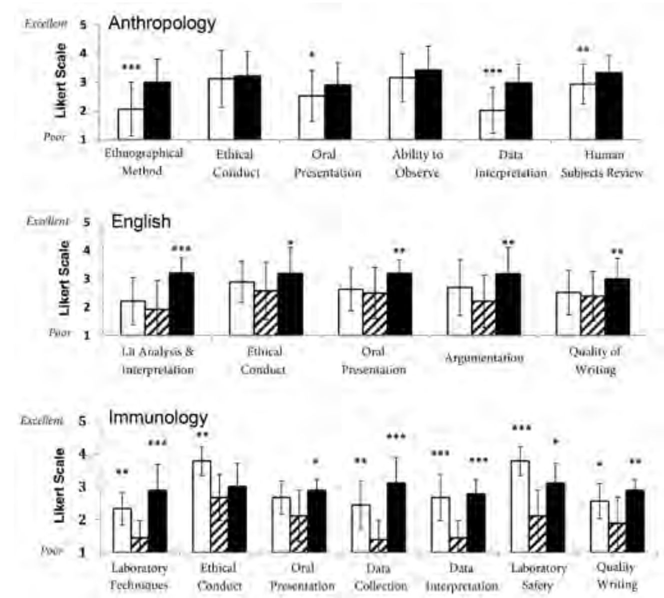

*Questions asked in pre-course (open bars), RPTP (striped bars), and post-course surveys (filled bars): Rate on a scale of 1-4 your knowledge about: how scientists work; how scientists think; usage of primary literature; research process; integration of theory and practice/application of concepts to literature, participation-observation; cultural contextualization; theoretical concepts; and comparative engagement. Data are presented as mean ± standard deviation. *,**,*** P<0.05, <.01 and <0.001, respectively, compared to RPTP- or post-survey responses (student t-test).*

to suggest that overrating of prior knowledge is a continuing problem and that the accuracy of knowledge estimation decreases as the academic excellence of students drops (Bell and Volckmann 2011).

Whether the overrating by the chemistry students occurred because they were academically poor, overconfident students or as a result of a multitude of other factors, is not clear. In contrast to Bell and Volckmann's (2011) study, our immunology students, belonging to a group of excellent, very motivated, and driven students, overrated their initial knowledge as well.

Unlike the more commonly known "scientific method," research methodologies in the humanities are generally regarded as being "not transparent," which in conjunction with the density of the theoretical literature and lack of consensus on the process of research inquiry, perhaps explains why fields such as English studies have been slow

**Figure 2. Student Survey Responses Regarding Research Skills**

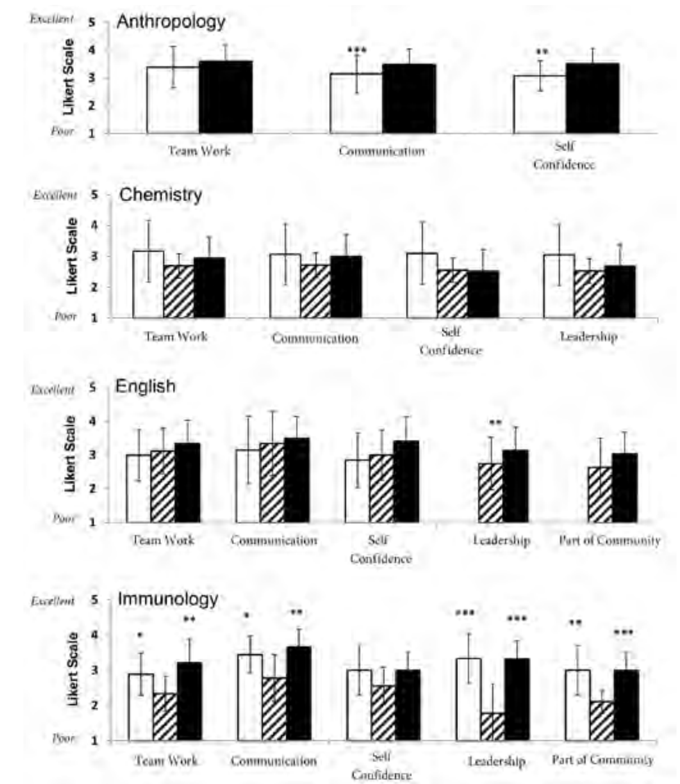



*Questions asked in pre-course (open bars), RPTP- (striped bars), and post-surveys (filled bars): Rate on a scale of 1-4 your knowledge about: ethnographical method /techniques of literary analysis and interpretation/laboratory techniques; ethical conduct; oral presentation; ability to observe/data collection; data interpretation/ argumentation; human subjects review/laboratory safety; and quality of writing. Data are presented as mean ± standard deviation. *,**,*** P<0.05, <.01 and <0.001, respectively, compared to RPTP- or post-survey responses (student t-test)*

to embrace undergraduate research (Grobman and Kinkead 2010). Consistent with that idea, we noted that data from the pre-course survey of students in anthropology (average Likert score of 2.5) showed that they did not overrate themselves on questions about the research process. However, this result might also be attributed to the discipline-specific language used in the anthropology and English surveys. For instance, had the anthropology survey asked students to rate themselves on "knowledge of the research process" instead of on "knowledge of the ethnographic research process," we suspect students would have overrated themselves just like students in the science courses.

Comparison between the pre-course and the RPTP surveys (Figure 1) showed that our decision to revise the methodology to incorporate the RPTP survey in our study enabled us to evaluate student perceptions with greater accuracy, but not in all disciplines. Results from students in English and immunology showed highly statistically significant differences (p<0.001) between the pre-course and RPTP surveys, suggesting that these students had entered the classes overconfident about their initial knowledge of the research process; and yet, there were no differences in chemistry (Figure 1). As mentioned before, the nature and diversity of the student population in the general education chemistry course—that is, the potential presence of overconfidence and low motivation in these students—might have contributed to this anomaly. Since it was

**Figure 3. Student Survey Responses Regarding Collaborative Learning**




*Questions asked in pre-course (open bars), RPTP (striped bars), and post-course surveys (filled bars): Rate on the scale of 1-4 your knowledge about: team-work skills; communication skills; self-confidence; leadership skills; becoming a part of interpretive or laboratory community. Data are presented as mean ± standard deviation *,**,*** P<0.05, <.01 and <0.001, respectively, compared to RPTP- or post-survey responses (student t-test).*

also the first time the instructor was implementing the POGIL model and the case study teaching methods in this large general education class, it made the project even more complex.

Comparison of the post-course and the RPTP survey data clearly showed the highest statistically significant differences on all questions concerning the research process in English and immunology (Figure 1), indicating that the students felt they had learned a great deal once they reflected upon their initial overratings. Comparison of the pre- and the post-course survey data in anthropology (Figure 1) showed a similar trend, except for the questions on how scientists think and work. Those two questions had been given a high Likert score of 3 in the pre-course survey, suggesting that student overrating may have occurred in this course as well.

Although General Chemistry I and Introduction to Anthropology are both general education courses with a less advanced, non-major student enrollment, they showed markedly different results. We attribute those to a number of factors: the difference in class size, the discipline-specific wording of the survey questions in anthropology, greater student choice of projects in anthropology versus chemistry, and the differences in the disciplines themselves with STEM (science, technology, engineering, mathematics) courses perhaps being rated as "more difficult" by students. Clearly more research is needed to draw definitive conclusions.

*Findings on research skills*. Similar to our results from students' assessment of their prowess in the research process, students also overrated their research skills in English and immunology (Figure 2). Comparison of pre-course and RPTP survey responses showed significant differences in immunology, but not-so-significant differences in English, suggesting perhaps that English students, being more experienced juniors and seniors compared to less advanced immunology students, had better judged their initial research skills when entering the class.

In all the categories evaluated of the research skills section of the English post-course survey, the responses were significantly higher compared to RPTP survey responses (Figure 2). Similar results were observed in anthropology and immunology. Yet student perceptions of their knowledge of how to ensure ethical conduct in research showed few or no statistically significant differences in anthropology, English, and immunology (Figure 2). Either the students did not recognize the importance of such ethical conduct in these areas, or across the board felt that they already "knew" everything they needed to know about ethics.

*Findings on collaboration skills*. Compared with knowledge of the research process and research skills, students ranked their collaboration skills the highest (Likert scale score average of 3) across the board in the pre-course survey (Figure 3). Even though the RPTP survey "correction" significantly reduced overrating among students in immunology for a majority of the questions in this section of the survey, it did not show significant differences in chemistry and English (Figure 3). Post-course survey data showed significant gains in students' perceived skills in collaboration in the immunology and anthropology classes, with no effect, in general, in chemistry and English (Figure 3), although in the qualitative data most English students mentioned learning about certain aspects of collaborative learning, including better time management and communication skills.

*Attitudinal shift toward the disciplines*. Attitudinal shift toward research in the respective disciplines was measured by asking questions about students' interest in conducting future research, and their perception of the importance of research for their careers. While immunology students expressed significantly higher interest ($p<0.001$) in involvement in future research in the post-course survey compared with the pre-course survey, no differences were observed in the other courses. The students entering all four courses felt that research experience is very important for their future careers (average Likert score >3). However, no significant change in that perception was observed in the post-course survey (data not shown).

**Table 1. Students' Responses to "List the new things you learned in this class about doing research in your discipline."**

| Course (total number of responses) | % Positive Responses - Most frequent responses | % Neutral/ Negative Responses |
|---|---|---|
| Anthropology (n=126) | 96.8<br>- Ethnographic research process<br>- Observation | 0/3.2 |
| Chemistry (n=71) | 91.5<br>- New techniques<br>- Data collection and interpretation | 0/8.5 |
| English (n=75) | 93.3<br>- Usage of research databases, specifically for English<br>- Application of new theories to read old literature /application of theories to anything you do | 0/6.7 |
| Immunology (n=28) | 100.0<br>- Laboratory techniques<br>- Importance of statistical analysis of data<br>- Patience | 0/0 |

**Table 2. Students' Responses to "List new things that you learned in this class about working in a group for doing research in your discipline."**

| Course (total number of responses) | % Positive Responses - Most frequent responses | % Neutral/ Negative Responses |
|---|---|---|
| Anthropology (n=115) | 95.7<br>- Constant and clear communication<br>- Everyone in a team must contribute<br>- Importance of different view points<br>- Adjusting different schedules | 1.7/2.6 |
| Chemistry (n=70) | 88.6<br>- Learned to work in a team<br>- Communication skills | 0/11.4 |
| English (n=74) | 95.9<br>- Communication skills<br>- Time management<br>- Delegation of work load<br>- Learned to work in a team | 0/4.1 |
| Immunology (n=31) | 100.0<br>- Realization about different strengths in different people<br>- New perspectives<br>- Opening up freely and bouncing ideas<br>- Becoming very close to your team members<br>- Adjusting different schedules | 0/0 |

*Qualitative data analysis*. The qualitative data, obtained along with the post-course surveys, included three open-ended prompts asking students to list three new things they had learned in the course regarding the research process (Table 1), working in a group (Table 2), and how the research experience affected their attitude toward the discipline (Table 3).

Analysis showed that the majority of students' responses regarding the research process (Table 1) and collaborative learning experiences (Table 2) were overwhelmingly positive in all courses (an average of 95 percent positive). Whereas the quantitative survey data had not shown consistent support for a positive attitudinal shift toward the discipline (except for the immunology students), the qualitative data clearly showed that the shift had occurred, with 95 percent, 95 percent, 54 percent, and 100 percent positive responses among students in anthropology, English, chemistry, and immunology, respectively (Table 3). Once again, chemistry was unique; the positive responses were the lowest (54 percent), and yet, 26 percent of the additional responses were neutral, not negative, regarding the discipline.

**Table 3. Students' Responses to "Describe how the research experience in this course affected your attitude towards your discipline."**

| Course (total number of responses) | % Positive Responses - Most frequent responses | % Neutral/ Negative Responses |
|---|---|---|
| Anthropology (n=79) | 94.9<br>- Respect for anthropologists' work<br>- Gained new perspective/clarified how anthropologists work | 3.8/1.3 |
| Chemistry (n=46) | 54.3<br>- Appreciate and understand chemistry more<br>- Broader perspective of real world application of chemistry<br>- Course is more interesting with using research experience | 19.6/26.1 |
| English (n=21) | 95.2<br>- Intensified love for English<br>- Acquired great knowledge and skills<br>- Positively impacted and broadened view about English and its applica tion in different areas | 0/4.8 |
| Immunology (n=15) | 100.0<br>- Gained confidence about the right choice for major<br>- Increased appreciation of science and admiration about scientists' work | 0/0 |

## Conclusions and Recommendations

In summary, three major conclusions can be drawn from our study on the impact of undergraduate research in two contexts, within courses in a general education curriculum and in two majors. Two of our conclusions were drawn from our students' perceptions, while the third emerged from reflections on our year-long collaboration through a faculty learning community.

There is little or no doubt that engaging students in discipline-specific research impacts their perceptions of their learning very positively for the most part. It is important to note, however, that quantitative analysis, without qualitative data, may not be sufficient for a complete understanding and evaluation of students' perceptions of their learning. Our quantitative data, while providing us with valuable information regarding student perceptions of their growth, were complex and at times, broadly inconclusive. The qualitative data, on the other hand, captured some of the nuances of the students' perceptions.

As seen in the summary analysis of our qualitative data (Tables 1-3), students appreciated their learning about the research process, recognized the importance of the methodology, and gained an enhanced sense of their competence in skills such as data collection, analysis, use of primary and secondary sources, and team work. Even in chemistry, where we had obtained the most complex results, students' comments on open-ended questions were mostly positive or at least neutral. Our most complicated data involved the students' misperceptions of their own knowledge and abilities, an area that clearly requires further research and perhaps replication of the study to confirm the results before any conclusive recommendations can be made for instruction.

Our second significant conclusion is that incorporating a research project in a general education course requires serious attention and broad clarity of purpose within the entire program. In our study, students in anthropology and chemistry, both general education courses, had difficulties quite different from those in the English and immunology, courses, which were electives within the respective programs for majors. Anthropology students, for instance, felt that they did not have enough training in methodology to be able to formulate a research question and gather the data for an ethnographic study. In the chemistry course, in order to include the research skills in the course, the instructor focused classroom time on those and gave students access to lectures online—a strategy that seemed to throw students off who did not immediately understand the advantages. Other issues in these general education courses included large class size, a feature of general education on many campuses, making it more challenging to bring students along in the process of learning. On the other hand, when the course was an elective and the class size was smaller, as was the case in the English and immunology courses, even if students from other related majors took the course, the overall student attitudes toward research were positive, realistic, and highly appreciative.

Finally, the process of conducting this study, planning the courses, analyzing the results, and reflecting on the whole experience, was supremely effective for the learning of every member of our group. As members of a learning community, we reaped all the benefits described by those who have studied FLCs (Cox and Richlin 2004). In addition, we have learned to appreciate multiple approaches to research-intensive pedagogies in our different disciplines and learned how to engage in cross-disciplinary conversations about teaching and learning. We discovered a mutually supportive community to discuss our teaching and learning experiences, appreciated the commonalities in students' learning outcomes across disciplines through formulating a common tool for assessment, and broadened our understanding of research design and inquiry in the different disciplines.

For other institutions that are considering incorporating undergraduate research into courses or incorporating research into courses in new ways, we recommend the following. First, create a faculty learning community from a small group of dedicated faculty from several disciplines who can work together over a whole year and learn to trust one another. Second, encourage them to create a collaborative assessment tool that includes both quantitative and qualitative data collection, through which comparisons across disciplines can be made. As we have shown, such a process can enhance faculty engagement and student learning experiences.

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**Marina Cetkovic-Cvrlje**
St. Cloud State University, mcetkoviccvrlje@stcloudstate.ed


*Marina Cetkovic-Cvrlje is a professor of immunology who earned her MD and PhD in cell and molecular immunology at Medical School, University of Zagreb, Zagreb, Croatia. Since 2006 she has taught senior level biomedical sciences/biotechnology classes at St. Cloud State University, St. Cloud, Minnesota, such as immunology, hematology and the capstone course in pathophysiology. She has mentored over 90 students in conventional undergraduate, faculty-mentored, authentic immunology-based research (type 1 diabetes immunopathogenesis) offered fall, spring and summer terms since 2006. She has been a strong advocate for undergraduate research and served as a founder and facilitator of the faculty learning community on early involvement in undergraduate research.*

*Latha Ramakrishnan is an associate professor of biochemistry, with a PhD in chemistry from the Indian Institute of Science, India. Since 2006 she has taught introductory level general chemistry, andsenior level biophysical chemistry and biochemistry classes, as well as engaging with five to ten undergraduate students per year in collaborative interdisciplinary research projects. She has implemented traditional as well as contemporary teaching methodologies, such as case study teaching and guided-inquiry learning, in all her teaching assignments, and co-designed the faculty learning community on undergraduate research with Marina Cetkovic-Cvrlje.*

*Shumona Dasgupta is an assistant professor of English who earned her PhD in English and postcolonial studies from Stony Brook University (SUNY). Her current project focuses on issues of representation while exploring the intersections between violence and subjectivity in contemporary South Asian literature and film. Since 2009, she has taught upper division courses on modern and contemporary British literature, global Anglophone literature, critical theory, and introduction to English studies at St. Cloud State University. She is an advocate for incorporating more inquiry-based learning and research-intensive experiences in English literature courses at the undergraduate level.*

*Kelly Branam is an associate professor of anthropology who earned her PhD in anthropology from Indiana University. She is a cultural anthropologist with major interests in political and legal anthropology; her geographical focus is native North America. Since 2008, she has taught lower and upper level anthropology undergraduate and graduate courses at St. Cloud State University. She has designed several undergraduate applied anthropology courses providing hands-on experiences to her students. In addition, for the last five years, she has co-directed an anthropology summer field school where she teaches ethnographic and applied field methods.*

*Lalita Subrahmanyan is director of St. Cloud State University's Center for Excellence in Teaching and Learning (CETL) and professor of elementary and middle level education. As director of CETL, she founded the Faculty and Professional Learning Communities initiative and is the program director. Her areas of research interest have included gender and the sciences, curriculum and instruction, middle level education, and multicultural education; she has made several national and international presentations. As a professor in a teacher education program, she was a strong advocate for constructivism and inquiry-based learning.*





Susan F. Hirsch, Ned Lazarus, Andria Wisler, Julie Minde, Gina Cerasani,
*George Mason University*

CUR Focus

# Pursuing Research Through Focus Groups:
## A Capstone Experience Meets Disciplinary, General Education Goals

In four class meetings of a general education capstone course, students at George Mason University's School for Conflict Analysis and Resolution (S-CAR) learned to design, conduct, analyze, and present focus-group research—all by studying their fellow undergraduates.

This activity simultaneously familiarized students with skills for facilitating focus groups—skills valued in academic and professional settings—while also providing effective, experiential training in a research protocol.

In post-activity evaluations, students and instructors decisively affirmed that the activity had enhanced students' in-class engagement, as well as achievement of the course's learning objectives. Three initiatives had sparked the development of this versatile assignment: 1) the university's learning objectives for general education, which include developing interdisciplinary and critical thinking in the context of a capstone course; 2) a university-wide project to foster a culture of student scholarship that encourages courses in which undergraduates create and present original scholarly projects; and 3) a research project funded by the Fund for the Improvement of Postsecondary Education, titled "Linking Theory to Practice," through which our project team develops, tests, and disseminates experiential-learning activities designed to enhance teaching of conflict analysis and resolution.

Thus, on one hand, the focus-group experiential learning profiled in our article, formally called Engaging Students Through Focus Group Methodology, is the result of a unique confluence of initiatives at George Mason University. On the other hand, however, we are convinced that this research activity can be used in many different upper-level general education courses. Moreover, by involving students in lower-level courses as participants in the focus group, the activity contributes to scaffolding research experiences into either general education or disciplinary courses—or both—and affords advanced students the opportunity to apply theory-driven research to practical issues and problems. This article provides an overview of the activity and its original inspiration, a step-by-step description of the instructional process, preliminary evaluation results, and ideas for adaptation to other courses and disciplines. We hope that this discussion will inspire *CUR Quarterly* readers to adopt such an activity in a diverse range of fields.

### Background

Since the 1930s, the focus group has been a popular method of qualitative research, used by academics, health professionals,

*George Mason University students conducting a storyboard workshop with Job Corps student leaders. (Photo credit: RJ Nickels)*

evaluators, literacy activists, the military, practitioners working to achieve peace, and, especially, market-research professionals (Krueger and Casey 2009; Flores and Alonso 1995). Given its widespread use in and outside the academy, focus-group research is a valuable skill for students to acquire before they enter the labor market. At George Mason University's School for Conflict Analysis and Resolution (S-CAR), our newly designed experiential-learning activity is providing undergraduates with a hands-on introduction to this powerful research tool. The activity has achieved promising results in enhancing students' academic engagement and acquisition of research skills. Since the activity was designed to meet both disciplinary and general education objectives, it is inherently versatile and adaptable for research on almost any topic.

A focus group is an organized, facilitated discussion designed to enable researchers to better understand the range of opinion among target groups of people about an issue, product, or service. The researcher acts as a moderator, listener, observer, and analyst who must pay equal attention to the content of participants' comments and the dynamics of the conversation (Stewart et al. 2007). The format encourages spontaneous discussion among participants, which allows the researcher to take a less directive role in comparison to one-on-one interviews. In order to identify patterns in participants' perceptions and opinions, researchers typically conduct multiple focus groups on the topic of interest and examine the data afterward using a variety of quantitative and qualitative techniques. Widely used in many contexts, focus groups are well suited to the field of conflict analysis and resolution because they are an effective method for airing diverse and divergent perspectives on potentially controversial topics. As just one example, Mercy Corps, a non-governmental organization, uses focus groups in Pakistan to assess the extent and type of conflict experienced by young people (Mercy Corps 2010).

Our experiential activity introduces students to this research method through readings, class discussion, and a model focus group conducted in class by a veteran facilitator. Once trained, students practice the techniques they have witnessed on one another and then conduct a focus group with student participants from a different course. Finally, the focus-group leaders jointly analyze the data collected and present findings on their chosen topic. To date, 147 S-CAR students in three capstone courses and an intensive service-learning course have participated in the activity.

At George Mason, undergraduates can major or minor in conflict analysis and resolution, a growing interdisciplinary field that emphasizes the integrated study of theory, research, and practice. Through coursework and field experience, students learn to take a critical and holistic approach to analyzing complex problems at multiple levels of society. At the same time, they are exposed to a variety of conflict-resolution techniques, such as mediation, dialogue facilitation, and negotiation, and then afforded the opportunity to practice them. The 30 diverse courses offered by the School for Conflict Analysis and Resolution cover topics ranging from organizational conflict to human rights to peace-building and are available not only to its 219 majors and 61 minors but also to the larger student body of more than 20,000 undergraduates. Each semester, dozens of non-majors join S-CAR students in two course offerings—one introductory and one capstone—that fulfill the university's general education requirements.

Given its practice-based nature, the field of conflict resolution has displayed a commitment to experiential and inquiry-based learning since its inception (Smith 2007). Innovative approaches to teaching, such as student-centered research, role playing, simulations, and community-based course projects, are hallmarks of the curriculum for teaching conflict analysis and resolution. Based on this tradition of experimental pedagogy, our activity was conceived of as an opportunity for capstone research that would serve multiple disciplinary and general education objectives.

## Capstone Required

At GMU, all upper-level undergraduates must complete a capstone course in which they synthesize knowledge gained through their general education courses. Specifically, our focus-group activity was created for "Integration," the capstone course for students majoring in conflict analysis and resolution. This capstone, which also serves as a capstone for general education, challenges students to synthesize diverse forms of knowledge and to apply theory learned through prior coursework to real-world problems. Given those objectives, S-CAR's capstone has always included an individual research project to prompt students to draw connections across their studies. Three initiatives sparked the addition of the focus-group activity to "Integration" in the fall of 2011.

First, GMU has recently reinvigorated its general education offerings by creating new learning goals. The new goals for the capstone course in general education emphasize critical thinking and effective oral and written communication. The goals say that by the end of the course, students should be able to "connect issues in a given field to wider intellectual, community or societal concerns using perspectives from two or more disciplines." (A description of GMU's general education requirements can be found at: http://provost.gmu.edu.) S-CAR faculty perceived these new goals as inviting innovative, interdisciplinary approaches to gathering data, analyzing it from multiple perspectives, and offering conclusions or recommendations tailored to particular audiences in and beyond the academic community. Most students enrolling in the S-CAR capstone are majors or minors in conflict analysis and resolution, although the course also attracts students from other majors, such as global affairs and psychology, who are seeking a general education capstone. The result is a dynamic interdisciplinary environment for student learning in which a new kind of research experience could be piloted.

Second, as part of regional accreditation requirements, GMU embarked in 2012 on a university-wide initiative to foster a culture of student scholarship. Called "Students as Scholars," the five-year initiative offers incentives for many forms of curricular innovation, including emphasis on scholarship in introductory general education courses; attention to the techniques of knowledge production (e.g., research methods) in each discipline; and opportunities for students to create and present original scholarly projects. (A description of GMU's "Students as Scholars" initiative can be found at: http://oscar.gmu.edu.) Providing an individual research opportunity for every student can be a tall order for a large state university. For instance, as the S-CAR undergraduate program grows, the supervision of individual research projects in the "Integration" course has become a significant challenge. The university's "Students as Scholars" initiative thus provided S-CAR faculty with a welcome opportunity to design a group research project that would engage students in an original scholarly creation without straining faculty capacity.

Third, in 2011 S-CAR faculty procured a grant from the United States Department of Education's Fund for the Improvement of Postsecondary Education (FIPSE) for a three-year curriculum-development project titled "Linking Theory to Practice: Conflict Analysis and Resolution Pedagogy." The project aims to improve students' ability to apply conflict resolution and other theories to practical problems through experiential-learning activities in the classroom and intensive service-learning courses taken off-campus. Our focus-group activity is one of eight experiential-learning activities designed and tested by the project's team of S-CAR faculty and students. The experiential activities are embedded in the syllabi of existing courses in conflict analysis and resolution, with the goal of enhancing the kinds of student learning central to linking theory to practice, including critical thinking, facilitation skills, and analytic techniques. The project team also adapts and disseminates the experiential activities to partners at community colleges and universities.


*George Mason University students and faculty standing outside the Job Corps facility in Charleston, WV. They are discussing the focus group that they are about to conduct with Job Corps student leaders. (Photo credit: RJ Nickels)*

Designing a classroom exercise with multiple curricular aims in mind carries the risk that the end product might be overly complicated or could fall short of meeting one or another of the course's aims. The creators of our focus-group activity therefore sought to keep the activity simple and clearly organized, yet flexible with respect to content. The primary goal is to involve students in an engaging research experience.

## A Step-By-Step Description of the Activity

The focus group exercise proceeds through a sequence of activities undertaken over four consecutive class periods, as noted above. In preparatory sessions, an experienced instructor introduces students to focus-group methodology and leads a discussion of best practices for each of the primary roles of participants in focus groups: facilitator, note-taker, host, and research subject. The instructor emphasizes that the focus-group activity is actual research, and students work collaboratively to devise research questions that build on existing scholarship. Students then participate in a mock focus group led by the instructor, who uses "time-outs" to highlight and unpack the challenges characteristic of focus groups, such as what to do if no one speaks up and how to respond to humorous or provocative comments.

Working in small groups, students choose topics; brainstorm, design, and pilot questions; assign and practice roles; and create informed-consent procedures for participants. Colleges and universities vary with respect to policies requiring informed consent for research projects undertaken as part of a course, rather than as a contribution to scholarship. In our case, we acquainted students with the institutional review process, including informed-consent procedures, which they followed in conducting the focus-group research. These preparations culminate in the students conducting 45-minute focus groups with undergraduates from other courses.

The first instructors to use the focus-group exercise chose "social media and conflict" as the overarching research topic. Students' specific research interests were wide-ranging. Some students investigated undergraduates' perspectives on whether social media should be banned in educational settings and the extent to which students are politically active through social media. Another team conducting research on social media as a catalyst for interpersonal conflict asked participants such questions as: "What are some examples of proper social media etiquette?" "Improper social media etiquette?" and "How do social media interactions impact in-person encounters?"

In analyzing their data, student researchers identified themes and trends; they also puzzled over and ultimately made sense of ambiguous remarks and divergent perspectives (e.g., gender differences in approaches to social media) to arrive at tentative answers to their research questions. In instances in which research findings pointed toward a persistent problem, students developed recommendations addressing the source of the problem. For instance, when they concluded that social media had many negative effects on interpersonal relationships, the students recommended the development of a "new user tutorial" to urge responsible communication. The students' reporting of findings and recommendations to classmates through brief PowerPoint and oral presentations included opportunities for constructive criticism and reflections on the research process.

## Evaluating Students' Experiences

Every activity produced by S-CAR's experiential-learning project is thoroughly documented, assessed, and revised. Accordingly, the project team employs multiple methods to gather data on the focus-group activity each time it is used in a classroom, including pre- and post-activity surveys of students, audio and video recordings, debriefing discussions with instructors, and review of student assignments.

Prior to beginning the activity, the project team collected baseline data on students in the capstone course by using a survey to assess students' familiarity with focus groups, their confidence in their skills related to the activity, and their opinions on social media and conflict. A similar survey was administered after the students conducted the focus groups. The post-survey asked students to rank the activity as a learning and skill-building experience, to reflect on their level of engagement in comparison to typical class formats, and to offer feedback on the design and content of the activity. The surveys were anonymous; however, a generalized identity marker (e.g., date of birth) allowed for before/after comparison.

Students found the activity highly engaging and effective in terms of building practical skills. An overwhelming majority of student respondents (90 percent) rated the activity as a "good" or "excellent" learning experience and as an "engaging" or "highly engaging" classroom activity. A similar number of respondents also described the activity as enhancing their skills in facilitation and in appreciating the perspectives of people whose views might differ from their own, and they reported gaining confidence in their ability to conduct future focus groups.

Students' qualitative responses reinforce these positive impressions. When asked to choose three to five words to describe the activity as a learning experience, the most common responses were "interesting," "enjoyable," "engaging," and "practical." When asked for open-ended feedback, one student expressed a widely shared sentiment this way: "It was very engaging. I felt very interested the entire time. I enjoyed talking to the [focus group] participants and listening to their views and opinions. I believe that what I learned from the focus group project, I will be able to use in the future many times." Another student said that the activity enhanced her openness to opinions, her listening skills, and her patience. As she remarked, "We had to use all three while asking follow-up questions and listening to all participants' opinions."

Students shared critical feedback as well. They expressed concerns about the amount of course time devoted to the activity and the topical relevance of the activity to the course. Critical feedback centered almost entirely on the secondary aspects of course structure and topical content, rather than the design of the activity. These preliminary findings will be refined through additional data collection and analysis. Based on the initial evaluations, the activity will be implemented again with attention to integrating it more directly into the course's themes and structure.

## Adapting the Focus Group Activity Elsewhere

In June 2012, the project team's members adapted the focus-group activity for an off-campus, intensive service-learning course. In preparation, eight GMU undergraduates underwent the focus-group training used in the capstone course. Then the students used focus groups in their service-learning work at a federal Job Corps facility in Charleston, West Virginia. The GMU students conducted focus groups with Job Corps student leaders in order to learn about the types of conflict at the facility. Drawing on the focus-group data, they designed training in techniques for conflict resolution that they provided to the Job Corps student leaders.

The GMU students were responsible for all aspects of the Job Corps work—from generating research questions, to conducting focus groups with student leaders, to analyzing the results and designing appropriate training. The GMU students skillfully facilitated the focus groups, asking open-ended questions and establishing a rapport with the Job Corps students, who spoke in detail about their experiences of conflict. The rich narratives and diversity of perspectives obtained through the focus-group research allowed the GMU students to choose appropriate topics for the subsequent training sessions. For example, when the Job Corps students reported feeling trapped in repetitive cycles of conflict, the GMU students elected to introduce them to "storyboarding," which offers people embroiled in conflict a method for jointly identifying moments when an intervention might improve the outcome.

In post-course evaluations, the focus-group activity was rated as "excellent" by the GMU students. In debriefing discussions, Job Corps students said that they found the activity engaging and helpful. The enthusiastic response of the Job Corps students was gratifying to the GMU students, who were surprised to witness the transformative power of the questions that they asked. The students discovered that the focus-group discussion led their Job Corps counterparts to think about ways in which conflicts—at the facility and in their lives—might be resolved more constructively. The Job Corps administrators were so pleased with the experience that they took steps to initiate an ongoing relationship with the project team and GMU.

We are convinced that our focus-group activity can be used in many different contexts, including a variety of upper-level general education courses. The topic we used—social media and conflict—is integral to the contemporary undergraduate experience and directly linked to teaching core ideas in the conflict resolution field. Yet it is also inherently relevant to multiple disciplines. As the experience at Job Corps demonstrated, our focus-group activity can incorporate thematic content of any kind, just as focus groups are used in practice to study perspectives on a vast spectrum of subjects. As a testament to the multiple uses of the focus-group activity, one GMU instructor had students use it to assess their experiences with a course assignment. She then drew on the insights gained to improve the assignment for future courses.

The focus-group research experience affords a wide range of students the opportunity to apply theory-driven research to practical issues and problems. By involving students in lower-level courses as participants in the focus group, the activity also contributes to scaffolding research experiences into general education and/or disciplinary courses. Further implementation information is available in the Instructor Guide on the project website at http://scar.gmu.edu/experientiallearning-project/home.

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**Susan F. Hirsch**
shirsch4@gmu.edu

*Susan F. Hirsch, a cultural anthropologist, is a professor in the School for Conflict Analysis and Resolution (S-CAR) at George Mason University. She is the principal investigator for the curricular-development project supported by the U.S. Department of Education's Fund for the Improvement of Postsecondary Education (FIPSE) described in this article. Hirsch has published, among other topics, on Islam and law in east Africa, sociolinguistic and feminist theory, and law as a response to mass violence. With Frank Dukes, she is the author of Divergent Views of Mountaintop Mining in Appalachia: Changing Stakeholders in Environmental Conflict. Hirsch is currently conducting research on several initiatives related to global justice.*

*Ned Lazarus is a FIPSE-funded postdoctoral research fellow at George Mason University's School for Conflict Analysis and Resolution. His research focuses on conflict analysis and resolution, evaluation, experiential learning, peace education, and the Israeli-Palestinian conflict. He earned his doctorate at American University's School of International Service in 2011. His dissertation was a study of the long-term impact of the Seeds of Peace program, inspired by his work as the organization's program director for the Middle East, based in Jerusalem from 1996 to 2004. Lazarus has served as an advisor, evaluator, and facilitator for numerous Israeli-Palestinian peace-building initiatives, and he is currently leading a developmental evaluation of U.S. Agency for International Development-sponsored "people-to-people" reconciliation projects in the Middle East.*

*Andria Wisler is the director of the Center for Social Justice at Georgetown University. Wisler is the external evaluator for the FIPSE-funded project "Linking Theory to Practice." She is co-editing a volume on peace education evaluation (Information Age 2013) and writing an introductory textbook for peace and conflict studies (Routledge 2013). Her research and teaching are in the fields of peace education, conflict studies, and international educational development, and her principal interest lies in the transformative potential of educational initiatives in post-conflict societies and for girls living in urban poverty.*

*Julie Minde completed a master of science degree at George Mason's School for Conflict Analysis and Resolution (S-CAR) in 2011 and currently is a PhD student and graduate research assistant there. Her master's thesis examined how asymmetric identity politics affected the environmental crisis in the Aral Sea region. Her doctoral research focuses on how geospatial techniques can be used as part of confidence-building measures between parties to conflicts. She also received a master's degree in geographic and cartographic sciences from GMU in 2008 and a master of art in Russian language and literature from the University of Iowa in 1997.*

*Gina M. Cerasani is a PhD candidate in the School for Conflict Analysis and Resolution (S-CAR) at George Mason University. She teaches courses on community, group, and organizational conflict in the school's undergraduate program. She has developed classroom modules in simulated community conflict and is a member of S-CAR's Undergraduate Experiential Learning Project (UELP). In summer 2012, she co-led the GMU service-learning project at a Job Corps site in West Virginia. Her research and practice interests include conflict discourses and positioning, immigration, experiential learning and empathy, and community conflict resolution.*

# CUR Focus

Patricia J. Pukkila, Martha S. Arnold, Aijun Anna Li,
Donna M. Bickford, *University of North Carolina at Chapel Hill*

## The Graduate Research Consultant Program:
### Embedding Undergraduate Research Across the Curriculum

In an editorial in the *New York Times* in 2011, Gary Gutting, a professor of philosophy at the University of Notre Dame, argued that the primary role of universities is to "nourish a world of intellectual culture; that is, a world of ideas, dedicated to what we can know scientifically, understand humanistically, or express artistically." At research universities, faculty members are expected to make substantial contributions to their disciplines, to society, and to educating students. They want to see undergraduate students progress from novice-like behaviors to more expert-like understanding and appreciation of the intrinsic value of their disciplines. However, some faculty members find it difficult to expose students to authentic research and scholarship without support. The Office for Undergraduate Research (OUR) at The University of North Carolina-Chapel Hill sought to create a simple and flexible model to support faculty in making incremental changes in their courses so that student inquiry and research could become substantive components of their classes. Accordingly, we created the Graduate Research Consultant (GRC) program in 2003 (Pukkila et al. 2007).

The GRC program provides instructors with advanced graduate students (the GRCs) whose assistance makes it possible to turn course assignments into robust research projects. The primary role of the GRCs is to assist the undergraduates as they plan, carry out, and disseminate the results of their projects; GRCs do not evaluate the students' work. GRCs help undergraduates frame questions appropriate for the discipline, design and conduct original investigations, and report their findings to the class and sometimes also the broader community in oral or written form. The graduate students are paid for 30 hours of work during the semester at the standard hourly rate for teaching assistants. Faculty members select their own GRCs. Some faculty members have recruited GRCs from outside their home departments to take advantage of GRC expertise in specific research methods or to provide interdisciplinary perspectives for students.

The pedagogical framework for the program is that of inquiry and discovery (Boyer 1998; Alberts 2000; Pukkila 2004; Justice et al. 2007; Lee 2011). Each course shares common practices: Students learn and apply disciplinary-specific research methods to questions of interest and present the results of their research; the GRCs serve as research consultants or coaches for the students; and the faculty member teaching the course collaborates with the GRC. Within these general guidelines, however, each course differs based on the research practices of the field and the subject matter and level of the course. The program is exceptionally flexible, adaptable to any discipline, and embeds research and inquiry-based learning across the undergraduate curriculum. It benefits the undergraduates who are exposed to the research experience, the graduate students eager to further their professional and pedagogical development, and the faculty who are interested in including an inquiry-based research component in their courses.

The research projects and products produced by students in GRC-supported courses vary according to the specific course design. Table 1 provides examples of the courses in several disciplines that have used the GRC program. The GRC program has become a very effective strategy for embedding inquiry-based education into the curriculum and has now involved more than 19,000 undergraduates in nearly 650 courses. Further program statistics are available at: http://www.unc.edu/depts/our/pdfs/GRC_statistics.pdf. The GRC program has been used extensively by faculty teaching in our First-Year Seminar Programs, in general education courses, and in upper-level special topics courses. Increasing numbers of students introduced to research through these GRC-supported courses go on to take research-intensive courses in their major (see Assessment below).

**Table 1. 2011-12 GRC Courses: First Year Seminars and 100 & 200 Level Courses**

| Course Number | Course Name |
|---|---|
| AMST 277H | Globalization and National Identity |
| ANTH 089 | Public Archaeology in Bronzeville |
| ANTH 120 | Anthropology through Expressive Culture |
| ANTH 248 | Public Anthropology |
| ART 055H | Art, Gender and Power in Early Modern Europe |
| ART 089 | Druid Culture |
| ART 150 | World Art |
| ART 270 | Early Renaissance Art |
| ART 79 | Meaning and the Visual Arts |
| ASIA 051 | Cultural Encounters: Arabs and the West |
| BIOL 101H | Principles of Biology |
| BIOL 065 | Pneumonia and Flu |
| CHEM 190 | Special Topics in Chemistry |
| CHEM 070 | First-Year Seminar: You Don't Have to Be a Rocket Scientist |
| COMM 082 | Globalizing Organizations: Food Politics |
| COMM 089H | Countercultures |
| DRAM 089 | Ecodrama |
| ECON 056 | Asia and the West |
| ENGL 084H | Into the West |
| ENGL 086 | The Cities of Modernism |
| ENGL 087 | Jane Austen Then and Now |
| ENGL 089H | Reading and Writing Women's Lives |
| ENGL 102 | English Composition and Rhetoric (8 sections) |
| ENGL 102i | Writing for Business (2 sections) |
| ENGL 143 | Film & Culture (2 sections) |
| ENGL 088 | The Legacy of the Japanese American Incarceration from WWII to 9/11 |
| ENST 222 | Estuarine and Coastal Marine Science |
| FREN 260.001 | Introduction to French and Francophone Literature |
| FREN 260.002 | L'Argent ne fais pas le Bonheur? |
| GEOG 056 | Local Places in a Globalizing World |
| GEOL 072H | Field Geology of Eastern California |
| HIST 083 | African History through Popular Music |
| HIST 176H | The Incas and After |
| HIST 262 | History of the Holocaust |
| HIST 292H | Magic Prague: Biographies of a Central European City |
| INLS 089 | The Revolution Will Not Be Tweeted: Social Informatics in Popular Culture |
| KOR 150 | History, Memory and Reality in Contemporary Korea |
| KOR 151 | Education and Social Changes in Contemporary Korea |
| MASC 055 | Changes in the Coastal Ocean |
| MASC 057 | From "The Sound of Music" to "The Perfect Storm" |
| MATH 062H | Combinatorics |
| MATH 051 | Fish gotta swim, birds gotta fly: Mathematics and mechanics of moving things |
| MATH 060 | Simulated life |
| MUSC 063 | Music on Stage and Screen |
| MUSC 089 | Making and Marketing Music in a Digital Age |
| PHIL 145 | Language and Communication |
| PLAN 053 | Race, Sex and Place in America |
| PLCY 089 | The Character of Place |
| PLCY 210 | Policy Innovation and Analysis (5 sections) |
| POLI 130 | Introduction to Comparative Politics |
| POLI 209 | Analyzing Public Opinion Data |
| PSYC 058 | The Psychology of Mental States and Language Use |
| PSYC 066 | Eating Disorders and Body Image |
| PSYC 190.001 | Eating Disorders and Body Image |
| PSYC 190.002 | Exploring Infancy and the Development of the Mind |
| PSYC 225H | Sensation and Perception |
| PSYC 245 | Abnormal Psychology |
| RELI 072 | Messianic Movements |
| RELI 224H | Gender and Sexuality in Western Christianity |
| ROML 059 | Courts, Courtiers, and Court Culture in Early Modern Spain |
| ROML 061 | Language in Autism and Developmental Disabilities |
| SOCI 064 | Equality of Educational Opportunity Then and Now |
| SOCI 251 | Measurement and Data Collection |

### Faculty Adoption

Recommendations from colleagues, a workshop, and possible departmental adoption of the GRC program are three spurs to faculty members' decisions to introduce research into their pedagogy using the GRC model.

*Recommendations from colleagues*. When faculty members share their experiences of success with the GRC model, other faculty become interested in exploring this option. When faculty recruit graduate students for their GRC position or when graduate students who have served as GRCs are encouraged to apply for GRCs for their own courses, this pedagogical model becomes part of a broader departmental and institutional conversation and is more visible as an opportunity.

Patrick Curran, a professor in UNC-Chapel Hill's Department of Psychology, found the GRC Program transformative and crucial to his ability to create an undergraduate course in quantitative psychology. He observed that, "Although all of the other specialty areas in psychology offer an upper-level undergraduate introductory course (developmental, clinical, social, etc.), no such class had ever existed for quant psych. Our belief was that, given the required math, stats, and computer programming skills needed, quant psych was ',too advanced,' for introductory undergraduate study."

"Over time I came to think that this was actually a rather silly belief, as well as a bit insulting to the remarkable skills of our undergrads at UNC. I thus decided to design a brand new upper-level course cleverly titled 'Quantitative Psychology.' I hit my first major roadblock after about 30 seconds of thinking about the course content. It turns out that our prior belief was not entirely misplaced; indeed, there is an extensive level of expertise needed to navigate topics such as computer simulation, multivariate statistical modeling, probability sampling, and psychometric scaling.

"After much time spent staring at my office wall—followed by more time talking with colleagues—I stumbled upon a solution to my problem: the Graduate Research Consultant program. Whereas I was trying to develop a curriculum that focused on teaching students quantitative psychology, the GRC program allowed me to have students learn by doing quantitative psychology. This allowed me to sidestep the very real prerequisite problem entirely and instead approach the problem through hands-on research." (Posted in the GRC@ UNC Blog, March 8, 2012.)

*Faculty Workshop*. In the fifth year of the GRC program, we hosted a workshop entitled "The Place of Inquiry in the Undergraduate Classroom." This workshop had several goals, including to:

- Promote a dialogue on inquiry-based teaching methods across the disciplines
- Acknowledge and support continuing faculty experiments with inquiry-based pedagogy
- Reflect on faculty learning in the GRC Program
- Recruit new faculty to the GRC Program
- Offer an opportunity for faculty to talk with faculty in other disciplines
- Provide opportunities for faculty to continue the discussions started at earlier gatherings

The workshop was highly interactive and participatory. In addition to faculty and GRCs sharing their experiences in the GRC-supported courses, the provost and the dean of the College of Arts & Sciences spoke briefly about the importance of increasing inquiry-based learning and undergraduate research opportunities. The majority of the workshop time was devoted to small-group discussions in which faculty discussed how they might incorporate this model into one of their own classes.

One attendee commented: "It was remarkable to have in one place so many faculty members from a wide variety of units discussing issues of pedagogy for two hours." Plans for the 10th-year workshop are currently under way.

*Departmental-level adoption:* At UNC-Chapel Hill, a large number of faculty and teaching instructors in the Department of Romance Languages and Literatures (ROML) have embraced the GRC model in order to integrate inquiry-based learning and independent research into their courses. Faculty member Lucia Binotti notes that the department is beginning conversations exploring the possibility of using the GRC model to make scholarly research an essential component of their undergraduate students' apprenticeship, scaling the program to require all majors in the department to enroll in at least one GRC-supported course.

## Assessment of GRC Results

Studies demonstrate that conducting research as an undergraduate correlates with several positive student outcomes, including increased retention and persistence to graduation/degree completion, increased grade-point-average, increased satisfaction with the undergraduate academic experience, and increased likelihood of enrollment in graduate school (Nagada et al. 1998; Hathaway et al. 2002; Gregerman 2009). Additionally, undergraduates who engage in research experiences report positive changes in psychosocial characteristics, such as increased self-confidence and the ability to work independently (Brownell and Swaner 2010; Lopatto 2010). We hypothesized that participation in courses that exposed students to research would be similarly beneficial, especially if students went on to seek more intensive research experiences.

Our internal assessment of the GRC program has been conducted by UNC's Office of Institutional Research and Assessment through surveys and focus groups. Multiple evaluations over a number of years indicate that the program has produced a number of desirable results:

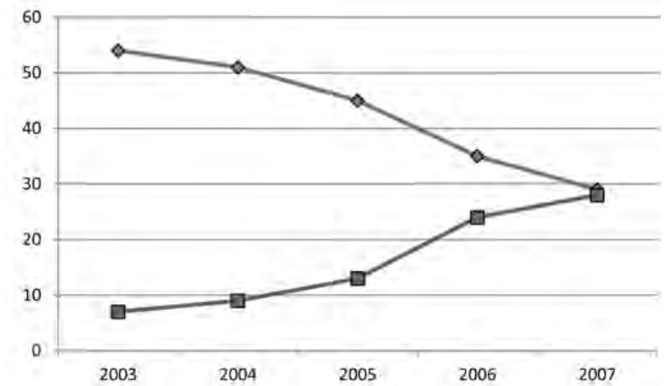
- Students report that the extent to which they could engage in research in the course was significant and transformative, with benefits that included understanding the research process, identifying research questions, using a research approach, completing a project, and communicating the results to others. This demonstrates the kinds of deep and significant learning that occur in GRC-supported classes.
- Of the students enrolled in GRC-supported courses between spring 2009 and spring 2011, 71 percent said they found the research experience valuable, very valuable, or extremely valuable. Said one undergraduate: "Of course I've done research papers, but it's never been like this before. This seemed like very serious and not something you could throw together the day before. And there was a lot of emphasis on the research practices, which was valuable. [There was] encouragement to use primary sources and lots of secondary sources."
- The GRCs themselves report extremely positive experiences. More than 60 percent of them reported influences on their own professional development and expertise in using an inquiry-based teaching/learning model, ranging from "significant" to "transformative." Almost 80 percent of them regarded the experience as "valuable" or "extremely valuable."
- Reported one GRC, "My experiences as a GRC have been invaluable to my development as a teacher. Each undergraduate I speak to challenges me to draw from resources within and beyond my own discipline... . While I've greatly benefitted from my interactions with students on a pedagogical level—the experiences I've had will prepare me for conferences with students in my future composition class—being a GRC has also contributed to my professionalization. I am gaining a sense of how to present myself to students: as a confident, knowledgeable scholar who is fully interested in and engaged with the student's work."
- More than 90 percent of faculty who have used a GRC indicate that they would use one again, and 84 percent of faculty using the GRC program reported that it had a significant or transformative influence on their students' learning.
- Faculty report benefits such as being able to implement the "student as scholar" model in their teaching, having students conduct genuine research, and enabling them to have an intensive research experience. They also report improved student papers and improved student writing, and that students became active learners. Noted one faculty member who had used a GRC, "I cannot speak too highly of the benefits of this program. This was the best iteration of this course I have ever taught, and it was the highlight of my year. The course is extremely demanding. It asks students to define an original research project, master a new research method, combine that method with more traditional approaches, and produce both a sophisticated written paper and a performance-based public presentation.

  "The GRC for this course was my invaluable co-teacher. She worked one-on-one with the students, helping them define projects and locate interviewees. She also played a central role in guiding the students' interactions with their interviewees and helping them prepare archival-quality tapes, transcripts, and supporting materials for deposit in the permanent archives—and thus to make an original contribution to knowledge.

  "This personal attention helped the students rise to a level of insight and performance far beyond the norm. The student evaluations were ecstatic, and many cited the GRC specifically for her contribution to what they saw as a unique learning experience."

We also wanted to know if student enrollment in research-intensive (RI) courses might be influenced by the increased availability of the GRC-coached research-exposure (RE) courses. We define research-intensive courses as those in which more than half of the class time is devoted to students conducting original research and presenting conclusions. We examined enrollment data for five cohorts of students (those entering UNC in 2003-2007). We observed that the percentage of students receiving neither RE nor RI credit declined from 54 percent for the 2003 cohort to 29 percent for the 2007 cohort (Figure 1). We were interested to observe a nearly corresponding increase in the percentage of students receiving *both* RE and RI credit (from 7 percent for the 2003 cohort to 28 percent for the 2007 cohort). It appears that students responded to the increased availability of RE courses (and possibly also to other campus emphases on undergraduate research) by enrolling in *both* RE and RI courses. The remaining students received only RI credit (33 percent in the 2003 cohort, declining to 25 percent in the 2007 cohort) or only RE credit (6 percent in the 2003 cohort, rising to 17 percent in the 2007 cohort). We conclude that the GRC program has contributed positively to the culture of undergraduate involvement in research and scholarship on our campus.

**Figure 1. Undergraduate participation in research-exposure and research-intensive courses.**




**Diamonds indicate percentage of students entering UNC-Chapel Hill in the year shown who received no course credit for research. Squares indicate percentage of students entering UNC-Chapel Hill in the year shown who received course credit for both research-exposure and research-intensive courses.*

## Funding Sources Expand

The GRC program was new when the campus began conversations in 2004 about choosing the focus of our Quality Enhancement Plan (QEP), which is part of the Southern Association of Colleges and Schools' "Reaffirmation of Accreditation" process. The resulting plan, "Making Critical Connections," submitted in 2006, included a strong emphasis on research experiences for undergraduates, and expanding the GRC program was one of the key objectives. The resulting benefits to the GRC program included campus-wide attention, resources, and access to the university's Office for Institutional Research and Assessment. Student enrollment in GRC courses increased nearly 10-fold during the five years of the QEP (from 500 in 2005-2006 before the QEP began to 4,980 in 2010-2011).

The value of the GRC program also has been recognized by several campus units that now provide financial support for the research-exposure classes. Currently, the Honors Program, the Department of English and Comparative Literature, the First-Year Seminars Program, the Carolina Center for Public

Service, and a grant to UNC-Chapel Hill from the Howard Hughes Medical Institute's Undergraduate Science Education Program each fund GRCs for specific courses. In addition, as we noted above, the Department of Romance Languages and Literatures hopes to use the GRC program as a catalyst to transform its curriculum. Also, the Center for the Study of the American South has agreed that faculty who apply for the center's course-enhancement funds may choose to use those funds to fund a GRC.

## Next Steps for the GRC Program

UNC-Chapel Hill's most recent Academic Plan (2011, 18) places substantial emphasis on expanding opportunities for undergraduate research, including a recommendation to "fully engage first-year undergraduate students in the academic life of the University by introducing them to unsolved problems, encouraging them to identify their research interests, and connecting them with faculty and graduate students who will inspire and mentor them." More specifically, the plan calls for increasing the number of GRC-supported courses, as well as including GRCs in new multidisciplinary lecture courses that are being developed. The GRC program's visibility in the academic plan will be extremely valuable as we continue to make undergraduate research the distinctive feature of a UNC-Chapel Hill undergraduate experience.

In addition to continuing to expand the program, we are also focused on building community among our GRCs and GRC faculty members. As part of this effort, we initiated a GRC blog (http://grc.web.unc.edu/) in early 2012. This virtual site offers space for faculty and GRCs to share experiences, best practices, and challenges. It also creates opportunities for reflection on the pedagogical practices that promote success in a research-exposure course.

In the recent CUR publication *Characteristics of Excellence in Undergraduate Research (COEUR)*, Rowlett et al. (2012, 3) note several important factors and best practices that help to "support and sustain highly effective undergraduate research environments," including "broad disciplinary participation" and "accessible opportunities for undergraduates." Undergraduate research opportunities need to be available to students at all levels of academic performance and in all disciplines. The research-exposure courses offered through the GRC program help to achieve these goals and provide effective inquiry-based learning for undergraduate students, pedagogical and professional development opportunities for graduate students, and satisfying and successful teaching experiences for faculty. The program has allowed us to leverage the strengths of our research university to provide an excellent liberal arts education for thousands of students.

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**Donna M. Bickford**
University of North Carolina at Chapel Hill, dbickford@unc.edu

*Donna M. Bickford is associate director of the Office for Undergraduate Research (OUR) at the University of North Carolina at Chapel Hill, as well as an adjunct assistant professor in the Department of English and Comparative Literature. Bickford directed the Carolina Women's Center at UNC-CH from 2006 to 2011. Prior to her arrival in Chapel Hill, she taught at the University of Rhode Island and was awarded a Fulbright Scholar Grant to teach at Abo Akademi University in Turku, Finland.*

*Patricia J. Pukkila is professor of biology at UNC-Chapel Hill and also associate dean and the founding director of the university's Office for Undergraduate Research. Her laboratory investigates chromatin dynamics during the synchronous meiotic process in the model mushroom Coprinus cinereus. She has received the Bruce Alberts Award for distinguished contributions to science education from the American Society for Cell Biology, and she was named a Fellow of the American Association for the Advancement of Science for work in regulation of meiosis and for leadership in promoting undergraduate education and research. Pukkila has been a CUR Councilor since 2002.*

*Martha S. Arnold is an independent curriculum consultant. Prior to her retirement from UNC-CH, she served as associate director of the Office for Undergraduate Research for five years, where she coordinated the assessment of the undergraduate research portion of the campus's Quality Enhancement Plan. She convened the initial focus group that contributed the basic design of the GRC program, and oversaw its rapid expansion and assessment. She previously served as director of curriculum development in the university's Center for Teaching and Learning for four years.*

*Aijun Anna Li is senior research associate in the Office of Institutional Research and Assessment at the University of North Carolina at Chapel Hill where she works with academic and administrative units to develop and conduct effective assessment activities. Prior to her arrival in Chapel Hill, she evaluated various federally funded educational technology projects at the SERVE Center of the University of North Carolina-Greensboro. She received her PhD and master's in education from the University of Illinois—Champaign-Urbana.*

# CURQ VIGNETTES

### Home Energy Assessments in a General Education First-Year Seminar

C. Wesley Walter, *Denison University, walter@denison.edu*

In my course Renewable Energy and Sustainability, a general education first-year seminar at Denison University, the students do a research project in which they perform home energy assessments using volunteers' houses as their "labs." In teams of two or three, the students visit a particular house to visually assess the conditions and interview the homeowner about energy usage. Each team develops its own list of five factors that they will analyze in detail, tailored to the specific situation at that house. Examples of factors that students have evaluated include lighting, space heating, "vampire electric power," attic insulation, water heating, and thermostat settings. The students take relevant measurements at the house, such as electric power usage by appliances or hot water temperature. They analyze the information they've gathered, together with the household's utility bills, to evaluate the current energy usage and annual costs for the different aspects of energy usage. The students then develop specific recommendations for possible improvements in energy conservation, including the estimated potential cost savings.

The research project culminates in an energy-assessment report that is transmitted to the homeowner. The report includes discussion of the students' findings about the current household energy usage and recommended improvements. This research project has worked well for students, helping them to put the course material to use in a meaningful, real-world context. As an added bonus, knowing that their reports will be read and possibly acted upon by the homeowners helps to motivate the students to work hard on their research and to do their best writing.

### Biblical Studies Research in Introduction to the New Testament

Amy Peeler, *Wheaton College, amy.peeler@wheaton.edu*

My Introduction to the New Testament course includes an assignment to write an exegesis, an interpretive examination of a text, which is a task normally reserved for upper-level classes. This assignment asks students to engage deeply with a particular text throughout the semester even as they are learning generally about the entire testament.

Carried out in several installments, the assignment begins with research on a socio-cultural issue that informs their scriptural passage. Students must consult an ancient source to learn more about the issue they have chosen. In addition, they must also consult secondary literature so that they can make their own claims on issues such as authorship, dating, location, and genre. In the next installment of the assignment, the students follow a rubric of questions that encourages them to read the text many times from different perspectives, getting a sense of its grammar, narrative, rhetoric, and theology. Once they have organized their own thoughts on the passage, they must seek out the views of other interpreters, including those in academia, from the past, and from the non-Western world. Finally, they write a brief thesis paper, the exegesis, arguing a particular point about the passage. At the end of the course, students present their work to their peers, and by articulating their thesis, they convey what they have learned through the entire process and about the text itself. Overall, this assignment equips my students with the basic skills—and confidence—to interpret texts with wisdom, a skill they will all need even if they do not go on to become professionals in the field of Biblical studies.

### What Happened On Your Birthday: A Model for Building Undergraduate Research into the General Education U.S. History Survey

Robert F. Zeidel and Kate Kramschuster, *University of Wisconsin-Stout, zeidelr@uwstout.edu*

Research in the discipline of history necessitates access to primary sources, which complicates integration of such activity into introductory classes. Most students simply do not have access to major depositories of historical material, and those who do typically lack the requisite skills to find and use appropriate documents. Digitalization of historic newspapers and periodicals alleviates this problem, however. Using the databases to investigate the student's "historical birthday" offers an original research opportunity. In our Modern U.S. History Survey assignment, students can investigate what occurred on the exact day they were born; in the Early U.S. Survey, students can investigate what happened on their birthday during a significant year—not the actual year they were born. They easily can locate materials for both assignments.

This research introduces students to a variety of sources and search strategies. They are taught to use digital databases to find primary sources—a newspaper article by date and a magazine or journal article by relevant topic. For example, in the Modern U.S. History Survey, students enter their birth date into NewsBank, a subscription newspaper index, in order to find a pertinent article published that day. They are encouraged to choose an article of national significance. After finding it, students identify key words in the text, including names and events, and then use them to locate a related magazine or journal article in the Academic Search Complete database. Database features allow them to limit the dates to those near their birth. Students then use the sources to write a short interpretive and analytical narrative. Instructors provide guidance to help students understand what makes a particular piece of historical evidence important and show them how to connect it to a larger theme. Each student finds her or his own sources, as opposed to writing a paper based on primary sources selected by anthology editors or depository archivists, thus actually engaging in original research.

# From the International Desk

Ray Land, *Durham University, United Kingdom*

## Undergraduate Research in Scotland: An Enhancement-led Approach

Scottish higher education increasingly finds itself, as do sectors elsewhere, having to cope with the complexities of a globalized and uncertain world. This manifests itself in the speed of knowledge generation and transfer, as well as the speed of digital communication. The seemingly ubiquitous intensification of risk, in relation to environment, health, security, finance and technology has only been exacerbated by the onset of economic austerity. At the same time, the pressing scientific, social, and economic problems of our times—climate change, sustainability, security, international debt crises, public health, aging populations—require graduates with appropriate attributes to cope effectively and imaginatively in such environments.

Ideally, graduates are being prepared to view issues through more than one disciplinary lens, in order to bring these urgent issues more clearly into view. They also should be comfortable crossing epistemological, social, and ontological boundaries in pursuit of the solutions that policy-makers and employers desire. Barnett (2000a, 257) has characterized the "supercomplex" nature of this environment as follows:

> A *complex* world is one in which we are assailed by more facts, data, evidence, tasks and arguments than we can easily handle *within* the frameworks in which we have our being. By contrast, a *supercomplex* world is one in which the very frameworks by which we orient ourselves to the world are themselves contested.

How graduates with such attributes might be developed, and how they can be encouraged to engage in such "re-invention" is a matter of pressing concern and timeliness for Scottish higher education. The National Survey of Student Engagement in the U.S. (Kuh 2008), probably the largest longitudinal study of student engagement in higher education, found that ten "high-impact activities" correlated with increased student engagement. One such activity was undergraduate participation in collaborative research. Barnett has commented further (2000b, 163) that "being engaged in research of a frame-developing kind and projecting those frames to wide publics is a strong ... condition of teaching that is aimed at bringing about supercomplexity in the minds of students."

Further, Baxter Magolda's longitudinal study over the last twenty-five years (2009) has identified a process of student development through inquiry that leads to "contextual knowing or self-authorship." She argues, "Moving away from uncritical acceptance of knowledge to critically constructing one's own perspective" is "more complex than learning a skill set. It is a transformation of how we think—a change in our assumptions about the certainty, source and limits of knowledge" (2006, 50). As von Humboldt (1970) recognized some 200 years ago in a similar period of social, technological, and conceptual shift, such transformation in students through co-inquiry produces not just sound scholars, but also effective citizens with a critical moral perspective. It is also a reasonable assumption that the acquisition of such skills, attributes, and capacities will equip today's students to perform many high-level employment roles.

### Context and Culture

The fostering of an undergraduate research culture in Scotland can be viewed as part of a current distinctive policy climate. In recent years in the Scottish higher-education sector there has taken place one of the most concerted policy interventions yet witnessed explicitly designed to establish an approach to enhancing the quality of higher education across a whole university system. This has been characterized as a "push for a new Scottish policy culture" (Saunders 2009, 93) and certainly, politically and culturally, it arose at a significant juncture in recent Scottish history. The inception of this initiative, the Scottish Quality Enhancement Framework (QEF), took place in 2003, only four years after the establishment of the first Scottish government in nearly three hundred years. This bold move toward constructing a clear identify for the higher-education sector can be seen as part of the building of a broader and distinctive Scottish policy culture at that time. The impetus continues into the present as Scotland prepares for a major referendum in 2014 on possible national independence from the United Kingdom.

The Scottish higher-education sector is a close-knit community, but one that contains a high degree of institutional variation. This variability and diversity is present despite the limited size of the sector—nineteen higher-education institutions—with short lines of communication with each other and with government departments and agencies. There is a shared culture and a sense of community that foster both competition and collaboration, and a shared identity that can often give rise to a sense of solidarity.

The QEF is coordinated by the Quality Assurance Agency on behalf of the Scottish Funding Council and is designed to provide an integrated approach that emphasizes enhancement rather than solely assurance (the latter referring to judgements made against defined criteria to ensure the meeting of a standard). Quality enhancement (QE) is defined as "a commitment by colleges, universities and other relevant bodies to continuously enhance the quality of provision that students enjoy." Each institution is required to be evaluated every five years. (For a fuller explanation of the enhancement framework, see Land and Gordon 2013.) An important dimension of this complex and ambitious policy is a high degree of collaboration and partnership among stakeholders. Policy-makers aimed to achieve a sense of ownership and legitimization of the enhancement framework among all those with a vested interest. In particular, considerable emphasis has been placed on listening to the voices of students and encouraging their participation not just as consumers of a service but also, after appropriate training, as genuine partners in the review of quality.

There also has been a concerted attempt, at least in the early years of the initiative, to move away from an overly managerial and prescriptive audit approach—one sometimes characterized as "high fidelity"—to one that would be more consultative, pragmatic, and collegial, although perhaps less consistent or "low fidelity." Grassroots participation was intended to replace top-down compliance, and judgments were designed to be less driven by metrics and rankings than derived from a more nuanced basis of evidence. Consensual rather than coercive decision making—carrots rather than sticks—has been stressed. This model implies a strong awareness of the need for realistic and feasible measures that have a reasonable hope of implementation in a varied but compact sector. The overriding factor in this equation is the need for mutual trust. As Saunders suggests (2009, 59), "This enabled a familiarity, an ownership and a legitimation that other forms of implementation strategy might find hard to emulate. We term this a theory of 'consensual development.'|"

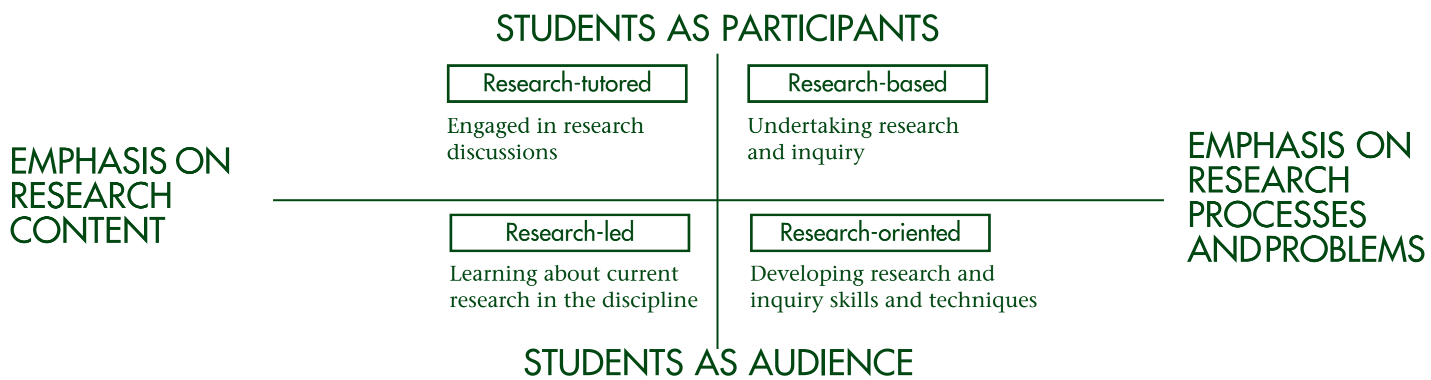
## Institutional Collaboration in Enhancement

A further distinctive element of the Scottish framework is the periodic (roughly biennial) identification of an enhancement theme around which selected institutions gather to collaborate and share diverse solutions appropriate to their own institutional contexts. This work is coordinated by the Scottish Higher Education Enhancement Committee (SHEEC). Since 2003 a burgeoning repository of resources—publications, presentations, reports, and case studies—has been made freely available on the committee's website. Two recent enhancement themes, titled "Research-Teaching Linkages: Enhancing Graduate Attributes" and "Graduates for the 21st Century," drew increased attention to the need for and value of undergraduate research.

Both of these themes recognized and subsequently advanced the notion that encouraging students to participate in inquiry-based or "research-minded" activity could deliver a range of benefits. These included increased student academic engagement, as well as enhanced capacity of individuals as rigorous scholars, proactive employees, and ethical and responsible citizens—attributes envisioned by policy-makers as necessary for the successful modern Scottish society and economy. A rich array of valuable scholarship has grown out of the work done in connection with the enhancement themes, which addresses institutional, disciplinary, and pedagogical practices. This work, which merits wider dissemination, includes nine discipline-related national studies of undergraduate research, as well as studies exploring various dimensions of undergraduate research. Jenkins' (2009) overview of the research-teaching linkages theme is a valuable gateway into this literature.

A number of conceptual tools were employed in addressing the themes. For example, Gunn (2011) helpfully discussed the notion of "research-mindedness" as one analytical lens. Another tool was Healey's (2005) model of potential research-teaching linkages (after Griffiths 2004), shown in Figure 1 below. In terms of the Healey model, a shift from the "research-led" tendency (lower left-hand corner of the diagram) to a "research-based" tendency (upper right-hand corner) was deemed necessary in order to effect an active culture of undergraduate research that would develop the desired attributes in graduates. All four approaches shown in the model were deemed important, but only the "research-based" approach was considered likely to lead to the capacities necessary for dealing with the "supercomplex" society described by Barnett.

**Figure 1. Healey's Model of Undergraduate Research and Inquiry**




*Source: Healey and Jenkins (2009, 7), based on Healey (2005, 70)*





The enhancement work in Scotland identified a polarization in approaches to the development of undergraduate research. At one end of the spectrum the approach might be characterized as a "junior model of the practitioner," with the emphasis placed on research outcomes, the acquisition of competence in research methods, and publication. Approaches that focus on research internships, undergraduate research publications, and undergraduates assisting faculty in their (faculty-led) research might fall into this category. The emphasis is on excellence and selectivity—engaging the best students who probably choose themselves to conduct research. It is an elite (and elitist) model in the positive sense of those terms. Activities in this narrative are often organized by an institution's office of research.

The alternative approach is similar to what Jenkins and Healey (2009) have termed "mainstreaming." This emphasizes the development of important student attributes gained from research within the undergraduate curriculum and tends to be inclusive of all students. This approach might be characterized as fostering "research-mindedness" or skills of inquiry. It is informed by notions of graduates' ultimate employability and is concerned primarily with educational outcomes. Activities in this framework are often organized by an institution's office of teaching and learning, and it was this approach that groups working on the enhancement themes were seeking to advance.

These sector-wide enhancement projects encouraged the adoption of a broad and inclusive interpretation of research, encompassing Boyer's (1990) four types of scholarship (discovery, integration, application, and teaching). The projects embraced where appropriate:

- research formally evaluated and ranked by research councils, funding bodies, or government
- practice-led research
- consultancy-based research
- research of local economic significance,
- contributions to the work of associated research institutes or other universities
- various types of practice-based and applied research, including performances, creative works, industrial or professional "secondments" (the temporary transfer of a person from their normal duty to another assignment) and research internships
- inquiry-based or problem-based learning.

## Qualities Sought in Graduates

The steering group studying research-teaching linkages, which included faculty and students, considered how to develop the desirable student attributes through the taught programs. It focused on how, at level of the institution and the academic program, links among research strategies, activities, outputs, and processes could support student learning and enable the development of key research-oriented attributes in graduates. At the undergraduate level, such potential attributes included:

- critical understanding
- awareness of the provisional nature of knowledge
- awareness of how knowledge is created, advanced, and renewed
- ability for effective communication and dissemination of findings
- an ability to analyze problems and issues and to formulate, evaluate, and apply evidence-based solutions and arguments
- an ability to apply a systematic and critical assessment of complex problems and issues
- an ability to deploy appropriate techniques of analysis and inquiry
- familiarity with advanced techniques and skills
- inventiveness and creativity in formulating, evaluating, and applying evidence-based solutions and arguments
- effective project management of time, resources, operations, and information
- an understanding of the need for a high level of ethical, social, cultural, environmental, and professional conduct.

An important emphasis for this steering group was provided by recent Australian work. Krause's (2007) "knowledge transfer conceptual framework" warns against the dangers of polarization between research and teaching. She argues the need to acknowledge emerging conceptions of knowledge transfer, notions of "public scholarship," and "third stream" activities" (i.e., revenue-raising activities undertaken by academics over and above their first two stream activities of teaching and research. These could take the form of collaborations with commercial companies, such as providing professional development programs, one-off consultancies, or knowledge transfer partnerships (KTPs) in which research posts would be funded as a joint enterprise between private companies and universities). This is in keeping with the influential work by Gibbons et al. (1994) on changing modes of research, including a contemporary shift to publicly commissioned, team-based, applied, and shorter duration "mode 2" research, e.g., a university working with a local engineering firm to test the durability of a new material. In contrast, the concept of "public scholarship" has received less debate in the UK. Krause refers to public scholarship as occurring when universities engage "in reciprocally beneficial ways with communities at [the] local, national and international level." It is more commonly discussed in the United States, where it has grown out of "service learning" and is related to Boyer's (1996) concept of "the scholarship of engagement."

In terms of defining attributes desired in graduates, the steering group readily acknowledged that the language used to describe student development is fraught with inconsistencies in terms of use and meanings. Indeed, terms such as attributes, skills, competencies, and abilities are often used interchangeably. A fellow Australian, Barrie (2004, 262), defines desirable attributes as being "the skills, knowledge and abilities of university graduates, *beyond disciplinary content knowledge*, which are applicable to a range of contexts." A significant amount of research has been undertaken, predominantly in Australia, to look at how institutions can use the concept of graduates' attributes to be more transparent and explicit about how students can expect to develop throughout their higher education. An important dimension of defining needed attributes, which arguably is less obvious when talking about skills, is the extent to which the definition enables inclusion of values and behaviors, as well as technical abilities. Interpreting graduate attributes in this way enriches the debate and begins to capture the transformational elements of the higher-education experience. This, in turn, raises more fundamental questions about the role of a university education in today's society.

## Vignettes of Undergraduate Research

Comprehensive information on all the Scottish enhancement themes can be obtained from a dedicated website at: http://www.enhancementthemes.ac.uk/resources/publications. A full account of the variety of undergraduate research in Scottish universities is available from Land and Gordon (2008a, 2008b). The following is a brief selection of vignettes from their work (2008b) showing the range of student research.

*University of Strathclyde Mechanical Engineering: First-Year Design Through Problem-Based Learning*

Students are aware that they will undertake a "mechanical dissection" of a car before enrolling at university; the exercise is highlighted in the degree prospectus and "open days" (when students have the opportunity to visit a university and find out more about the subjects they are interested in before they apply). At the beginning of the students' first year, the structure of this class is explained so that students know when during the year they will be working on the car dissection. It is also emphasized that the tasks they must undertake are related to the development of research skills for use later in their course. Students are divided into groups and each group spends a couple of hours selecting a part of the car (for example, the front or rear suspension, or a part of the braking system) and removing that part. The following day each group meets with two lecturers to discuss the physical principles behind the component's function and then selects a couple of parts for further examination. These parts are examined under a microscope to ascertain the materials and processes involved in their manufacture. The students then (in the style of problem-based learning) research the functions, physics, manufacture, and design of the components and produce a poster explaining these characteristics. They present their draft poster to two staff members who discuss the content with them and inform the students of any further work necessary to bring the poster to an acceptable standard. The students then have to produce a brief PowerPoint presentation covering the same material as the poster for a conference plenary session at which two students chosen at random from each group describe their component to the rest of the cohort. After their presentation, each group has to field a couple of questions from one of the other groups of students. In preparing the poster and presentation, students will need to explain topics not covered elsewhere in their first-year course.

The overall aim in developing this class was to show the students how the rather theoretical academic work they cover in their lectures is relevant to the practical challenges of engineering. The tasks associated with producing the poster and presentation also build skills in team work, research, and communication and, further, encourage independent learning. The students have said this exercise "is probably the only thing that everyone spends the whole first year waiting for," that it "expands on so many skills," and that it "allows you to see how an engineer would think."

*University of Aberdeen School of Divinity, History and Philosophy: Temporary Ordination in Second Life*

This initiative is seeking to build a simple "virtual monastery," loosely modelled on a small Soto Zen monastery, with appropriate clothing and avatars so that students in the Encountering Buddhism course can experience the challenges and responsibilities of being members of a religious order dependent on patrons for food, clothing, and other resources. (The monastery is developed using the online virtual world SecondLife software, http://www.secondlife.com.) The outcome is a research-informed teaching environment for second-year and fourth-year students that uses role-playing to convey the ritualization, ethical constraints, internal cohesion, and social separateness of Buddhist monastic life. This allows them to understand the ritualization of everyday life that is a part of monastic behaviour; experience the challenges and constraints of being dependent, as a mendicant community, on the charity of the surrounding community; and understand the distinction between the ethics of personal commitment—as taught in popular books on Buddhism or in discussions on religious and monastic experience—and the ethics of a vow of behavior.

*University of the Highlands and Islands Marine Science: Fieldwork Aboard Vessels*

One example of good undergraduate research practice with a small group of students is found within the honors program in marine science. Each year a maximum of 15 students embark on a four-year program at the Dunstaffnage Marine Laboratory, where they have unprecedented access to research vessels, a wide range of shore and coastal habitats, and state-of-the art laboratories. The labs support work in fields including physical oceanography, marine biology, marine resource exploitation, and sedimentary bio-geochemistry. During all four years, students undertake fieldwork aboard the vessels and work in the specialized laboratories.

Modules are led by experts in the disciplinary fields, so the students are exposed to the latest conceptual and technological developments. A wide range of pedagogical activities are tied directly to students' acquisition and development of higher-level research skills. These include, for example, technical-report writing beginning in the first year; training in experimental design in the second year; reviewing of academic papers and writing abstracts in the third year; writing research proposals and undertaking research projects in the third and fourth years; and deconstructing the certainty of science and communicating science in the fourth year. Although not a systematic approach to embedding research-teaching linkages at the core of the curriculum, this occurs because of the nature of the students' environment at the laboratory.

## Conclusion: A Future Agenda

A number of issues arise from the foregoing discussion of undergraduate research practice in Scotland. A particular implication of the mainstreaming approach discussed above is the need for appropriate faculty development. Such an approach for all students in undergraduate curricula requires a degree of scaffolding for students. Faculty require an awareness of curriculum design and are obliged to negotiate a learning threshold that places emphasis on student activity and student learning, as opposed to faculty research expertise.

An interesting future research agenda also arises from such undergraduate research. How do undergraduates perceive their own development and academic identity through their experience with research and co-inquiry? How does this narrative relate to shifts in a student's disciplinary understanding and identity, as well as developments in their practical capacities and perceptions of whether the experience has increased their employability? Given the interdisciplinary nature of many of the intractable issues facing societies in the 21st century, what learning gains have students experienced from intercultural encounters and border crossings? What are the identifiable factors in the design of research-based curricula and co-curricula that are most likely to optimize student engagement? Scottish higher education institutions continue to explore such issues. One hopes that similar issues might also emerge in the papers at future CUR conferences and issues of the *CUR Quarterly*.

The Scottish research-teaching linkages work offers much that may be of value to institutions in the United States at departmental, institutional, national, discipline, and accreditation-agency levels. It offers a practical framing tool (Land and Gordon 2008a, 68-72) and an audit tool (*ibid 72-73*) to analyze current practice, as well as the resources already mentioned above, all freely available online.

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**Ray Land**
Durham University, UK, ray.land@durham.ac.uk

*Ray Land is professor of higher education at Durham University in the United Kingdom and director of Durham's Centre for Academic Practice. He previously held similar positions at the Universities of Strathclyde, Coventry, and Edinburgh. He has been a higher-education consultant for the Organisation for Economic Co-operation and Development and the European Commission and is currently involved in two higher-education projects in Europe and Latin America sponsored by the European Commission. He has published widely in the field of educational research, including work on educational development, learning technology, and quality enhancement. He is best known for his theory (with Jan Meyer) of threshold concepts and troublesome knowledge.*



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COUNCIL ON UNDERGRADUATE RESEARCH

Emily C. McLaughlin, *Bard College*, David C. Forbes, *University of South Alabama*, Michael P. Doyle, *University of Maryland, College Park*

# Guidance for Entering Academics in Organic Chemistry

## Introduction

As faculty in academic institutions, our primary instructional responsibilities are to equip and empower our students. By making effective teaching and learning a priority, a faculty member ensures that students will obtain the skills needed to succeed as they move on from the college or university. During a student's time with us we must be proficient in capturing and then demonstrating the excitement of the sciences and, at the same time, equip that student with the fundamental principles of his or her field, in this case, organic chemistry.

Stice showed in a 1987 study that college-level students retain only 25 percent of what they hear and 30 percent of what they see, compared to 90 percent of what they say (Stice 1987). These remarkable numbers show that learning is not a spectator sport regardless of the instructor's abilities. The interactive approach to learning is a necessary tool to ensure that students leave a classroom having understood and remembered the material presented to them. This is similar to the Gutenberg method of teaching in which textbook and lecturer together provide the fundamental concepts to the students and involve the students in the classroom on a regular basis (Morrison 1986).

Concurrent with one's instructional responsibilities is the pursuit of one's scholarly activities—*research*. Accordingly, the introduction of research to students in organic chemistry—their direct interaction with the unknown and unexplored—provides a unique and valuable experience rarely available outside the walls of an institution of higher education. Research offers the student an individualized, hands-on experience that, when paired with an effective classroom experience, offers a truly enriched educational environment.

Research provides a unique opportunity for students to define their own scholarly activities. That is, students in the lecture setting are presented on the first day of classes with predetermined dates for their quizzes/exams/final. The lecture material is scheduled and organized on a grid format with little input from the class. Research is open-ended, and the data generated are never predetermined. Using research as a vehicle for learning, the overall experience allows for added benefits. The professor now takes on the role of mentor, in addition to that of teacher, as he or she interacts one-on-one with students, while at the same time assuming an important role in the student's professional development.

Outlined below are the responsibilities with which each of us has been charged as a faculty member. The items are specifically focused for those in organic chemistry, but we hope they will benefit all entering academe.

## Historical Perspective

Make no mistake; we, as faculty members in an academic institution, are hired to teach. The replacement or creation of a faculty line is driven by the need to offer our students a quality education and is most often justified by the enrollment numbers of a particular institution. While the rationale for hiring practices has not changed for quite some time, the expectations for full-time, tenure-track faculty have changed. By the early 1960's the expectations for teaching at graduate and undergraduate institutions had already diverged, with large classes/limited number of courses characteristic of graduate institutions and small classes/high numbers of courses typical of undergraduate institutions. Research was expected of faculty and their graduate students at graduate institutions and, at the same time, research by faculty with undergraduate students was rare.

Today the expectations of full-time, tenure-track faculty have expanded to include a thriving research program; newly appointed faculty members are expected to develop one and existing faculty are expected to have one in place. This expectation is best satisfied with the individual's ability to publish papers in peer-reviewed journals and gain annual sponsorship in the form of external grants at a sustained level. The change or shift in the expectations for faculty in the chemical sciences has had the largest impact on those (1) obtaining a bachelor's degree in the chemical sciences at research institutions and (2) entering the academic ranks of a primarily undergraduate institution (PUI). These research expectations are now integrated into the educational environment of our science majors and into the faculty tenure and promotion process.

Twenty plus years ago, those graduating in chemistry with a bachelor's degree may or may not have had research as a focal point of their undergraduate studies. Research might have been an elective class or independent study for an undergraduate; it might have been driven primarily by the motivation of the student and the willingness of a faculty member to sponsor a student. Organic chemistry laboratories often contained sequential experiments for which one or more steps could be changed to discover the "unexpected" outcome (Mohrig and Neckers 1979). Others dealt with the excitement of competition (time for completion, % yield, purity) to challenge students (Fieser and Williamson 1987). Today, the chemical literature details curricular changes that are best described as student-oriented pedagogical enhancements, including discovery-based experiments or student-originated "research," and the research experience of students is intimately coupled with the curriculum (For examples, see: Iimoto and Frederick 2011; Dintzner et al. 2012; Flynn and Biggs 2012; Hollenbeck et al. 2006; Cooper and Kerns 2006; Paselk 1994; Ruttledge

1998; Gorman, DeMattia, and Doonan 1970; Newton, Tracy, and Prudenté 2006; Baum, Krider, and Moss 2006; Demczylo, Martinez, and Rivero 1990).

One measure illustrating the shift of research expectations at the undergraduate level is publication trends among undergraduates (Doyle 2002; Doyle 2000). Publications are the end product of a series of events stemming from experiences both in the classroom and lab. Having a paper published on one's independent research in a peer-reviewed journal prior to graduation was atypical decades ago. Today, it is not uncommon to see chemistry students having their work published prior to their sophomore year of study.

The impetus for the integration of research into the undergraduate curriculum was financial support for instrumentation and, more importantly, administrative support for the maintenance of these instruments. It is not uncommon for certain chemistry programs to have over $500,000 invested in instrumentation. It is also not surprising that a high level of research productivity is seen in those programs. Accordingly, the dollar support earmarked for equipment maintenance by the institution sends a clear message to both entering students and faculty. This, in turn, has created a major cultural shift in administrators' expectations about how students are best served, leading them to expect newly hired faculty members to develop an independent research program using the resources available to them.

## Infrastructure

*Tenure and Promotion.* Full-time, tenure-track faculty members are commonly evaluated for tenure and promotion prior to the completion of their sixth year of employment at the same institution, according to standards of the American Association of University Professors (Metzger 1990). The candidate prepares a portfolio detailing his or her professional activities during the pre-tenure (probationary) period for departmental evaluation. The evaluation generally involves the input of external reviewers, senior members of the department, the chair or head of the department, the college, and the final hiring authority, which most likely consists of the senior vice president or provost, the president, and then the board of trustees of the institution. While each institution is unique, the tenure and promotion process evaluates the candidate's ability to document his or her professional development in the areas of teaching, research, service, and collegiality.

The primary role of the external reviewer is to comment on the significance of the candidate's research activities. The senior members and head of the department will most likely focus on long-term outcomes, having directly witnessed the professional and personal development of the candidate. Finally, the review process at the college level and above serves to check that the procedures were followed and that the expectations of the candidate were met, if not exceeded.

The candidate is responsible for assembling the portfolio used in this evaluation process. Tenure assures job security. Promotion allows one to rise through the academic ranks in title and is often a direct means to substantially increase one's base salary. All faculty, during their probationary years, should (1) be familiar with their institution's faculty handbook, which will detail the process of how the institution perceives tenure and promotion; (2) consult the senior members of the department for advice and feedback; and (3) request from the department head annual progress reports, signed by both the chair and the full-time tenure-track faculty member, which should become a formal part of the candidate's portfolio. The three points stated above can be facilitated through a more informal faculty mentorship. Many institutions have developed programs that pair senior faculty members with new assistant professors in similar departments; often these mentor/mentee relationships form naturally during the first few years of an appointment. The construction of a solid support network within one's home institution fosters an environment for growth in both teaching and research for all faculty.

*Teaching Assigment.* A faculty member's teaching assignment at predominantly undergraduate institutions during the nine-month contract is typically the equivalent of four courses per term (or 12 contact hours, sometimes split between lab and lecture hours). Although much higher teaching assignments existed before the 1970's, the increasing importance of research in undergraduate institutions has resulted in lower formal course requirements and higher expectations for research. At some institutions faculty have a teaching assignment of nine or fewer contact hours, and the American Chemical Society's Committee on Professional Training sets fifteen as the maximum allowed for faculty in an approved program. A course may be a three-hour laboratory or lecture course. Count on class preparation time, office hours, and discussion or advising sessions to add to the teaching assignment. Release time from formal teaching is sometimes granted to research-active faculty members. Release time is also associated with post-tenure administrative appointments such as department chair or head.

## Support

*Internal Support.* Prior to starting a career in academe, a young academic should ask what internal administrative support will be available at the particular institution. Does the institution or department provide personnel to prepare the supplies needed in a teaching laboratory? Is there someone in the department who maintains the instrumentation (all or part of major instruments)? Is administrative assistance available for the scheduling of meetings, answering telephone calls, copying exams, etc.? Are teaching assistants who are either graduate or senior undergraduate students available to assist? Does the institution or department supply consumable research supplies (routine solvents, gloves, disposable pipets, etc.) to the individual research labs? Do stockroom personnel handle the collection and disposal of waste materials?

A faculty candidate also should pose questions relating to professional advancement. If the institution expects the potential faculty member to be visible in research, that institution will supply support to assist in the establishment of a research program. At predominantly undergraduate institutions, these amounts vary (and typically range from $25,000 to $50,000) and are predicated upon size and research expectations of the particular program. Unlike what may be found at research universities, even moderately priced equipment is often shared. If the institution's mission is primarily teaching, the start-up costs may be associated with the purchase of computer equipment and teaching aids.

*External Support.* Even before beginning an academic appointment, a new faculty member should consider writing a proposal for research support (to support personnel, including summer salary, supplies, and instrumentation). In the case of organic chemistry, the proposal should go to the Petroleum Research Fund of the American Chemical Society (ACS-PRF) Undergraduate New Investigator Award (www.acs.org/prf) or the Research Corporation for Scientific Advancement's (RCSA) Cottrell College Science Award (http://www.rescorp.org/grants-and-awards). Each has different criteria, but each award is designed to assist a new faculty member in starting a research program. It may be helpful to reach out to current awardees to gain a sense of the proposal-writing process, and recent award recipients are listed on the respective websites. Once a research program is established, more funding opportunities arise, which include but are not limited to funding from the National Science Foundation (RUI – Research in Undergraduate Institutions, and ROA – Research Opportunity Award) and the National Institutes of Health (AREA – Academic Research Enhancement Award). As already described, additional private sponsorship can be obtained from the ACS-PRF and RCSA, as well as the Camille and Henry Dreyfus Foundation.

When beginning the process of proposal preparation, it is important to obtain a good sense of the entire grant review process of the sponsor, as well as the expectations of the program officer and reviewers. It is appropriate for the faculty member to contact the program officer about the intent to apply for funding. The program officer will serve as a guide to the application procedure, as well as provide brief commentary on how the faculty member's research plan will fit into the call for proposals. Participation in workshops such as the CUR Dialogues (http://www.cur.org/conferences_and_events/cur_dialogues/) or National Science Foundation Days (http://www.nsf.gov/events) will facilitate this grant-writing process.

## Curriculum

*Major.* The traditional core curriculum for chemistry programs begins with an introduction to chemistry that is normally devoted to chemical principles and their applications. The introductory course serves a broad clientele, from potential chemistry and biology majors to engineering, pre-medicine, nursing, and a variety of other pre-professional students. It is, in fact, a major "service course" in colleges and universities, one that has politically, at least in the United States, justified a significant portion of the budget for chemistry faculty. Significant changes have taken place in the chemistry curriculum since 1989. Driven in part by the large increases in enrollment over the previous four decades (1953-1996), some chemistry departments now permit students with Advanced Placement or International Baccalaureate credit to enroll in organic chemistry as their first college chemistry course. Others begin the chemistry curriculum with organic chemistry or start the organic chemistry curriculum after one term of introductory chemistry. The American Chemical Society's Committee on Professional Training (CPT), which has the responsibility to broadly define programs of study for students who aim to be professionals in the chemical sciences at approved schools, has provided guidelines for the core curriculum requirements in chemistry (America Chemical Society 2008; Larive and Polik 2008).

*American Chemical Society's Certification Program.* The phrase "a rising tide lifts all boats" is often used in reference to economic trends. The graphic visualization of boats rising together with the tide, regardless of size or status, can just as well be used when considering a policy on national certification. That is, while selected components of chemistry programs can be grouped, the different levels of resources available to academic institutions and their different educational priorities prevent them from offering a uniform undergraduate experience. Through being certified by the American Chemical Society (ACS), a student demonstrates that he or she has met threshold standards, and potential employers, as well as graduate and professional schools, know that a specific breadth of knowledge and experience has been achieved. Having an approved program that can meet the academic standards for certifying students should be a high priority.

The American Chemical Society's CPT establishes Guidelines for Approved Programs, approves programs at colleges and universities, and defines student certification requirements. Undergraduates should have a minimum of "28 semester credit hours of basic instruction with comparable emphasis on analytical, inorganic, organic and calculus-based physical chemistry," according to the guidelines. Biochemistry must also be a part of the undergraduate curriculum. The 28 credit hours of study should also include the equivalent of "seven semester credit hours (300-350 contact hours) of laboratory instruction." Under the guidelines, these seven hours would include "the synthesis and characterization of inorganic and organic compounds, the elementary chemical analysis and instrumental methods of analysis, and experimental physical chemistry." Laboratory instruction also should include "practical experience with instrumentation for spectroscopy, separation techniques, electrochemical methods, and computerized data acquisition and analysis" (American Chemical Society, 2008).

These are, of course, minimum standards, and they do not infer requirements for the total chemistry curriculum for undergraduates who may pursue specific emphases in chemistry when selecting their advanced course requirements. They do, however, make a profound statement that a core of knowledge exists within every student recognized as a chemical scientist.

*Minor*. The minor in any discipline is designed to offer a cluster of courses within a specific field. For chemistry, this option for many programs requires a minimum of 20 semester credit hours, roughly translating to the equivalent of five courses, each with a laboratory experience (200 contact hours). The vast majority of those who enroll in organic chemistry are there having just completed a two-term general chemistry sequence and so, as rising juniors, many have satisfied 80 percent of what is needed to minor in chemistry. Accordingly, upon completion of the two-term sequence in organic chemistry, which has general chemistry as a prerequisite, a common fifth course is quantitative analysis. The minor keeps open the option for a student to major in chemistry prior to taking any upper-level courses.

## Course and Laboratory Teaching Resources

In the organic chemistry laboratory, micro-scale organic methods and "green" chemistry practices are integrated into many programs. Micro-scale techniques have the advantage of minimizing waste and costs associated with waste disposal, without compromising the learning environment (Singh, Szafran, and Pike 1999). With a microwave reactor, it is possible to extend the methods to many solvent-free or aqueous-based techniques (Leadbeater 2005; Dintzner, Wucka, and Lyons 2006; Zovinka and Stock 2010; Candeias et al. 2012). In many situations, students employ one or more spectroscopic tools for additional structural identification, such as gas chromatograph/mass spectrometry (GC/MS), infrared (IR) and nuclear magnetic resonance (NMR) spectrometry. As a result of the availability of this instrumentation, individual laboratory experiments rely less on simple organic compounds and instead employ more complex, naturally occurring compounds and stereoselective reactions (Leslie, Leeb, and Smith 2012; Wong, Sultana, and Vosburg 2010).

## Student Recruitment and Mentoring

Recent pedagogical changes that offer research experiences as part of the instructional laboratory experience may, interestingly, alter the career path of those considering a minor or even a major in chemistry. The objective of the lab experience is to offer students the opportunity to identify and contribute to the scholarly work in their field of interest. Mentoring students in the research laboratory gives them significant exposure to new ideas that they may not see in typical coursework. This is a time when students are most likely to identify their own motivation for studying chemistry and is the beginning of their preparation for a fruitful a career in the chemical sciences.

## Faculty and Student Collaborative Research

A successful start to any academic career hinges upon the development of a faculty member's research program. Creating a niche using external support to produce work that generates academic papers is an excellent means to demonstrate productivity. Careful planning is required to determine what the faculty member and those working with him or her require to be considered successful. With limited resources and a timeline for tenure and promotion, maximizing productivity is a must for the new faculty member. In most cases, the department will furnish the consumables and have adequate instrumentation available. The faculty member's research proposals outline the methods to be developed and describe long- and short-term goals. With time and proper training of those within a research group, the data accumulated by members of the group will provide the findings that can be communicated in a peer-reviewed journal. The challenge is in how one can start with preliminary data, establish proof of principle, and then document viability of the research plan. Success will lead to the faculty member's visibility, which will ultimately provide funding, further collaboration, and opportunities for students to continue to learn and grow in their own career pathways.

*Safety*. Because sloppy laboratory management can have grave consequences, maintaining a culture of safe laboratory practices is of paramount importance, especially when faculty are entering the college/university ranks. From freshman to senior-year classes, safe laboratory management is the first topic that should be covered in all instructional laboratory sections. Laboratory instructors and teaching assistants have safety as their highest priority while monitoring the students in the laboratory section. And while it is true that students learn best from their mistakes, a wet lab is not the proper setting for trial and error practices. Proper procedures must be followed, given the inexperience of all first-time researchers (National Research Council 1995). All experimental chemists need to approach their work with a "what if" attitude, and students need to learn how to avoid preventable accidents. This is especially true when they are performing independent research. Safety is often the first topic discussed by the mentor with the student, and a "virtual leash" or steady supervision is often required until the mentor is confident that the student will perform experiments safely. The American Chemical Society has an informative website that can assist in this endeavor (http://memberhsip.acs.org/C/CCS/). A structured environment, which includes proper attire, a thoughtful plan of action when performing a reaction, good general housekeeping practices, and communication among all members of the laboratory, can prevent many accidents. Part of the process of professional development is taking ownership of one's work, which includes performing independent research in a safe environment.

*Data Handling and Information Retrieval*. All scientists rely on qualitative data and quantitative analysis. An example illustrating this point is a beaker of water placed on a hot plate. The necessary qualitative data or evidence that it is "hot" can be obtained by placing one's hand near the hot beaker. This qualitative observation can be validated quantitatively by placing a thermometer into the beaker of water. Similarly, in a program that includes researchers of different ages, backgrounds, experience, and interests, everyone must be educated in how best to handle and analyze their data qualitatively and quantitatively. Once equipped with the knowledge of how to properly observe, record, and analyze data or findings, the researcher will be able to properly store this information for future use when writing a manuscript or preparing a presentation.

The medium for record keeping twenty-five years ago was the laboratory notebook, which documented all research activities and was the most effective means of recording and storing data. Today wireless campuses allow the processing of data at any location, and laptops and portable data storage (jump or flash drives and online storage) are the norm. *What is and always will be a time-honored tradition is the need to document reaction observations in an organized fashion.*

Advances in organic chemistry, especially in the area of synthetic methodology, occur at a very rapid pace, and students and faculty should not have to contend with barriers to accessing the primary literature. Access to the chemical literature is an essential component of an ACS-approved chemistry program. The underlying principle is that the most effective researcher is one who can properly search the chemical literature. With ACS certification, faculty and students have access to no fewer than 14 journals, all from the Committee on Professional Training's list of approved journals. This includes at least one from each of the following areas: analytical, biological, inorganic, organic, and physical chemistry (ACS-CPT Journal List 2008). ACS-approved programs have access, when researchers perform literature searches, to a host of referred journals in the chemical sciences, as well as access to full abstracts in Chemical Abstracts. Many institutions are now able to access web-based tools such as SciFinder® (https://www.cas.org/products/scifinder) and Reaxsys® (https://www.reaxys.com/info/) to enhance and facilitate searching the chemical literature.

*Skill Set*. Time, patience, and the willingness to learn are key ingredients when developing the skills to be an organic chemist. An excellent starting point for a first-time student in a lab is updating the chemical and equipment inventory. This task is simple, yet very instructive for any first-time researcher because it helps the student become knowledgeable and familiar with the materials he or she will encounter in the research lab. Once the task of laboratory organization is completed, a newcomer is paired with a senior member or members of the group so that the common practices of reaction setup and monitoring are followed. When effectively put into practice, knowledge will be transferred and skills developed at a moderate, yet productive, pace.

Similarly, new students will need to become proficient in using the instrumentation available to the research group or department. Acquiring these important skills demonstrates independence and, in certain instances, the ability to troubleshoot equipment problems. Having the students generate in-house guides or rubrics offering step-by-step instruction in how an instrument is used is an effective mechanism in their achieving proficiency with the equipment. Such guides are not only necessary for first-time researchers but also are informative for others who need to use particular instruments in the department.

Closure on projects and experiments is perhaps the least-emphasized, yet most important, skill to be acquired. An inclusive list would contain updating one's reaction page, thinking about the next reaction or series of reactions, and most importantly, leaving the lab as one found it. This includes cleaning glassware, restocking solvent bottles, and returning the chemicals/equipment to the stockroom.

With the acquisition of the necessary skills to run, monitor, work up, purify, and characterize materials prepared in a research lab, students are labeled as "trained." The correlation between productivity and a stage at which one is classified as trained is obvious. A proficient sophomore research student is a very attractive commodity when he or she is considering graduate programs, as well as internal and external summer research opportunities and even study-abroad research experiences. The dividends are numerous (Forbes and Davis 2008).

*Formulation and Dissemination of Results*. The first definable characteristic of scientific inquiry in the physical sciences is the problem statement. Research begins with the process of formulating a problem statement, which will identify the area of research to be explored. An inquisitive mind and a desire to conduct research will only go so far. The mentor is charged with providing guidance, but the student is helped to focus on the task at hand by having a well-composed problem statement.

For many students, the statement emerges from repeated discussion and is fine-tuned through searching the chemical literature. Once composed, a well-structured problem statement can serve as the cornerstone of a research program and also is often one of the first points stated when the researcher makes a presentation or submits a proposal. To be able to effectively communicate one's research program in a sentence—not just in a 15-minute synopsis or an hour-long lecture—is an exercise worth pursuing. Many students, in fact, will have the opportunity to give a formal research presentation prior to graduation, in an on-campus research symposium or perhaps a regional meeting. This oral presentation will center on his or her problem statement and provides students with good experience for any subsequent research in graduate school.

## Sustaining an Active Research Program

Undergraduate education is stronger and more meaningful when it contains a consistent and engaging research component. As outlined above, students build skills in problem solving, organizing and communicating information, and working in a team environment. In this team environment, often the experienced or senior students in the laboratory take initiative to teach their junior counterparts the techniques and skills mentioned above, including searching the chemical literature and preparing a poster or short presentation. For faculty members, the mentoring experience with undergraduates is immensely beneficial to furthering the faculty member's research project, but also more importantly to the development of the students as scholars in the field.

The key to success in maintaining a thriving undergraduate research program includes dissemination of data (both publications and presentations with student co-authors), and sustaining an active network of collaborators and colleagues, which ultimately leads to visibility in the field of chemical research. Visibility leads to external research funding. Far too often research is given a back seat amidst the daily demands of an academic career, but with careful planning and wise use of start-up funds (internal and external), a faculty member can quickly create momentum. Constant communication on what has been done, what is in the research pipeline, and what is anticipated will provide the greatest dividends. Other productive activities for a new faculty member can include organizing a regular seminar series at the institution, inviting outside scholars to speak, and participation in professional workshops. These activities can also add to the experience of students in addition to contributing to institutional visibility.

## Professional Ethics

The relationship between mentor and student is sacred. A mechanism must be in place whereby an open dialogue can occur at any time between the two parties. Because research and frustration go hand-in-hand, timely reminders are needed of the ethical responsibilities of both mentor and student on how best to act and make the decisions necessary to maintain a healthy and productive research environment. While not listed as a requirement for most programs, a separate course on professional ethics should be part of the curriculum of every chemistry major. As it stands currently, many programs include discussions of professional ethics as part of coursework and also on an individual basis through meetings and group discussions. Guidelines on academic professionalism are available through the web site of the American Chemical Society (http://portal.acs.org).

## Conclusion

Bruce Alberts, before becoming president of the National Academy of Sciences, described a scientific career as one that encounters a number of obstacles, which succeeds only upon achieving the status of a doctorate in philosophy (Alberts 1994). The trajectory from freshman scientist to PhD candidate can be very difficult, especially without sufficient direction from faculty. Each of us should be honored to participate in the advancement of any young chemist's career. The relationship between student and mentor is invaluable and extends far beyond the confines of the undergraduate institutions. We believe that our roles as educators are not only to teach the disciplinary subject matter but also to become true mentors to students and junior faculty as they embark on their own careers. The topics and skills detailed above regarding both teaching and research are intended to assist all those entering the field of academe.

### Helpful Resources

*American Association of University Professors (AAUP). http://www.aaup.org/aaup*

*American Chemical Society's Committee on Professional Training (ACS-CPT).*
*http://portal.acs.org/portal/PublicWebSite/about/governance/committees/training/acsapproved/degreeprogram/WPCP_008491*

*Academic Excellence – Michael P. Doyle, editor, published by Research Corporation.*
*http://www.rescorp.org/gdresources/uploads/files/publications/academic_excellence.pdf*

*Chronicle of Higher Education.*
*http://www. chronicle.com*

### Funding opportunities

*Research Corporation for Science Advancement – grants and awards.*
*http://www.rescorp.org/grants-and-awards*

*American Chemical Society – Petroleum Research Fund.*
*http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_SUPERARTICLE&node_id=1251&use_sec=false&sec_url_var=region1&__uuid=0f596290-bd62-4634-9532-54a4df5d86c7*

*National Science Foundation.*
*http://www.nsf.gov/funding/*

*National Institutes of Health.*
*http://grants.nih.gov/grants/funding/funding_program.htm#RSeries*

*Camille and Henry Dreyfus Foundation.*
*http://www.dreyfus.org/awards/overview_and_programs.shtml*

### Laboratory Techniques and Resources

*Not Voodoo - Demystifying Synthetic Organic Laboratory Technique*
*http://chem.chem.rochester.edu/~nvd/*

*Al's Notebook - Commonly used experimental procedures and for synthetic chemists*
*http://www.alsnotebook.com/*

### Literature Review and Dissemination of Data

*ACS Style-Guide.*
*http://pubs.acs.org/page/books/styleguide/index.html*

*SciFinder.*
*http://cas.org/products/scifindr/index.html*

*Reaxsys.*
*https://www.reaxys.com/info/*

*Gordon Research Conferences.*
*http://www.grc.org/*

*National Organic Symposium.*
*http://www.organicdivision.org/ama/orig/NOS/index.html*

***McLaughlin and Forbes dedicate this manuscript to Professor Michael P. Doyle on the occasion of his 70th birthday and in recognition of his excellence and commitment to undergraduate research.***

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**Emily C. McLaughlin**
Bard College, mclaughl@bard.edu


*Emily McLaughlin is an assistant professor of chemistry at Bard College in Annandale-on-Hudson, NY. She completed her PhD dissertation in total synthesis under Professor Jeffrey Winkler at the University of Pennsylvania in 2006. Soon thereafter, she commenced her post-doctoral training at the University of Maryland with Professor Michael Doyle. McLaughlin is currently teaching and mentoring undergraduate students in the pursuit of new methodologies designed for the preparation of non-natural amino acids* and heterocyclic scaffolds. Her work is supported by Bard College, the ACS-PRF (UNI) and the Research Corporation for Scientific Advancement (Cottrell College Science Award).*

David C. Forbes

*David Forbes is a professor of chemistry at the University of South Alabama. His training both as a graduate student in the labs of Professor Scott Denmark at the University of Illinois Urbana-Champaign and as a post-doctoral research associate with Professor Michael Doyle, which started at Trinity University and continued at the University of Arizona, was in the area of synthetic organic chemistry. David has mentored over 50 undergraduate research students since his academic appointment in 1998 and has maintained an externally funded research program which centers on the development and application of new synthetic methodologies. David currently serves as chair of the the chemistry department. In 2006 he was honored with a Henry Dreyfus Teacher-Scholar Award, and he currently serves on the Executive Committee of the Arnold and Mabel Beckman Foundation Beckman Scholars Program.*

Michael P. Doyle

*Michael (Mike) Doyle is internationally regarded in the field of organometallic catalysis and is a major driving force in the development of dirhodium complexes for relevant synthetic organic transformations. In addition, Doyle is equally celebrated for his efforts and leadership in the promotion of undergraduate research. He completed his graduate studies at Iowa State University as an NIH fellow and continued on to his postdoctoral training at the University of Illinois, Chicago. Shortly thereafter, he joined the faculty at Hope College and rose to the rank of full professor by 1974. Doyle is currently the chair of the Department of Chemistry and Biochemistry at the University of Maryland where he continues to mentor undergraduates, graduate students, and postdoctoral scholars. He has been the recipient of numerous awards and accolades throughout his career, including the Camille and Henry Dreyfus Teacher-Scholar Award (1973) and the Arthur C. Cope Scholar Award (2001). He has authored over 250 publications, 10 books, and 20 book chapters. Most notably, his publications feature more than 130 undergraduate coauthors.*



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- The source of funding for the work.

**For questions, contact:**

Undergraduate Research Highlights Editor
Nicole Bennett
bennettns@appstate.edu

**For questions, contact:**

*CUR Quarterly* Editor-in-Chief:
Kelly McConnaughay
Associate Dean of Liberal Arts and Sciences
Bradley University
kdm@bradley.edu

Council on Undergraduate Research
734 15th Street NW, Suite 550
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