Building Undergraduate Research Experiences into General Education

Guidance for Entering Academics in Organic Chemistry
Volume 33, Number 4

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Cover Photo: First-year students at Pennsylvania University are investigating the biological mechanism of plant adaptation to wildfire in the Santa Monica Mountains. Students shown are measuring enhanced photosynthesis and transpiration characteristics of fire-adapted plants after shoot removal by wildfire. (Photo credit: Stephen D. Davis)

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Cover Photo: First-year students at Pennsylvania University are investigating the biological mechanism of plant adaptation to wildfire in the Santa Monica Mountains. Students shown are measuring enhanced photosynthesis and transpiration characteristics of fire-adapted plants after shoot removal by wildfire. (Photo credit: Stephen D. Davis)
Weaving undergraduate research/scholarship into and across these courses that make up a student’s educational experience, given the goals of general education and the percentage of students who will go on to graduate school, it behooves us to find ways to integrate undergraduate research. The practical value of undergraduate participation in descriptive science research is evident. 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.

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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 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

"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.

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Mary Crowe
Associate Provost of Experiential Education
Florida Southern College
CUR President
From CUR’s Executive Officer

As a student attending a private liberal arts institution in the ’90s, 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 “silos-ed” general education program at a large public comprehensive institution in the ’90s, I vacillated between a sense of mission to continue the liberal arts tradition, and a stifling 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 learned to infuse some inquiry-based elements into the large lecture setting, but didn’t have a smidgen of a vision about reorienting 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-culture paradigm, and an emphasis on assessing outcomes of the (re)created general education curriculum. Several of the articles, for example Pukkia et al. and Carr et al., provided practical methods for collectively expanding the number of undergraduates 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. The intense competition that will continue to unfold in the delivery of general education courses creates a tremendous need for new tools to help faculty and students succeed.

The February 2013 CUR Dialogue conference featured back-to-back plenary presentations by Jane Widman, 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 have 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 Dialogue 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 the delivery of research culture and practice. In the 25th 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 Editor's View

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 seminar. The Keck Scholars Program, the authors report, encourages students to access primary sources to investigate their “his- torical birthday.” Amy Pepper 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 Ani Krevzen 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, provides a Common Classroom Assessment Tool (CCAT). The CCAT provides valuable opportunities. The collection of articles and vignettes in this issue, from private to public institutions, provides valuable opportunities.
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

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.

MEET THE EXECUTIVE OFFICER
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 significant contributions to peer discipline, even in the absence of extended exposure to discipline-specific methods. Students are not only learners; they are also developing scholars. They are not only gaining knowledge; they are also developing role models of scholarship; creating a learning environment in which peers are role models of scholarship; and through learner-centered and discovery-based practices; sharing their scholarship with first-year students and faculty members of the religions of Asia.

Since the first-year seminar is the only course that is required for all first-year students and 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 (Woodswill 2011) to deep learning and personal scholarship.

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 (McKillop 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 and receive funding for their research projects. Similar to standard grant-acceptance protocols, faculty members 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.

Figure 1 – The Keck Scholars Program Seminar Framework

![Figure 1](Image 450x505 to 567x597)

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)

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

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. This minimal growth in students’ perceptions of their abilities to analyze or communicate research is likely due to the limited time spent on this type of 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’ inability to dig deep into their research given the time restrictions of one semester.

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)

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<td>0.72</td>
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<td>0.82</td>
<td>0.001</td>
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</tbody>
</table>

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

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

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).
faculty developed best practices for involving peer mentors (Table 5). 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 student 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, schol- larly work, and creative activity, they actively make use of all resources available to them to pursue their 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 transforma- tive ideas, paradigm shifts, and a distinctive advancement of new knowledge. A few students who have made a significant impact in the past are Charles Darwin, Richard Henry Dana, Jr., Bill Gates, and Mark Zuckerberg (Darwin 1864; 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 emerg- ing issues. The ideas of first-year students are often more creative, novel, adventurous, 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 experi- ences 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. We also want to thank the faculty, students, and staff members who have made this program a success.

Acknowledgements
The authors would like to thank the W. M. Keck Foundation for its support of this program, as well as the support received from the office of the dean of Seaver College at Pepperdine University. Special thanks to Alex Rossa and Kamron King for their editorial contributions and to Valerie Skinner for essential research contributions. We also want to thank the faculty, students, and staff members who have made this program a success.

References

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 chalapeta cepahalops 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/development.

Constance M. Fulmer is associate dean for teaching and assessment at Seaver College of Pepperdine University. She holds the Blanche E. Eyster 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 con- servation, 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.
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 its emphasis 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 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 growths 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 2010b; Kierniesky 2005), but as Seymour et al.’s (2004) review showed, not many scholarly textbooks or qualitative research reports have been written. Since 1998, there have been no standardized criteria for undergraduate research surveys. 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 Immunology, an underclassmen course in the spring 2012. The second goal was to ensure student success in the course during this study—an even mix of juniors and seniors (anthropology and chemistry) and those that were program electives (English and immunology).

In 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. In our weekly working sessions we had extensive 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 the 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 their 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 experience 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.

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” (Gizhman 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 analyzing 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 (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 Immunology, an underclassmen course in the spring 2012. The second goal was to ensure student success in the course during this study—an even mix of juniors and seniors (anthropology and chemistry) and those that were program electives (English and immunology).
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 numeric and qualitative 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 comparative analysis and results 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.

Figure 2. Student Survey Responses Regarding 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: ethnographical method/theories of literary analysis and interpretative/laboratory techniques, ethical/behavioral conduct, oral presentation. 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).

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 also the first time the instructor was implementing the RQ1IL 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 progress 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 such ethical considerations.

**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 the section of the survey, it did not show significant differences in anthropology and English (Figure 3). Post-course survey data showed significant gains in students’ perceived skills in collaboration in the immunology and anthropology classes, with 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.’

<table>
<thead>
<tr>
<th>Course (total number of responses)</th>
<th>% Positive Responses</th>
<th>% Neutral Responses</th>
<th>% Negative/Neutral Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology (n=126)</td>
<td>96.8</td>
<td>3.2</td>
<td>0/0</td>
</tr>
<tr>
<td>Chemistry (n=71)</td>
<td>96.7</td>
<td>3.3</td>
<td>0/0</td>
</tr>
<tr>
<td>Immunology (n=28)</td>
<td>100.0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

### 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.’

<table>
<thead>
<tr>
<th>Course (total number of responses)</th>
<th>% Positive Responses</th>
<th>% Neutral Responses</th>
<th>% Negative/Neutral Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology (n=115)</td>
<td>95.7</td>
<td>4.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Chemistry (n=74)</td>
<td>86.1</td>
<td>14.3</td>
<td>0/0</td>
</tr>
<tr>
<td>Immunology (n=31)</td>
<td>100.0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

### 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, 96 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.

### Conclusions and Recommendations.

In summary, three 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 making 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 to the broad purpose of 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, the instructor focused classroom time on those who have graduated students to enter 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 for students to be engaged 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, 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 of undergraduate research in a faculty learning community as a member of our group. As members of a learning community, we realized all the benefits described by those who have studied FLCs. The faculty members have learned to appreciate multiple approaches to research-intensive pedagogy in our different disciplines and learned how to engage in cross-disciplinary and cross-cultural 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.
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.

On this theme, one focus-group experiential learning proﬁled in this issue, 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 classes as participants in the focus-group activity, the course participants’ main research project facilitates the teaching of conflict analysis and resolution.

Susan F. Hirsch, Ned Lazarus, Andria Wisler, Julie Minde, Gina Cerasani, Marina Cetkovic-Cvrlje

CIR 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.

On this theme, one focus-group experiential learning proﬁled in this issue, 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 classes as participants in the focus-group activity, the course participants’ main research project facilitates the teaching of conflict analysis and resolution.

Susan F. Hirsch, Ned Lazarus, Andria Wisler, Julie Minde, Gina Cerasani, Marina Cetkovic-Cvrlje

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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 group with participants from another class to practice. The focus-group leaders jointly analyze the data collected and present findings on their chosen topic. Each year, students in the capstone coursework 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 GMU's 21,950 students 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. Traditionally, experiential 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. Students select a capstone that 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, effective written and oral 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.) 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. S-CAR’s “Students as Scholars” initiative thus provided S-CAR faculty with a welcome opportunity to design a capstone research project that would engage students in an original scholarly creation without straining faculty capacity.

Second, 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. S-CAR’s “Students as Scholars” initiative thus provided S-CAR faculty with a welcome opportunity to design a capstone 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 curricular development project titled “Linking Theory to Practice: Conflict Analysis and Resolution Pedagogy.” The project aims to improve students’ ability to apply conflict resolution and negotiation theories to practical settings. The survey of 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 as a 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 distributes the experiential activities to partners at community colleges and universities.

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. Other students focused on how to use social media as a catalyst for interpersonal conflict. Students 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 pointed toward a persistent problem, student developed recommendations addressing the source of the kind of problem. For instance, when they concluded that social media had many negative effects on interpersonal relationships, 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.

**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 humor 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 acquiesced 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 a 45-minute focus group with undergraduates from other courses.

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**Evaluating Students’ Experiences**

Every activity produced by S-CAR’s experiential-learning project is thoroughly documented, assessed, and reviewed. Accordingly, the project team employs multiple methods to gather data on the focus-group activity each time it is used in a classroom. For instance, surveys of students, focus group discussions, and 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 design and implementation. 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 students found that the focus-group 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 understanding of the perspectives of people of 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 around 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 participants, learning to design and lead a focus group in order to gather data that they could use to produce a report involving a course assignment. They then drew on the insights gained to improve the assignment for future courses.

The focus-group research experience affords a wide range of participants’ opinions.”

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References


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 stu-
dents 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 ini-
tiate 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 experi-
ences 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 gen-
eral education and/or disciplinary courses. Further implementa-
tion information is available in the Instructor Guide on the project website at http://scarc.gmu.edu/experiential-learning-project/home.

National Conference on Undergraduate Research (NCUR) is an opportunity for more than 3,000 undergraduate students to present their research, scholarship, or creative projects. NCUR 2014 will be held April 3-5, 2014, at the University of Kentucky.

For more information, visit http://www.cur.org/ncur_2014/.
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 scholarly writing support. The GRCs 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 presentations. 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 18,000 undergraduates in nearly 650 courses. Further program statistics are available at: http://www.unc.edu/depts/out/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

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>CHEM 100</td>
<td>First-Year Seminar: Don’t Have to Be a Rocket Scientist</td>
</tr>
<tr>
<td>COMM 082</td>
<td>Globalizing Organizations: Food Politics</td>
</tr>
<tr>
<td>COMM 089H</td>
<td>Countercultures</td>
</tr>
<tr>
<td>DRAM 089</td>
<td>Ecodrama</td>
</tr>
<tr>
<td>ECON 056</td>
<td>Asia and the West</td>
</tr>
<tr>
<td>ENGL 084H</td>
<td>Into the West</td>
</tr>
<tr>
<td>ENGL 086</td>
<td>The Cities of Modernism</td>
</tr>
<tr>
<td>ENGL 087</td>
<td>Jane Austen Then and Now</td>
</tr>
<tr>
<td>ENGL 089H</td>
<td>Reading and Writing Women’s Lives</td>
</tr>
<tr>
<td>ENGL 102</td>
<td>English Composition and Rhetoric (8 sections)</td>
</tr>
<tr>
<td>ENGL 102I</td>
<td>Writing for Business (2 sections)</td>
</tr>
<tr>
<td>ENGL 143</td>
<td>Film &amp; Culture (2 sections)</td>
</tr>
<tr>
<td>ENGL 088</td>
<td>The Legacy of the Japanese American incarceration from WWII to 9/11</td>
</tr>
<tr>
<td>ENST 222</td>
<td>Estuarine and Coastal Marine Science</td>
</tr>
<tr>
<td>FREN 260.001</td>
<td>Introduction to French and Francophone Literature</td>
</tr>
<tr>
<td>FREN 260.002</td>
<td>L’Argent ne fais pas le Bonheur?</td>
</tr>
<tr>
<td>GEOG 056</td>
<td>Local Places in a Globalizing World</td>
</tr>
<tr>
<td>GEOL 072H</td>
<td>Field Geology of Eastern California</td>
</tr>
<tr>
<td>HIST 083</td>
<td>African History through Popular Music</td>
</tr>
<tr>
<td>HIST 174H</td>
<td>The Incas and After</td>
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<tr>
<td>HIST 262</td>
<td>History of the Holocaust</td>
</tr>
<tr>
<td>HIST 292H</td>
<td>Magic: Prague - Biographies of a Central European City</td>
</tr>
<tr>
<td>INLS 089</td>
<td>The Revolution Will Not Be Tweeted: Social Media in Popular Culture</td>
</tr>
<tr>
<td>KOR 150</td>
<td>History, Memory and Reality in Contemporary Korea</td>
</tr>
<tr>
<td>KOR 151</td>
<td>Education and Social Changes in Contemporary Korea</td>
</tr>
<tr>
<td>MASC 055</td>
<td>Changes in the Coastal Ocean</td>
</tr>
<tr>
<td>MASC 057</td>
<td>From “The Sound of Music” to “The Perfect Storm”</td>
</tr>
<tr>
<td>MATH 062H</td>
<td>Combinatorics</td>
</tr>
<tr>
<td>MATH 051</td>
<td>Fish gotta swim, birds gotta fly: Mathematics and mechanics of moving things</td>
</tr>
<tr>
<td>MATH 060</td>
<td>Simulated life</td>
</tr>
<tr>
<td>MUSC 063</td>
<td>Music on Stage and Screen</td>
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<tr>
<td>MUSC 089</td>
<td>Making and Marketing Music in a Digital Age</td>
</tr>
<tr>
<td>PHIL 345</td>
<td>Language and Communication</td>
</tr>
<tr>
<td>PLAN 053</td>
<td>Race, Sex and Place in America</td>
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undergrad 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 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.

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 including 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 to the GRC 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.’

- The GRC program has contributed to the culture of undergraduate involvement in research and scholarship on our campus.

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Next Steps for the GRC Program

The 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 focusing 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 current 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.

References


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.

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Home Energy Assessments in a General Education First-Year Course
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 order to understand the energy 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, and then analyze the information they’ve gathered, together with the household’s utility bills, to determine 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 estimated potential cost savings. 

This research project culminates in an energy-assessment report that is transmitted to the homeowner. The report includes discussion of the students’ findings along with 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 essay, an interpretive examination of a text, which is a task normally reserved for upper-level classes. This assignment asks students to engage deeply with their assigned passage and reflect on what they have learned through the entire course 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. 

Robert F. Zaidel and Kate Kronmacher, University of Wisconsin-Stout, zaidel@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 research in a variety 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 narrative. Each student finds her or his own sources, as opposed to writing a paper based on primary sources selected by anthol- ogy editors or depository archivists, thus actually engaging in original research.

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 the Scottish higher-education sector has taken place one of the most concerted policy interventions yet witnessed to create 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” (callenders 2009, 91) 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 forward constructed a clear identity for the higher-education sector can be seen as part of the building of a broader, more integrated and distinctive Scottish policy culture at that time. The impe- tus 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 institu- tions—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 fosters both competi- tion 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 overarching approach that emphasizes undergraduate research rather than solely assurance (the latter referring to ‘judgments made against defined criteria to ensure the meeting of a set of standards’). Quality enhancement (QE) is defined as “any collabora- tion by universities, universities and other relevant bodies to

From the International Desk

Undergraduate Research in Scotland: An Enhancement-led Approach

Scottish higher education increasingly finds itself, as do sec- tors elsewhere, having to cope with the complexities of a glo- balized 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 intensi- fication 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—cli- mate 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 policymakers and employers desire. Barnett (2000a, 257) has characterized the “supercor- nplex” 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 concern across government departments 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 participa- tion in research. Callenders (2006, 168) has noted that “being engaged in research of a frame- developing kind and projecting those frames to wider 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-autonomy.” She argues, “Moving away from unshared 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 knowl- edge” (2006, 50). As von Humboldt (1979) 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.
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 legitimation 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 has also been a concerted attempt, at least in the early years of the initiative, to move away from an overly managerial and prescriptive 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 reasonably high level of trust at all levels.”

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 undergraduates’ 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 “research-mindedness” that develops the 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 pursue.

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.

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 acquisitiveness of competence in research methods, and publication. Approaches that focus on research internships, undergraduate research publications, and undergraduates assisting the 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 these 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 approach seeks to develop the “research-minded” tendency (lower left-hand corner of the diagram) was deemed necessary in order to effect an active culture of “research-mindedness” that develops the 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 pursue.

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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, competences 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 circumstances.” 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.enhancingundergraduatescotland.org/publications/

A full account of the variety of undergraduate research projects 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 can expect 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 and working of problem-based learning (research the functions, physics, 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 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 theory they are taught is applied in real situations. 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 year working 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 monastery in the real world, 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 Second Life 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 external separateness of Buddhist life. This allows them to understand the ritualization of everyday life that is a part of monastic behaviour: experience the challenges they face in maintaining the monastic community, on the charity of the surrounding community, and understand the distinction between the ethics of personal conduct and the development of 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 manufacture of shore and coastal habitats, and state-of-the-art laboratories. The labs support work in fields includ-
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.

Introduction
As faculty members working 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 lecture 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—the 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 develop 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 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 lecture together provide the fundamental concepts to the students and involve the students in the classroom on a regular basis (Morrison 1986).

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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
In most universities today, 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 enrolment 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. After the early 1980s 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/two or three 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 student, 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 Kems 2000; Pasek 1994; Rutledge et al.).
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 Assignment. A faculty member's teaching assignment at predominantly undergraduate institutions during the nine-month contract is typically equivalent of four course-equivalents per term (or 12 contact hours, sometimes split between lab and lecture hours). Although much higher teaching assignments may be possible in some cases, it is often necessary to have a teaching load of nine or more course-equivalents for research-active faculty. 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 to prepare for research endeavors. Release time is also associated with post-tenure administrative assignments, such as department chair or head.

Support

Internal Support. Prior to starting a career in academia, a young academic should ask what internal administrative support will be available to hire and evaluate the candidates' 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 level and focus above serves to check that the procedures were followed and that the expectations of the candidates were met, if not exceeded.

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. For example, unlike what may be found at research universities, even moderately priced equipment is often shared. If the institution's mission is primarily teaching, the startup costs may be included 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 sessions, equipment, and consumables). 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 to find out what worked and what did not in the past. The American Chemical Society’s Committee on Professional Training sets guidelines and establishes a new investigator award. The government also should consider writing a proposal that can meet the 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 national certification requirements. Undergraduate should have a minimum of 28 semester credit hours of basic instruction with basic comparison emphasis on analytical, inorganic, organic and classical, and research methods. The curriculum also should 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 instrumentation, and an introduction to the study of biological and physical chemistry.” Laboratory instruction also should include "practical experience with instrumentation for spectroscopy, spectrophotometry, titration techniques, chromatography, 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 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 minimizing waste and costs associated with waste disposal, without compromising the learning environment (Singh, Stafan, 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 Warneck 2006). As a result of the advantages of individual laboratory experiments rely on simple organic compounds and instead employ more complex, naturally occurring compounds and stereoselective reactions (Leslie, Lee, and Smith 2012; Wong, Sultana, and Vosburg 2014).

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, Stafan, 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 Warneck 2006). As a result of the advantages of individual laboratory experiments rely on simple organic compounds and instead employ more complex, naturally occurring compounds and stereoselective reactions (Leslie, Lee, and Smith 2012; Wong, Sultana, and Vosburg 2014).

Student Recruitment and Mentoring

Recent pedagogical changes that offer research experiences as part of the institutional laboratory experience may, interest- ingly, 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 they can begin to identify their own motivation for studying chemistry and is the beginning of their preparation for a fruitful career in the chemical sciences.

Faculty and Student Collaborative Research

One of the incentives to start 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 for many promising students. It is important that the faculty member and those working with him or her require to be considered successful. With limited resources and a time-line for major promotion, maximizing productivity is a must for the new faculty member. In most cases, the department will furnish the consumables and have adequate instrumentation. The faculty teaching research guidelines 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 prac- tices is of paramount importance, especially when faculty are entering the college/university ranks. From freshmen to senior-year class, 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 may make mistakes, a wet lab is not the proper setting for trial and error practices. Proper procedures must be followed, given the importance 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 ethics” or steady supervision will keep the research on track. With the acquisition of the necessary skills to run, monitor, work up, purify, and characterize materials prepared in a program that includes researchers of different ages, back- grounds, 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 presenta- tion.

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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 syn- thetic methodology, occur at a very rapid pace, and students and faculty should not have to contend with barriers to access- ing recent research because the chemical literature is an essential component of an ACS-approved chemistry program. The underlying principle is that the most effec- tive 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: ana- lytical, biological, inorganic, organic, and physical chemistry (ACS-JPT Journal List 2006). ACS-approved programs have access, when researchers perform literature searches, to a host of refereed journals in the chemical sciences, as well as access to full abstracts in Chemical Abstracts. Many institutions are now compulsory use of databases such as SciFinder® (https://www. cas.org/products/scifinder) and Reaxys® (https://www. reaxys.com/info/) to enhance and facilitate searching the chemical literature.

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 laboratory, the chemistry student can be acquired. 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.

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-constructed problem statement. For many students, the statement emerges from repeated discus- sions and is fine-tuned through searching the chemical lit- erature. 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 contemplating. Then the 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 scietific writing and publishing. Faculty members, the mentoring experience with undergraduates is immensely beneficial to furthering the faculty member's research project, but also to the development of the students as scholars in the field.

The key to success in sustaining a thriving undergraduate research program includes dissemination of data (both publications and presentations) and 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 outstanding 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 discussion take place hand-in-hand, timely reminders are needed for 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. 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 succeed 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 not only to teach the disciplinary subject matter but also to create true passion and interest in 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 academic research.

Helpful Resources

American Association of University Professors (AAUP). http://www.aaup.org
American Chemical Society's Committee on Professional Training (ACS-CPT). http://portal.acs.org/portal/Public/WebSite/about/governance/committees/training/acsapproved/degreeprogram/WPCP_008911
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/acs/coc/content?_nfpb=true&_tn=ts_trk_pльтctraphic_links&nodeId=132115&secid=pdf&node=920&sec=pdfs&subnode=229-42634-9532-8a44d3bb6c67
National Science Foundation.
http://www.nsf.gov/funding
National Institutes of Health.
http://grants.nih.gov/grants/funding/funding_program.htm

Literature Review and Dissemination of Data

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

References


Emily C. McLaughlin
Bard College, mclaughlin@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.
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 methodologies. David currently serves as chair of 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.

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 30 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 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.

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Undergraduate Research Highlights

Highlights consist of brief descriptions of recent (past six months) peer-reviewed research or scholarly publications in scholarly journals. These publications must be in print and must include one or more undergraduate co-authors. A quarterly call for submissions will be sent to all members and posted on the CUR Web site.

Submissions should include:

• Title of the article and full journal citation (inclusive pages).
• A brief description (3-5 lines) of the research and its significance.
• Title and department or program affiliation of the faculty member. A brief description of the student co-author(s). Include the year of study in which the student(s) undertook the work, the opportunity through which the work was undertaken (independent study project, summer project, REU program, senior thesis project, etc.), and the current status of the student (graduate school, employed, still enrolled, etc.).
• The source of funding for the work.

For questions, contact:
Undergraduate Research Highlights Editor
Nicole Bennett
Currett@Appstate.edu

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The CUR Quarterly publishes short reviews of books and other new publications the editors deem of interest to the undergraduate research community. Books or other publications will be reviewed within 12 months of publication. The Book Review Editor will select appropriate titles for review and solicit reviewers. In order to ensure that the reviews are as timely as possible, the Book Review Editor will expect to receive finished reviews within two months of assignment. Each printed issue of the CUR Quarterly will include one review.

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Ari Alen-Rindell
Ahernmr@Uga.edu

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The CUR Quarterly publishes articles relating to all aspects of undergraduate research that are of interest to a broad readership. Articles regarding the effects of the research experience on the development and subsequent endeavors of students, and how to initiate, support, or sustain undergraduate research programs are appropriate for this journal. The CUR Quarterly is not the appropriate venue for publishing results of undergraduate research.

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Prepare to Submit —
• Copy of article (MS Word or compatible format, Times font, 12-point, double-spaced, 1 inch margins, and single-spacing between sentences); 2000-3500 words is the typical length of an article, but longer or shorter articles may be appropriate for certain topics.
• Key words for indexing (up to 10).
• Personal information:
  — Institutional title, mailing, and email addresses for the corresponding author.
  — Biographical sketch for each author (4-6 sentences).

How to Submit —
Authors are encouraged to discuss disciplinary articles with the appropriate Division Editor prior to submission. Contact information for all Editors is listed at the front of every issue of the CUR Quarterly. Once you are ready to submit you will need to visit [http://curQuarterly.net](http://curQuarterly.net) and complete the online submission process.

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