



Characteristics of Excellence in Undergraduate Research (COEUR)



Characteristics of Excellence in Undergraduate Research



Edited by: Nancy Hensel
The Council on Undergraduate Research



Characteristics of Excellence in Undergraduate Research

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Editor's Note:

For over 30 years the Council on Undergraduate Research has encouraged faculty to engage undergraduate students in research and has assisted institutions in the development of undergraduate research programs. Founded by ten chemists in 1978, the organization has grown to include 645 institutional members including community colleges, public and private institutions, liberal arts colleges, research universities, and several universities outside the United States. The organization also has well over 7,000 individual members across all disciplines. CUR has become the national voice and is becoming the international voice for undergraduate research. *Characteristics of Excellence in Undergraduate Research (COEUR)* is based on the collective experience, over many years, of CUR members who have engaged undergraduate students in research, developed undergraduate research programs, mentored new faculty to include undergraduate research in their teaching repertoire, and coached universities in the development of undergraduate research programs. Roger Rowlett, Linda Blockus, and Susan Larson have drawn on this extensive knowledge base to design an instrument to assist institutions to self-assess the maturity of their undergraduate research programs. The instrument aspires to present the best practices in undergraduate research. It can be used as a guide for institutions that are striving to enhance the learning experiences of students through research program. It can also be used as a beacon for institutions that are in the beginning stages of developing an undergraduate research program. Several undergraduate research experts have contributed essays to this monograph that illuminate how *COEUR* can be used by departments, colleges, and universities to evaluate undergraduate research programs. CUR believes that undergraduate research is one of the most powerful learning strategies for undergraduate students. Undergraduate research is also a significant contributor to American innovation and economic development. The skills students can develop through engagement in research will serve them well in their future careers. It is hoped that *Characteristics of Excellence in Undergraduate Research* will be of value to institutions and will contribute to the development of new programs and the enhancement of existing programs. CUR is appreciative of the commitment and generosity of its members in making their expertise available to other faculty and institutions.

Nancy Hensel
President of New American Colleges and Universities
CUR Executive Officer 2004-2011

Nancy Hensel served as Executive Officer from 2004 until 2011 when she became president of the New American Colleges and Universities. During her tenure at CUR she was principal investigator for seven National Science Foundation grants to assist faculty and institutions to develop undergraduate research programs. While serving as Provost at the University of Maine at Farmington, she initiated the undergraduate research program. She also initiated an undergraduate research program at the University of Maine at Presque Isle where she served as president. She has been invited to speak at many national conferences, US campuses as well as at international meetings and campuses.

Introduction

“Coeur” in French, of course, means “heart,” and the etymology of the word is the same as the word “core.” *Characteristics of Excellence in Undergraduate Research (COEUR)* represents 30 years of the Council on Undergraduate Research’s highly successful mission to assist and support faculty and institutions in bringing undergraduate research, scholarship, and creative activity to the heart—the core—of an excellent undergraduate education.

My own undergraduate research experience was a turning point for me. For the first time I understood that learning could be truly active and transferrable to other situations and that I could and should take responsibility for creating knowledge and answering real questions. Along with those realizations came many other habits of mind. Each has served me in all aspects of my life and career as a student, mentor, teacher, scholar, administrator, and now college president.

Responsibility, persistence, synthesis, analysis, thoroughness, teamwork, leadership, commitment, patience, perspective-taking, and ethical behavior—hallmarks of a quality undergraduate research experience—are essentials that I bring daily to my work leading an institution. Since my first experience as an undergraduate researcher, it has been my goal to “pay it forward” to future generations of students and faculty by supporting undergraduate research in every way possible. I began with the first classes I taught as a graduate student, with my first student mentee’s work accepted for presentation at a *Sigma Xi* conference. I continued as a faculty mentor and scholar during every year of my career, mentoring dozens of students in my own lab and in their individual projects. As an accreditor, and through my work with CUR as a facilitator at the CUR Institutes, I translated my own research and empirical background into assessment expertise—including the assessment of undergraduate research. During my presidency, my institution’s support of undergraduate research and the movement of such activity to the mainstream of student’s education have increased dramatically; undergraduate research is now one key way to fulfill a general education requirement.

COEUR is a major step forward in supporting faculty in their endeavors as mentors and scholars, but it is also a “call to action” for those of us who lead departments, divisions, schools, colleges, and universities. It represents the culmination of the 30 years of CUR’s work to fulfill its mission, and notably, is a testament to the dedication and love of countless volunteers—individuals and allied organizations—whose tenaciousness has never faltered. It signifies undergraduate research’s centrality as a well-developed, well-understood, well-integrated, and essential component of a quality college education. In form and substance, it sets forth a comprehensive blueprint for achieving best practice in faculty development to sustain the highest quality student learning.

As a handbook, primer, and road map, *COEUR* will serve equally well those of us with experience and longstanding commitment to undergraduate research, *and* those of us who have high aspirations to learn about it and to support it. In these pages, readers will find the personal stories of individuals and institutions that are leaders on the way to achieving an audacious aspiration. I invite you to aspire to the same dream.

MaryAnn Baenninger

President of the College of Saint Benedict, a liberal arts college that prides itself on its commitment to undergraduate research as a model of engaged learning. Baenninger is a career-long volunteer in and supporter of CUR’s mission.





Characteristics of Excellence In Undergraduate Research (*COEUR*)

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Preamble

The mission of the Council on Undergraduate Research (CUR) is to support and promote high-quality undergraduate student-faculty collaborative research and scholarship. CUR defines undergraduate research as an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline. Undergraduate research—a term that encompasses scholarship and creative activity—is recognized as a high-impact educational practice that has the ability to capture student interest and create enthusiasm for and engagement in an area of study.

CUR, as the leading voice in undergraduate research, has more than 30 years of experience working with faculty and institutions to build and sustain undergraduate research and with evaluating undergraduate research programs. This document represents a compilation of the experience of CUR in building and evaluating undergraduate research programs at all types of institutions, including public and private, primarily undergraduate through research intensive. This document is intended as a guide for those who oversee undergraduate research and those who wish to build, evaluate, and maintain robust, productive, meaningful, and sustainable undergraduate research programs. Institutions, programs, academic departments, faculty, and administrators should find this document valuable as they work to develop and enhance their undergraduate research enterprise.

Characteristics of Excellence in Undergraduate Research (COEUR) is a summary of best practices that support and sustain highly effective undergraduate research environments. This document is organized in sections that correspond to various functions or units of a typical college or university campus. In CUR's experience, successful programs exhibit many of the characteristics enumerated in this document. Further, many of the characteristics described in this document overlap and are important elements in an integrated, synergistic approach to enhancing undergraduate research.

1. Campus mission and culture

Creating a campus culture that values and rewards undergraduate research is essential for sustaining a robust undergraduate research program. CUR believes that such a culture emerges when institutions have a scholarly faculty and leaders committed to providing high-quality undergraduate research experiences for students; broad disciplinary participation in undergraduate research; and opportunities that are accessible to a wide cross section of students.

1.1 Institutional commitment

Institutional commitment to undergraduate research as a high-priority activity for its faculty and students is essential for creating a successful undergraduate research environment. College administrators must clearly articulate how undergraduate research aligns with the mission and/or strategic plan of the institution. Providing appropriate resources and recognition to faculty and students engaged in research will increase the success and sustainability of undergraduate research initiatives. Involvement of other campus constituents, such as student-affairs personnel (e.g., in providing on-campus housing for summer undergraduate researchers), facilities/physical plant staff (e.g., in creating appropriate spaces for research), the office of human resources (e.g., in working with student payroll), the office of advancement/development (e.g., in fundraising for undergraduate research) are also necessary in creating a campus climate that effectively promotes undergraduate research. Specific ways in which institutions can demonstrate their commitment to creating a culture that values and encourages undergraduate research are described in subsequent sections of this document.

1.2 Scholarly faculty

A key component to a successful undergraduate research environment is an institutional commitment to a scholarly faculty. For students to derive the most out of an undergraduate research experience, it is important for faculty to be current and active scholars in their fields. Institutions that adopt a teacher-scholar model, in which faculty are expected to regularly produce scholarship that is recognized by their peers and in which a premium is placed on teaching, have in place one critical element of effective undergraduate research mentorship and productivity.

1.3 Faculty commitment

A scholarly faculty is necessary but not sufficient to establish and sustain an outstanding undergraduate research environment. Faculty members also must be committed to undergraduate research as an important part of their roles and responsibilities. Not all faculty scholarship will involve undergraduates, but it is essential that faculty members value both the contribution of undergraduates to scholarship and the participation of undergraduates in scholarly activities as an important part of their education. Such faculty should seek to create opportunities for undergraduates to be involved in research.

1.4 Broad disciplinary participation

Institutions with highly successful undergraduate research environments have faculty and student involvement across diverse disciplines so that students have research options in as broad a range of inquiry as possible. Students majoring in all academic areas, including professional disciplines, should have opportunities to participate in faculty-mentored research, scholarship, and creative activities.

1.5 Accessible opportunities for undergraduates

The intellectual experience of pursuing research is beneficial to all students. As such, engagement in undergraduate research should not be limited solely to seniors or to honors-level students. Rather, undergraduate research opportunities should be accessible to as broad a range of students as is practical.

1.6 Integration with other engaging and high-impact opportunities

The undergraduate research enterprise on a campus should be integrated and coordinated, where possible, with other high-impact practices to maximize student development, leverage

resources, and incorporate undergraduate research across the institution. While some collaborations will be more obvious (e.g., honors programs; building research awareness in a freshman orientation class; working with service learning initiatives to develop community-based research projects; helping student researchers apply for national fellowships), other less obvious partnerships can provide another layer of excellence for students. These include study abroad (international research experiences); leadership programs (enhancing leadership and peer-mentoring skills); career centers (leveraging research experiences into employment and new career directions); and residential life (residence halls with research-themed communities). Additionally, leaders of broad learning and education initiatives (e.g., general education, global citizenship, communication proficiency) should look to undergraduate research programs to further their goals, and leaders of undergraduate research should look to such initiatives for approaches to maximize student learning.

2. Administrative support

While faculty members are critical in the implementation of undergraduate research, administrative support and commitment are essential to sustain the undergraduate research enterprise. Support can be construed not only in terms of funding, supplies, and equipment, but also in terms of time, personnel, recognition and reward models, and administrative flexibility and creativity.

2.1 Internal budgetary support

To build and sustain successful undergraduate research environments, expectations for faculty-student scholarship must be accompanied by appropriate resources. Successful institutions recognize that undergraduate research is associated with real costs for materials and personnel, and they use that understanding in allocating resources to academic departments, programs, and perhaps individuals. Different disciplines will have varying needs for internal budgetary support for undergraduate research; however, administrators should recognize that undergraduate research requires financial and human resources for all disciplines. In addition, institutions should recognize the need to provide matching funding for research grants from external sources, when appropriate, and to provide for long-term operational and maintenance costs for acquired research equipment and/or infrastructure.

2.2 Startup funding

Faculty startup funding to support scholarship should be commensurate with institutional expectations for scholarship and undergraduate student participation in faculty research. New faculty should be awarded startup research funding to establish the necessary infrastructure and research materials to enable them to begin effective and productive research. Startup funding packages might provide items such as specialized research equipment or research materials (e.g., journals, books, databases), funds to travel to research sites or archives, and faculty and/or student research stipends. Appropriate time for faculty to develop their research space should also be provided. In disciplines in which external funding is available, startup funding should be sufficient to help faculty develop a scholarly track record that will allow them to be competitive for external research funding.

2.3 Faculty load credit for supervising undergraduate research

If undergraduate research is an institutional priority that fulfills a critical role in student education as well as scholarship, then time for faculty to engage in research and mentor students must be protected. At institutions where most faculty members have heavy teaching loads, faculty should be appropriately compensated, through appropriate teaching load credit or reassigned time, for supervising undergraduate research. More research-intensive, doctoral-granting insti-

tutions also should recognize the importance and time-consuming nature of faculty work with undergraduates. There are various models of how to compensate faculty with course-load credit, including having undergraduate research count as part of the faculty member's credit-hour load (as much or more than 10 percent of one's teaching load credit at predominantly undergraduate institutions); rotating load credit among faculty within departments; or offering small-enrollment courses in which faculty receive credit for teaching their research team.

2.4 Reassigned time for research-related tasks

In addition to receiving workload compensation for supervising undergraduate research, providing appropriate reassigned time for faculty to engage in research-related tasks is likewise important. Faculty, especially those with relatively heavy teaching loads at primarily undergraduate institutions, may face difficulty in finding sufficient time to write research grant proposals, complete scholarly articles or books, or coordinate and administer such research activities as serving on research-related committees (Institutional Review Board (IRB), facilities, library acquisitions, etc.), supervising personnel, or administering multi-faculty research projects. These are essential activities for maintaining active and robust research programs, however, and many institutions support these activities through reassigned time for faculty.

2.5 Undergraduate research administrative support

2.5.1 Undergraduate research program office

Most highly successful undergraduate programs are associated with a central office of undergraduate research, which oversees campus-wide undergraduate research activities that include but are not limited to on-campus research symposia, summer research, student workshops, mentorship training, and disbursement of funds for student travel. Some undergraduate research offices may award internally or externally funded summer research assistantships to students and/or to faculty. Establishment of a designated position for an undergraduate research program director provides a clear statement of the importance and expected potential of the undergraduate research enterprise on a campus. The program director's position (and associated costs) should be funded through the institutional budget, rather than depending on soft money, even though new initiatives funded through external grant dollars are often the catalyst for creating a position that evolves into a permanent post on campus. Where the program director is located in an institution's organizational structure is critical, but this will likely vary by institutional type and idiosyncrasies of each campus environment. The director of undergraduate research should have appropriate professional credentials, such as a master's degree in an academic discipline or in student affairs and prior entry-level experience. Additionally, support for continued professional development for the director is critical to establishing and sustaining a level of excellence for the undergraduate research environment.

Some institutions do not have the demand or resources for full-time professional staffing for an office of undergraduate research or for a director of undergraduate research; some may instead have an appointed coordinator of undergraduate research (often a faculty member committed to and knowledgeable about undergraduate research issues with reassigned time devoted to this role). Having a central advocate for undergraduate research on campus is important for publicity, coordinating campus undergraduate research events, maintaining awareness of internal and external opportunities for enhancing undergraduate research, and conducting assessment. Some offices/coordinators of undergraduate research work with a campus advisory board, which often includes student members. These boards are an important element for building advocacy and for providing direction and guidance.

2.5.1.1 *Space*

Adequate administrative space should be provided in a location on campus with high student and faculty visibility, possibly near other similar administrative or student services offices and with easy access to meeting rooms. Affordable, highly visible space also should be easily available for campus-wide symposia/celebration days. When a faculty member assumes the role of campus undergraduate research coordinator on a rotating basis, it can be disruptive to the establishment and long-term growth of the program to rotate the office to the coordinator's departmental office.

2.5.1.2 *Infrastructure Support*

Funding should be provided for routine office expenses (including computer and software upgrades), the costs of workshops and events, publicity, professional development for the coordinator, and membership dues for the coordinator's CUR membership. The publicity budget should include funds for outreach internally to students and faculty, as well as resources to promote the program's success stories to a broader audience. External publicity may be best done in partnership with other offices on campus.

2.6 *Travel and other student funding*

Both faculty and student scholars greatly benefit from presenting research results at professional meetings and conferences. This activity provides faculty and students the opportunities to build professional networks and generate and discuss research ideas. Institutions with exemplary undergraduate research programs provide sufficient funds for faculty and students to present research results at a minimum of one professional meeting or conference each year. In addition, exemplary institutions provide funding for faculty to travel with undergraduates to conferences the individual faculty might not otherwise attend, such as student-centered conferences. Having faculty at these meetings helps students gain the most from their conference experience. In addition to providing funding for student travel to present their completed research, offices of undergraduate research often support an internal program of small equipment, supply, and travel grants to help students initiate their research.

2.7 *Research grants office*

Institutions should have a research grants office to keep track of and alert faculty to funding opportunities. An office of sponsored research will also manage the grant-application process, including electronic submissions with the appropriate institutional certifications, and will assist faculty with post-award administration. In cases where establishment of an independent grants office is not possible, institutions must designate a knowledgeable person to be responsible for acting as the institutional representative for grant submissions; this person must be given sufficient reassigned time to perform this job well. Institutions with established units for administering grants should work to ensure that faculty members submitting proposals are aware of funding opportunities to involve undergraduates in their work and that they know about internal resources and programs that could bolster their proposals and help them achieve maximum impact and efficiency. Grants staff should also be available to assist with student-initiated proposals for external grants or awards that require institutional consent and support.

3. *Research infrastructure*

An essential feature of a supportive undergraduate research environment is infrastructure. Without appropriate space, equipment, and other research resources, even the most talented and

creative faculty members cannot sustain productive research and scholarship that involves undergraduates.

3.1 *Space*

Institutions must provide adequate, dedicated space for the undergraduate research enterprise to flourish; this is especially critical in the sciences and creative arts, but it is relevant to all fields of study because secure, but accessible, space is necessary for faculty and students to gather for research conversations and activities. Classrooms or teaching laboratories/studios are not typically properly configured to accommodate research activities, and they may not be available at the right times or for sufficient blocks of time for productive faculty-student collaborative research to be performed. In the experimental sciences, a typical faculty-student research laboratory is 500 to 600 square feet in size, including dedicated desktop workspace for students. Laboratory and studio spaces should meet modern lighting, safety, and ventilation requirements and be properly climate-controlled for use year-round. Private space may be needed for confidential research interviews, focus groups, or observational studies. For all fields of study, comfortable conference and meeting space is critical; ideally this space would be in locations near faculty offices, studios, or laboratories. Research data and supplies should be kept in a secure location for reasons of confidentiality and safety.

3.2 *Instrumentation and equipment*

In the experimental sciences and creative arts, instrumentation and appropriate studio equipment are critical for effective research and education. Exemplary undergraduate research programs have on-campus access to the appropriate instrumentation and equipment required for faculty-student collaborative research, and the institutions have well-defined departmental and institutional plans for acquisition, maintenance, and periodic replacement of this infrastructure. At institutions without appropriate on-campus instrumentation, campuses should make arrangements to use equipment housed at nearby facilities (e.g., a relatively small, primarily undergraduate institution might arrange to make use of the core facilities at a nearby research institution).

3.3 *Library resources*

To sustain a successful undergraduate research program, it is essential to have adequate library resources so that faculty and students can investigate new research ideas, search for information, prepare competitive research proposals, and write research manuscripts and student research theses and reports. Inadequate library resources can be a significant barrier to the productivity and long-term success of an undergraduate research program. Faculty and students should have access to primary literature, and institutions should have a strategy for acquiring appropriate journals, monographs, and books to support undergraduate research. In cases where appropriate collections are not available on-site, institutions should provide timely interlibrary loans or other means of acquiring needed documents and/or make funding available for faculty and students to travel to necessary collections. Faculty and student researchers must have access to appropriate disciplinary tools for searching primary literature and obtaining up-to-date information (e.g., SciFinder Scholar, Web of Knowledge, SCOPUS, etc.). Ideally, these resources will be available to faculty and students electronically, so that the tools can be used anywhere. Support for information-literacy training and development of research skills should be built into the curriculum.

3.4 *Computational resources*

Faculty should be provided with computer hardware equipped with an operating system of their choice, suitable for using software and utilities appropriate to research in their discipline.

Similarly, students should be able to access computing equipment appropriate for the research they are conducting. A high-speed computer network should be available in offices and research spaces, and this network should support typical protocols that are required for research.

3.5 *Other research resources*

Faculty and students may also need access to museum collections; local, national or regional archives; geological samples; historical artifacts; or other specialized research materials germane to their research. If these are not available on-campus, institutional support to borrow or travel to these resources is critical.

3.6 *Research oversight structures*

Any institution conducting research with undergraduates needs to have certain research oversight structures in place, including an Institutional Review Board (IRB) for research projects involving human subjects; an Institutional Animal Care and Use Committee (IACUC) for research projects involving vertebrate animals; and chemical, environmental, and biological hazard policies and oversight structures. These and other mechanisms are required to comply with state and federal regulations for relevant research projects, and they are likely to be a condition for research funding. In the case of ethical review committees, they also provide oversight for training of undergraduates in research ethics associated with human and animal subjects.

3.7 *Support, administrative, and technical staff*

Many institutions have discovered that support and technical staff can enhance undergraduate research by allowing faculty and students to focus more effort on research, rather than spending valuable time tending to administration of research and teaching or maintenance and repair of equipment. For example, laboratory or studio support staff can stock supplies, configure computer equipment, and/or prepare materials for teaching laboratories; instrument technicians can install and provide preventive and unscheduled maintenance for equipment; technicians can order and maintain supplies, and/or prepare routine research materials; administrative assistants can oversee fiscal management of project expenses and coordinate review processes by working with the IRB and IACUC. Additional support with computer maintenance, curating artifacts and artwork, and library references can make for a more effective research environment.

4. *Professional development opportunities*

To remain effective scholars throughout their careers, faculty need the opportunity to learn new research methodologies, obtain recurrent research training, establish external research collaborations and scholarly networks, complete scholarly pursuits, and freshen mentorship skills. Many of these activities are part of a robust faculty mentoring program. Such professional development opportunities are critical to undergraduate research because faculty members who are current scholars in their areas of expertise are able to engage students in research that is relevant and conforming to modern praxis. Other professionals involved in the oversight of undergraduate research also benefit from professional development, and relevant opportunities should be made available to them as well.

4.1 *Research leaves*

Professional leaves are essential for faculty to remain current, knowledgeable, productive scholars, and by extension effective mentors of undergraduate research. Thus institutions should promote regular opportunities for research leaves, and if possible, this should include both sabbaticals and leaves for junior faculty. Recurrent training is especially critical in the sciences and

arts because rapid technological changes require faculty to acquire new competencies to continue to be productive scholars.

4.2 *Research training opportunities*

Opportunities to learn new research skills and techniques via workshops, mini-conferences, short courses, or research training “camps” should be encouraged and supported.

4.3 *Non-research-related professional development*

It is important to recognize that faculty and administrators may benefit from participating in workshops, conferences, and communities of practice not directly related to their research. Institutions that support travel to non-research meetings provide career and professional development that also can enhance undergraduate research. For example, such opportunities may provide faculty with new pedagogical techniques that can be applied to undergraduate research; allow faculty and administrators to experience diversity training, making them more effective at supporting and mentoring students of a variety of backgrounds; and provide training on how to purposefully implement and assess undergraduate research programs.

4.4 *Mentorship training*

4.4.1 *Faculty*

Ongoing opportunities for faculty to reflect on their mentoring skills and discuss mentoring issues with colleagues are essential to providing a student-centered research experience. Undergraduate research programs are encouraged to offer orientation sessions for mentors that clearly outline faculty, student, and program expectations. Faculty should be encouraged to attend professional development meetings on mentoring and leadership development. Faculty should also be encouraged to draft personal professional development plans. Junior faculty should be mentored by more experienced peers as they begin to juggle the potentially competing demands of teaching, service, scholarship, and mentoring of undergraduates.

4.4.2 *Graduate students and postdoctoral fellows*

Recognizing that at some institutions, graduate students and postdoctoral fellows play a significant role in mentoring undergraduate researchers, appropriate training opportunities should be provided to enhance their skills and ensure undergraduates are receiving excellent mentoring. This is critical because many of these graduate students and postdocs will eventually assume faculty positions and become the next generation of faculty mentors for student researchers.

5. *Recognition*

An institution that values undergraduate research as a high-priority activity that is integral to its educational mission will provide clear, tangible forms of recognition for faculty and students who engage in it.

5.1 *Promotion and tenure guidelines*

If undergraduate research is an important institutional activity, it should be clearly and prominently described in promotion and tenure guidelines for faculty. Many institutions specifically identify mentoring, faculty-student collaborative research, and publication of student co-authored peer-reviewed research as especially valued activities for promotion and tenure. To be effective, promotion and tenure guidelines must be clear and effectively communicated to new faculty and to new members of tenure and promotion committees or faculty evaluation teams.

5.2 Salary review

Likewise, undergraduate research activity and productivity should be recognized in faculty salary reviews and decisions on merit pay awards.

5.3 Campus awards

Institutions with exemplary undergraduate research programs recognize and publicize the importance of undergraduate research through public awards for excellence. Programs and departments that provide outstanding undergraduate research experiences for students should be recognized. Examples of recognition include but are not limited to awards for excellent faculty mentoring, outstanding undergraduate research theses, prize-winning student publications, and outstanding research posters.

5.4 Prominent publicity for research accomplishments

Excellent undergraduate research programs promote their successes by prominently featuring undergraduate research on the institution's website, in its print and electronic publications, and in its outreach to public and social media. In addition, students involved in undergraduate research may be encouraged to apply for prestigious scholarships and graduate fellowships, and any such awards should be widely publicized. Wide publicity should also be given to any awards that faculty receive from professional societies and any awards received by students at professional meetings. Appropriate infrastructure and administrative support are required to identify successes and utilize germane publicity outlets.

6. External funding

External funding is essential for the development of a rich, productive, and cutting-edge faculty-student research environment. Although the availability and importance of external funding for research varies by discipline and sometimes by state and region, an institutional culture of supporting and encouraging the acquisition of external research funding is important to sustain research. Very few institutions have sufficient resources to sustain a viable research program with internal funding alone. Rather, institutions and faculty must partner to leverage internal funding with external funding to sustain strong undergraduate research programs and infrastructure over the long term. It should be emphasized that competitiveness in external funding is directly related to research productivity, that is, the production of peer-reviewed research scholarship. External funding comes with increased expectations for the dissemination of peer-reviewed projects. To sustain an excellent undergraduate research program, institutions must provide an environment in which faculty have the time necessary to meet the increased expectations for publication or other recognized types of dissemination.

6.1 Faculty research funding

In successful undergraduate research environments, faculty members seek and receive external funding to help support undergraduate research students, research technicians, graduate students and/or postdoctoral fellows, and also to acquire research equipment and infrastructure. Although many research grants may be used, in part, to support undergraduate research, there are grant programs specifically designated for undergraduate research and for predominantly undergraduate institutions. Examples at the federal level include the National Science Foundation's Research in Undergraduate Institutions (RUI) and Research Experiences for Undergraduates (REU) programs, as well as the National Institutes of Health's Academic Research Enhancement Awards (AREA, or R15). Some private foundations (e.g., the Research Corporation for Science Advancement, the American Chemical Society Petroleum Research Fund, and the Camille and

Henry Dreyfus Foundation) specifically provide faculty with funding to support research with undergraduates. Especially in disciplines in which research infrastructure is critical for high-quality research, external funding is essential for creating and maintaining a strong teaching and research environment.

6.2 Institutional funding for research

Colleges and universities that are committed to undergraduate research will also seek and receive institutional funding in support of undergraduate research. Some of these institutional awards are by invitation only, and many require a history of faculty research productivity and external grant-seeking success.

7. Dissemination

An essential element of all research is dissemination. While faculty and students should strive for peer-reviewed dissemination that contributes to new knowledge within their disciplines, other forms of research dissemination are also desirable. Students who do disseminate their research, via publications, presentations, exhibitions, or performances, should be celebrated on campus.

7.1 Peer-reviewed publication, exhibition, or performance

CUR defines undergraduate research as scholarship that makes an original contribution to a discipline or area of study. As such, research results should be disseminated in a form that is appropriate for a scholar in the research field, and the highest level of dissemination of undergraduate research is in the form of peer-reviewed publication, exhibition, or performance. In the physical or social sciences, this would typically mean a published article in a peer-reviewed journal. In this instance, students should be included as co-authors and should be involved in the writing and editing of the manuscript. In the arts or humanities, dissemination might be a juried exhibition, public performance, or publication. It is important that faculty and students strive for this level of scholarship because it typically provides the greatest intellectual benefits for students and is essential in faculty reward structures and for faculty seeking external research funding.

7.2 Presentation at professional meetings

Professional research meetings provide excellent opportunities for students to present research to other scholars in the field, gain feedback on their work, conduct professional networking, and try out presentation of research results prior to peer-reviewed publication. Institutions should endeavor to have policies and funding to encourage students' participation in such activities. Students who attend professional meetings should receive mentoring on how to navigate such opportunities.

7.3 Student research conferences

Not all undergraduates are ready to present research results at national professional meetings, especially early in their academic careers. In addition, some disciplines do not yet welcome undergraduate students at professional meetings. For such undergraduates, a student research conference (e.g., the National Conference on Undergraduate Research or the Annual Biomedical Research Conference for Minority Students) or a regional disciplinary conference might be a more appropriate venue to gain valuable experience in presenting and disseminating findings, connecting with others in the discipline, and gaining feedback on their ideas. Institutions should encourage and support student participation in these conferences.

7.4 *On-campus symposia*

Most institutions with successful undergraduate research programs host on-campus research symposia that bring together the community of undergraduate scholars in events that celebrate undergraduate research and provide opportunities for peer networking and cross-disciplinary conversation. Outstanding institutions promote broad student attendance so that more undergraduates may benefit from a research-rich environment and the opportunity to learn from their peers. A campus undergraduate research office that organizes such events may also offer other kinds of support, such as workshops on writing abstracts, on making and presenting a research poster, and on creating and delivering an oral presentation. This assistance may greatly enhance the quality of the campus event and provide multiple learning and skill-building opportunities for students.

8. *Student-centered issues*

It should be recognized that while a defining characteristic of undergraduate research is the creation and dissemination of new knowledge, undergraduate research also comes with a set of additional student-centered issues and faculty responsibilities that relate to the student experience and the educational impact of the activity. As a high-impact practice, faculty and administrative leaders should design undergraduate research experiences that incorporate the best practices in undergraduate education, such as the Principles of Excellence outlined by Association of American Colleges and Universities (AAC&U) and documents produced by disciplinary societies. Relevant issues include, but are not limited to, providing high expectations for the student, including a broad range of students, outlining paths to progress, assessing student development, and connecting the research topic to societal issues.

8.1 *Opportunities for early and sustained involvement*

Departments and programs should have mechanisms to identify and recruit undergraduate researchers early in their careers. Assessment data indicate that undergraduates make the most intellectual gains, and have the greatest opportunity for becoming research partners and co-authors of peer-reviewed publications, if they are involved in faculty-supervised research early and repeatedly in their academic careers (Lopatto 2009), and if they are invited to make long-term commitments to research. Early involvement also helps students acquire multiple research experiences during their undergraduate years, and this may help them define their career interests.

8.2 *Establishing and communicating expectations*

Faculty mentors should set high, clear, and realistic expectations for students engaged in undergraduate research. Such expectations might include, but not be limited to, the level of independent work expected, the minimum number of hours per week devoted to research, the minimum length of the research commitment (e.g., one semester or a full academic year), periodic and final oral presentations, a final report in a disciplinary-specific format, or other evidence of regular research progress. Such expectations should recognize the many demands on students' time, but should nevertheless encourage students to expand their engagement. Faculty should have regular discussions with students to provide feedback on their progress and revise expectations as needed.

8.3 *Developmentally appropriate expectations and intellectual ownership*

Excellent undergraduate research environments provide opportunities for students to become involved at different points along the developmental pathway. First- and second-years may begin engagement by performing duties that assist faculty or other members of a research team, becoming accustomed to the culture of research and learning skills along the way. Students may also begin by working on a project designed by a faculty mentor or one that is a continuation of

another student's project. At the more advanced end of the developmental pathway, students may conceive their own projects based on the relevant literature and take full ownership of the projects. All points of engagement offer valuable experiences for students; however, faculty mentors should encourage students to increase their levels of involvement over time, and programs should be structured so as to allow students to advance along a developmental continuum. Students should be informed about differing levels of engagement and development, and, as milestones are achieved, students should be provided with the knowledge to be able to assess their own progress. Institutions may wish to clearly label programs, courses, and student outcomes as "beginning, intermediate, and advanced."

Well-designed undergraduate research experiences allow students to take increasing intellectual ownership of their research projects as they become acquainted with relevant research methodology. It is not necessary, nor is it always desirable, for students to design their own research ideas *de novo*, as such projects may not align well with faculty expertise, institutional research infrastructure, or externally funded research plans. However, students can and should be offered choices of appropriate research projects and be allowed to contribute intellectually to the work.

Guidelines and expectations for sharing scholarly credit with students should be available for students and faculty. Campus policies should establish and clearly articulate how issues such as authorship and intellectual property rights, as well as ownership of data, will be handled.

8.4 *Community of student scholars*

Peer-to-peer interaction in the context of a community of undergraduate research scholars provides opportunity for student learning and for exploration of research and academic disciplines beyond their own experiences. Having a critical mass of students involved in undergraduate research makes it practical to develop opportunities for peer mentoring, regular disciplinary and interdisciplinary research seminars, research group meetings, and professional development workshops for students. Broad commitment of faculty at the department or program level is necessary to provide sufficient student research opportunities to build such a community of student scholars. Institutional support, such as through an office of undergraduate research, facilitates the development of peer-to-peer interactions.

8.5 *Peer mentoring/teamwork opportunities*

An important outcome of having a critical mass of undergraduate researchers and of their early and sustained involvement is the building of research teams with varying levels of experience or different disciplinary backgrounds. Such teams allow for peer mentoring opportunities that are important for the intellectual and professional development of undergraduates. Research teams also allow multiple students to share a single research project, with each team member being responsible for a specific part.

8.6 *Expanding and integrating student research opportunities with other engaging experiences*

Institutions that strive for excellence should recognize and embrace opportunities to combine undergraduate research with other engaging experiences when students have achieved a level of research competence and self-efficacy. Opportunities for students to participate in research projects with different mentors, with an interdisciplinary team, or in projects that draw upon multidisciplinary practices provide expanded learning and experience. Opportunities for students to conduct research abroad, in a structured program, or as an independent study are increasingly common. Students and their faculty mentors should be encouraged and supported in finding ways to apply their research through community-based research with service-learning programs, in exploring entrepreneurial applications, and in considering policy implications. Students who

conduct research should be expected to be able to communicate the results of their projects and the transformational nature of their experiences to citizens and public leaders. Opportunities for students to articulate their experiences beyond the academic community are the hallmark of a mature undergraduate research culture and can be illustrated with events such as state capitol days, community presentations (e.g., to chambers of commerce and tourism boards), podcasts, museum exhibits, and docent-led tours.

8.7 Faculty mentor availability

Faculty need to be directly accessible to students when they are conducting research in collaboration with or under the supervision of the faculty member.

9. Curriculum

Departments and programs should design curricula that expose students to skills necessary to undertake undergraduate research, and curricula should be designed in ways to facilitate faculty and student involvement in undergraduate research.

9.1 Research-supportive curricula

Institutions that highly value undergraduate research have departments and programs that are careful to design curricula to be supportive of research. Some basic principles are articulated here. CUR has compiled many specific examples of research-supportive practices (Karukstis and Elgren 2007).

9.1.1 Content

Successful and sustainable disciplinary or interdisciplinary undergraduate research programs are buttressed by a curriculum that provides students with the necessary training and methodology for them to be successful in the research environment. Research-supportive curricula also build in experiences that provide scaffolding for undergraduate research, allowing students to acquire and practice transferable skills that can be later applied to independent or faculty-student research. A research-supportive curriculum will expose all students to the importance of research and result in students gaining an appreciation for research methodology in their area of study, even if they do not participate in undergraduate research.

9.1.2 Integration of teaching and research

A powerful method of undergraduate education is the integration of teaching and research. Whenever possible, research training courses should incorporate research-like experiences or actual research itself. For example, in courses teaching laboratory techniques in the sciences, it is often no more difficult to incorporate real research problems than to use well-known teaching examples. Typically, students are assigned portions of real research projects in which the requisite coursework and skills will be encountered. Under the right conditions, students in such courses may become legitimate co-authors of peer-reviewed publications due to their contribution to the research project. In some disciplines, particularly in the humanities, themed senior seminar courses provide opportunity for faculty to mentor high-caliber research projects that may be disseminated at professional or undergraduate research meetings.

Integration of teaching and research can increase student engagement, help recruit students for participation in undergraduate research projects, and allow faculty to build research supervision into their teaching load. In order to achieve these kinds of experiences, departments need to think creatively about what courses they must offer and be open to offering courses on special topics that allow for the integration of research experiences. Administrators should be encouraged

to support courses that integrate research, even though enrollment is often lower in such courses than in more traditional offerings.

9.1.3 Course scheduling and managing faculty teaching loads

Undergraduate research requires a significant commitment of time by both faculty members and students. Faculty need to be available during the academic year to mentor undergraduates and also to conduct research on their own. Toward this end, both the quantity and quality of faculty members' teaching loads should be carefully managed to allow sufficient time during the week for faculty-student interaction. Department chairs and program directors should endeavor to create blocks of time for faculty to devote to supervising undergraduate research, for example ensuring that one day per week or each afternoon is free of classes. In addition, whenever possible, it is desirable to assign multiple sections of one course rather than multiple courses when designing a faculty member's teaching load. Such considerations are important as a CUR survey revealed that faculty members were decreasingly satisfied with their ability to sustain productive faculty-student research beyond nine contact hours of teaching per week (Wenzel 2001).

9.2 Additional training opportunities and workshops

9.2.1 Training in responsible conduct of research

All undergraduate students should be instructed in the ethics of responsible research. This can be implemented within individual courses or programs or the training may be conducted campus-wide. Additional opportunities for training in responsible conduct of research should be provided for summer research students.

9.2.2 Professional skills workshops

Undergraduate students should receive specific training in the appropriate oral and written research communication skills, for example, writing research reports and papers; designing posters; giving an effective oral research presentation; applying for fellowships and graduate programs; applying for juried art competitions; networking at conferences; etc. This training may be incorporated in gateway courses for disciplinary majors or it may be offered separately as training by departments or research programs. Faculty mentors are expected to discuss a variety of professional skills with undergraduates; however, programs of excellence will ensure that students have multiple opportunities to enhance their professional skills.

9.3 Student course credit for research

Institutions should have a mechanism to award course credit to students for participating in undergraduate research. In some cases, up to 25 percent of a student's normal semester course credit is awarded for research participation. Institutions should define prerequisites and expectations for awarding academic credit for research and scholarly projects.

9.4 Requiring undergraduate research

Some programs require all graduating majors to be engaged in research, during the senior year or at some other time. Ideally, these students should have the opportunity to be involved in long-term research projects with the potential to culminate in a significant, written report or artistic demonstration that draws from the literature and contributes to the field. Students should also publicly disseminate this work via presentation or exhibition. Many institutions with strong undergraduate research programs require all students awarded departmental honors to conduct a long-term, intensive research project that results in a significant thesis and oral defense.

10. Summer research program

A robust summer research program is essential to a vibrant undergraduate research environment. For students, the summer months offer a time when they can concentrate exclusively on a research project, without competing interests and responsibilities. For faculty at more teaching-intensive institutions, the summer months provide the only time during the calendar year when faculty can focus their efforts exclusively on research. For faculty at all institutions, this is a time with fewer external and institutional commitments, and it can afford the opportunity for more intensive mentoring of undergraduates.

10.1 Research-supportive teaching calendar

In a supportive undergraduate research environment, faculty teaching responsibilities should not include the summer months. This is especially important at more teaching-intensive institutions, where the summer months are typically the most productive times for research. It is also important for institutions to avoid creating imbalanced incentives for summer teaching that serve as disincentives for involvement in research and scholarship.

10.2 Faculty compensation

Many institutions provide compensation to faculty to conduct summer research with undergraduates. This compensation can take the form of faculty stipends, course credit, and/or credit toward research leaves; in some instances, funding for research supplies may be provided in lieu of or in addition to faculty compensation. If institutions value faculty involvement in summer research with undergraduates, compensation for this activity must be competitive with conflicting activities, such as summer teaching.

10.3 Student compensation

Students should receive adequate compensation for conducting summer research. Ideally, compensation should be above the minimum wage. Typical summer stipends for a 10-week, full-time research assistantship are \$3,500 to \$5,000. In some cases, students may receive academic credit for summer research instead of, or in addition to, a summer research stipend.

10.4 Student housing and access to facilities and student services

Attractive, on-campus student housing should be available to summer research students. Housing students on campus helps create an academic community of scholars during the summer months and facilitates summer research programming. Many institutions offer summer housing at no cost to students. Providing inexpensive, attractive summer housing helps recruit students to summer research, especially when other job opportunities may be more attractive in terms of salary compensation. Access to facilities and services (library, computer center, student health and counseling centers, recreation center, food services, etc.), should be provided for summer research students.

10.5 Student programming

Institutions should devise mechanisms to bring the summer research community together for common activities, including purposeful interaction between faculty and students. In addition to social activities, educational activities for students should include professional development workshops, ethics training, and speakers on research areas and careers. The summer is an ideal time for training activities that can be done in smaller, focused groups; this may include journal clubs, training in technical skills or data analysis, and introduction to new research approaches.

10.6 Summer research symposia

Students should have the opportunity to present the results of summer research to their peers and to faculty and administrators. Typical venues include poster sessions, oral presentations, performances, or exhibitions. Events can be formal or informal and may be scheduled at the end of the summer or at the beginning of the fall semester. Summer research symposia provide students with opportunities to learn discipline-specific dissemination practices and to receive feedback on their work, as well as allow the campus to celebrate the students' work.

10.7 Coordination among multiple programs

When a campus is host to a number of summer programs (multiple NSF REU sites, department programs, McNair programs, etc.), institutions that aspire to excellence will coordinate programs and collaborations on appropriate activities. Not only does such coordination and collaboration result in efficient use of resources and encourage sharing of best practices among programs, but students also benefit from interaction with peers in other disciplines.

10.8 Hosting visiting students

Many summer programs host undergraduates from other institutions to expand the reach of their program and diversify their summer research community. When visiting students are part of the summer undergraduate research program, several types of support should be available:

- An orientation to the campus, community, and program should be held. Information on safety and security issues and information about student services should be covered in the orientation (e.g., tornado safety, night-time security, student health center, counseling center).
- Students should have multiple points of contact available to address any concerns about the program, their housing arrangements, emergency situations and illness, and personal situations. Contact information for additional faculty or staff beyond their research mentor should be available.
- Activities designed to encourage interaction between visiting students and native students should be arranged.
- Thought should be given to the student experience “after hours,” on weekends, and during holidays when students are not engaged in their research. This is especially important for students without their own transportation or who are spending the summer in an unfamiliar environment.
- Housing and meal accommodations should be arranged for visiting students, and their needs for transportation to campus or the research site (if needed) should be addressed. Students should be made aware that members of the residential-life staff are available to provide assistance.
- Logistical support for registration, housing, payment of stipends, and other fiscal administration should be provided so that visiting students and faculty mentors do not need to navigate the fiscal issues without assistance. Insurance and liability issues should be considered.
- Faculty members mentoring guest students should understand their responsibilities and the program's goals and have contact information for a program director in the event of a problem or emergency. Ideally, an orientation for faculty mentors also should be held each year.

11. Assessment activities

Institutions and programs of excellence will have multiple approaches to assessment to recognize successes, illuminate gaps, and collect benchmarking data. Assessment plans should be appropriate for the context and purposeful in design.

11.1. Assessment of student learning

Research studies demonstrate the value of the undergraduate research experience on learning and student growth. Undergraduate programs and faculty mentors ought to consider the student learning outcomes of undergraduate research and develop a plan to assess the effectiveness of their program in meeting these learning outcomes (Lopatto 2009).

11.2 Program assessment and evaluation

Assessment of student learning outcomes is important; however, exemplary undergraduate research programs will go beyond this and collect assessment and program-evaluation data that will take into consideration and include:

- a mechanism to obtain feedback from students and faculty on their satisfaction with logistical operations and program activities
- a sustainable method to collect data on the number of students and demographic variables of students who participate in undergraduate research, the level of their engagement, and outcomes resulting from their participation (presentations, attendance at off-campus conferences, publications, etc.)
- a sustainable method to collect data on the efforts of faculty mentors and outcomes resulting from their work with undergraduates (co-authored publications)
- a mechanism to track external funding that directly or indirectly supports the undergraduate research enterprise
- a mechanism and encouragement for students to report on post-graduation educational and career plans related to their undergraduate research experiences
- resources (personnel, creation of databases and surveys, encouragement for students and faculty to respond to queries, etc.) to develop and sustain assessment and collection of benchmarking data.

Collection of benchmarking data should be institutionalized, and implementation therefore will best succeed with broad support from campus leadership and faculty; expert assistance from the registrar and institutional research; and collaboration with academic, student, and alumni affairs offices. Implementation of an effective assessment and data-collection plan cannot be the sole responsibility of the designated undergraduate research program coordinator/director. Additionally, collected information must be disseminated to key stakeholders on an annual basis.

12. Strategic Planning

Institutions that aspire to creating and sustaining an excellent undergraduate research environment will have thoughtful and clearly articulated benchmarks and strategic plans. Strategic plans should address goals for student and faculty participation in research (relating to quality, quantity, and breadth of disciplines), mechanisms for identifying and scaling up effective programs, and resources to test and implement new programs to provide appropriate opportunities for different levels of students, in or outside of the curriculum. Strategic plans should also recognize the resources needed for expanding and enhancing programs, including faculty contributions, staffing needs, space, and fiscal resources.

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*Permission not required for use of the COEUR survey.



Characteristics of Excellence in Undergraduate Research at Different Institutions

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Undergraduate research programs come in a lot of different shapes and sizes. My involvement with the world of undergraduate research began in 1998 when I became director of the Undergraduate Research Office at Carnegie Mellon University. I had the luxury of being a full-time director with a full-time support staff person, a significant annual operating budget, and a good deal of support both from the administration and the faculty. One of my early challenges in this position, however, was convincing the university's development office of the impact of undergraduate research experiences on students when I couldn't answer basic questions such as what percentage of Carnegie Mellon graduates had participated in UR. (If you talk with most directors of undergraduate research, they'll tell you all the reasons why this is not an easy question to answer). I eventually won over the development staff by giving them compelling stories of individual students who were doing amazing things and who were obviously impacted by the experience. As a result, I was able to substantially increase our endowed funds.

For the past five years I've been at a very different institution—Baldwin-Wallace College, a primarily undergraduate institution with far fewer resources. I currently direct its undergraduate research program, but it is one of several duties I have as the associate academic dean. I have a part-time support staff person (who supports all the projects in which I am involved), a student worker, and a fairly small annual operating budget. Yet we have a vibrant undergraduate research program, with activity in most disciplines on campus and very strong support from both the administration and the faculty.

Making the transition from a resource-rich to a relatively resource-limited institution, from Carnegie Research I university to a primarily undergraduate institution was a bit of a challenge. Fortunately for me, I had been very involved in both CUR and NCUR before I made the transition, so I had a large network of colleagues to help me think about how to manage in my new environment. It also really helped that I didn't have to convince my new boss, the college's dean, of the value of undergraduate research. She was already on board enough to have invested in an institutional membership in CUR.


The *Characteristics of Excellence in Undergraduate Research (COEUR)* document is an excellent tool for those who find themselves with responsibilities for undergraduate research, but who do not yet have experience in the arena or networks to turn to. It is also a great tool for those of us moving to new environments because it reminds us of the basics and of the range of activities and opportunities that make up a robust UR program.

In our current economic times, this document can be useful in helping us see all the ways in which we can build programs even when there aren't a lot of new resources available. While a

“fully developed” UR program requires a substantial operating budget, there is much that can be done to build capacity that doesn’t cost much at all. For example, a campus can:

- Develop a mission statement for UR and make sure it is aligned with the institutional mission statement
- Conduct an inventory of the range of UR activities taking place on campus and communicate these activities to the campus community
- Profile the work of students and faculty using existing publications such as the alumni magazine
- Offer workshops to students on a range of topics, such as ethics in research, presenting research, and finding and applying for UR opportunities external to the campus
- Develop course numbers so that UR can be noted on students’ transcripts
- Host an annual symposium to celebrate the excellent undergraduate research taking place on your campus

One needn’t stop there. Getting a campus’s faculty and administrators involved with CUR is helpful if they are not already engaged. CUR opens the way to involvement with higher education professionals who are passionate about undergraduate education and who are generous with their wisdom—a network of people who can help individuals and campuses through any undergraduate research transitions in which they are involved.



A Road Map to Initiating, Developing and Sustaining High Quality Faculty Undergraduate Collaborative Research and Creative Activities

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CUR's *Characteristics of Excellence in Undergraduate Research (COEUR)* provide a road map to initiating, developing, and sustaining high quality faculty undergraduate collaborative research and creative activities. While having a scholarly faculty can be a key component to ensuring the success of an institution's undergraduate research program, it is not the only element needed. Further, the absence of a strong scholarly faculty does not preclude institutions from developing undergraduate research as a high-priority pedagogical approach to educating students, if other institutional support is in place. Two institutions I have served may illustrate this point and generate ideas about how *COEUR's* "best practices" might be realized on other campuses.

As an incoming department chair, I moved into an institution that was transitioning to a teacher-scholar model. Institutionally, faculty development, travel, sabbatical, and student-support funds were in place. My department did not have faculty actively engaged in scholarship, teaching loads were heavy, and the campus offered minimal space, support staff, and/or instrumentation to support research. However, half of the department's faculty members were eligible to retire within five years, and the departmental budget allowed for the re-allocation of resources to develop a research-rich curriculum that allowed all students to be engaged in research at some level and supported research-training for our students based on faculty-student collaborative projects. Additionally, the administration supported change. Through a number of federal and foundation grants, as well as gifts to the college, we were able to hire research-active faculty before retirements occurred, acquire instrumentation to support those individuals, renovate teaching spaces to accommodate research activities, and develop a reward system that acknowledged the accomplishments of both groups of faculty. All of the above are recognized as *COEUR's* "best practices".

Working with the dean of the College of Arts & Sciences, teaching loads were effectively reduced by having course-load definitions changed from credit hours to contact hours and a low enrollment course in research methods was counted as part of the teaching load for each faculty member actively engaged in research. Likewise, careful course scheduling allowed faculty to have blocks of time to devote to research with students, which increased productivity. Student researchers received academic credit for their work through the research methods and/or independent research courses. Many students were funded through external programmatic grants or

an institutionally funded program that was part of a students' financial aid package. Our initial dissemination efforts were through primarily local and/or regional conferences, which quickly changed to national and/or international disciplinary conferences. At the end of my 19-year tenure at this institution, we had a departmental faculty that was actively engaged in research, publishing and presenting their work with student co-authors and seeking external funds for their scholarly activities.

As the incoming vice president for academic affairs at my current college, I surveyed the institutional resources and support structures available to help the campus transition from a teaching-only campus culture to one that recognizes the importance of having a faculty composed of teacher-scholars who can provide high-quality research and mentoring experiences for undergraduates. Faculty development, travel and sabbatical funds were in place. Many departments had a "research" requirement built into their degree programs, generally associated with capstone experiences. Science students participated in undergraduate research off-campus, both locally and across the nation, through federally-funded programs. A small academic internship program, which was partially research-based and included most disciplines, had active partners in regional industries, companies, and non-profit organizations. A nascent on-campus research symposium was open to all students in all disciplines. Existing infrastructure to support research was limited, except for library and computational resources, and no research-oversight structures were in place. Departmental budgets were inadequate to support faculty research, and teaching loads were high.

Over the past three years, several important administrative changes have been made within academic affairs that closely follow the "best practices" noted in *COEUR*:

- A system for rotating course reassigned time system to allow faculty to complete projects, write manuscripts or grant proposals, and/or incorporate new "research-like" projects into curricula has been established.
- Small faculty mini-grants to fund new initiatives that promote high-impact teaching pedagogies that will lead to faculty scholarly outcomes have been offered.
- Priorities have been established for faculty travel funds to provide a higher level of support for faculty travel to conferences, workshops, art shows, etc., to disseminate scholarly work and/or to secure needed-training/upgrading of skills.
- Competency- based outcomes for student learning have been incorporated into assessment plans for academic programs.
- Systemic gathering of student-outcomes data that includes information on participation in high-impact engagement practices has been initiated.
- Some research oversight structures have been established.

Working with the Faculty Status and Professional Interests Committees, the faculty promotion and tenure guidelines have been redefined to clearly articulate the importance of scholarly faculty-student collaborative work, as *COEUR* recommends. Institutionally, a salary-review process for all employees has been developed that will reward work performance at multiple levels. - For faculty, key components considered for the highest level of recognition in teaching and scholarship are the development of courses that use approaches requiring a "high-level of student engagement" and participation in scholarly endeavors producing the "highest levels of outcomes", for example, publication or peer-reviewed/juried performances, respectively. An institutional fund has been created to support student researchers, which is part of a students' financial aid package. Tied to these competitive awards is the requirement that the funded project must be completed by the end of the academic year and presented at our Celebration of Student Achievement Day. The celebration has grown substantially over the past three years due to: the allocation of a small amount of funding; the consolidation of the Honor's Convocation, Student Life Awards,

student research symposia, and student music performances into a day-long campus-wide event; and the new salary-review process that recognizes faculty involvement in student research and creative activity.

The student government association has provided some funding for student travel to conferences and housing costs for have been reduced for summer research students working locally. The college's development office is seeking funds to enhance faculty-student research, instrumentation, and student travel, as well as to renovate space and upgrade technology. We also are seeking external funding for a Center for Engaged Teaching and Learning. It would support faculty development to enable the creation and teaching of a research- supportive curriculum in all disciplines, service-learning initiatives, and undergraduate research and scholarship.

We still have much to do to transform our campus culture, but some of the needed groundwork has been laid to enable this paradigm shift to occur. Strategic planning is essential to ensure the success and sustainability of our efforts. For us and other institutions, *COEUR* provides the road map to utilizing an array of "best practices" to draw together many units of an institution to develop "a campus culture that values and rewards undergraduate research" as a central tenet of its mission.

Use and Utility of the *COEUR Characteristics*

Andrea Chapdelaine
Provost and Vice President for Academic Affairs
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As both a faculty member who has been engaged with undergraduate research throughout my academic career and as an academic administrator, I have continually sought ways to sustain and strengthen my institution's commitment to undergraduate research, as well as to assist other colleges and universities in that effort. A thriving undergraduate research program that is achieving its desired goals of deep student learning and facilitating a vibrant research enterprise requires multiple sources and methods of support. The primary value of CUR's *Characteristics of Excellence in Undergraduate Research (COEUR)* is that it provides a comprehensive set of guidelines for those seeking to further develop and nurture undergraduate research at their institutions. *COEUR* can be used to identify various facets of an undergraduate research program that are strengths or weaknesses. Use of *COEUR* in this way enables colleges and universities to establish goals and benchmarks for their programs against a set of nationally developed standards.

By presenting these characteristics in distinct categories representing almost every component of an institution of higher education, *COEUR* can be easily mapped onto college decision-making and organizational processes. As I engage in planning, whether through organizational restructuring, grant writing, budgeting, assessment methods, developing faculty reward models, engaging in facilities renewal planning, or curriculum revision, constant reference to *COEUR* will help ensure that the needs of Albright College's undergraduate research program are being taken into account, resulting in a stronger and more institutionally supported endeavor.

By using *COEUR* in this manner, I quickly identified several areas in which Albright's commitment to undergraduate research could be strengthened. For example, there are other campus programs that could be integrated and leveraged to expand undergraduate research opportunities, as suggested in *COEUR* characteristic 1.6, "Integration with other engaging and high impact opportunities." Despite the fact that undergraduate research is organizationally and physically attached to these other programs (e.g., internships, service learning), the cross-fertilization has yet to be fully realized. Similarly, although undergraduate research is deeply embedded in the curriculum in the natural sciences, that is not the case in other divisions of the college (see *COEUR* characteristic 9.1, "Research-supportive curriculum"). Finally, like many institutions, we struggle to adequately assess the direct impact of undergraduate research on student learning, as recommended in *COEUR* characteristic 11, "Assessment Activities."

In addition to serving as a set of guidelines by which institutions of higher education can evaluate the status of undergraduate research, the comprehensiveness and detail of *COEUR* supply a wealth of new strategies to facilitate undergraduate research, especially for institutions in the earlier stages of building a campus-wide program or in a particular discipline lacking undergraduate research activity. As a facilitator at the CUR social science and humanities institute, *COEUR* will be of assistance as I work with campus teams to identify strategies to initiate new programs or to further strengthen existing programs at their institutions. For example, one of the areas often

needing greater attention at many colleges and universities, even those with very strong programs, is effective marketing of undergraduate research for recruitment, public relations, and fundraising. In section 7, “Dissemination,” *COEUR* suggests several ways to promote and publicize one’s program. Similarly, areas that are often more difficult or slow to change in academe, such as curriculum and faculty reward structures, are discussed in detail in sections 5 and 9, respectively. This material can be used by chief academic officers to facilitate those more difficult, but necessary, conversations.

A final important characteristic of *COEUR* that adds to its utility is its inclusiveness. Although undergraduate research has been most prominent in the natural sciences and with traditional undergraduates (i.e., 18- to 21-year olds, residential students), *COEUR* takes a step forward in the undergraduate research literature by providing both criteria for excellence and examples that are broader, encompassing nontraditional students, as well as all disciplines. Given the growing body of research demonstrating the significant impact of undergraduate research on student learning, especially for academically at-risk students (Kuh 2008; Lopatto 2010), it is critical that colleges and universities make every effort to provide these transformational learning experiences to all of their students. By drawing attention to these underserved groups, *COEUR* will facilitate that effort greatly.

As I stated at the outset, a successful undergraduate research program must be embedded in the culture of an institution and thereby supported through multiple organizational structures, policies, and programs. By using *COEUR* to guide efforts aimed at achieving this goal, an institution is much more likely achieve this desired result.

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COEUR: Advancing Undergraduate Research on Campus and Beyond

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The distillation of 30 years of CUR experience and leadership that culminates in the *Characteristics of Excellence in Undergraduate Research (COEUR)* comes at a most important time in the ever-dynamic field of higher education. While undergraduate research is recognized widely as a high-impact learning practice, pressures to reduce costs and increase faculty productivity counter this priority. While colleges and universities celebrate the increasing original contributions to knowledge generated through undergraduate research, the external press for accountability prioritizes other output and outcome measures.

Colleges and universities are challenged to reassert the social imperative of post-secondary education and must plan keenly and deftly so as to achieve maximal effectiveness in student learning and post-graduation success. Careful study of research-based evidence of the most effective learning experiences can help inform such prioritization and focus.

Undeniable is the mounting evidence of the learning outcomes and personal and professional developmental gains students realize through undergraduate research. Also undeniable are the significant impacts of thousands of undergraduate research veterans, having benefitted from undergraduate research years or even decades ago, who are now leaders in various industries and sectors throughout the nation and world. This strong evidence of the transformational power of undergraduate research implores colleges and universities to move this high-impact practice from the periphery to the center of students' learning program.

COEUR therefore provides a rich guide for universities and colleges, and for the field of higher education writ large, to be responsible stewards—fiscal stewards *and* stewards of enduring social progress. COEUR can help each college and university maximize the contributions to its mission through the high-impact learning practice of undergraduate research.

As provost at Stetson University, I find COEUR a welcome resource. COEUR can effectively structure a comprehensive institutional self-study, guide strategic planning for concrete advances in mission-driven undergraduate research initiatives, and shape the institution's story of the role of undergraduate research in its effectiveness as an institution.

Most impressive is the comprehensiveness of COEUR, guiding colleges and universities in creating institutional cultures that are maximally supportive of effective undergraduate research. In the examples below, I draw out four ways in which COEUR is timely in my university's continual advancement of undergraduate research as a central, mission-based element of students' learning experience.

Facilitation of cross-disciplinary reflection and exchange. COEUR epitomizes “broad disciplinary participation” in undergraduate research. This goal is exciting and challenging for many colleges and universities, especially institutions that support a broad range of liberal arts and professional disciplines. COEUR will be a very useful tool for facilitating discussion among faculty and academic leaders from disparate disciplines, helping to create greater mutual understanding of disciplinary similarities and differences, and encouraging the exchange of ideas from one

discipline to another. Indeed, some of the most effective innovations in undergraduate research can come from sharing practices across disciplines. Such discussion and exchange may also help facilitate interdisciplinary collaborations.

Supporting faculty engagement in undergraduate research. Prioritizing high-impact learning practices has, to date, more often resulted in adding, rather than replacing, work for faculty. *COEUR* will be very helpful in advancing the effort to move undergraduate research and other high-impact learning practices from the periphery to the center of academic programs. *COEUR* enumerates several important elements in this effort, including the integration of high-impact learning into the curriculum and therefore in faculty workload. Also important is the emphasis in *COEUR* on faculty professional development and support initiatives.

Building a comprehensive university culture that supports undergraduate research. A particular strength of *COEUR* is the recognition that maximally effective undergraduate research programs are integrated into the campus culture. *COEUR* provides a fruitful mechanism for engaging a variety of university units and leaders as partners in maximizing the effectiveness of undergraduate research. At Stetson University, for example, a focus of our Student Success initiative is strategizing ways to support and maximize student engagement in high-impact practices. Our librarian faculty members serve as *personal librarians* for students from initial enrollment through the completion of the required senior research project. Other important elements explicated by *COEUR* are the development of a “community of student scholars” and cultivation of student leadership and support.

“Dare to be significant™” through undergraduate research. *COEUR* suggests consideration of “connecting the research topic to societal issues.” At Stetson University, we emphasize *significance* in our educational program, prompting students to be daring and thereby expand themselves so they may live lives of significance. *COEUR* will help us to explore how we can facilitate students’ broader awareness and understanding of the significance of their undergraduate research project, and the significance of their overall engagement in undergraduate research. *COEUR* will also help us to continue to advance the development of our university-wide community-based research program.

These examples of strategic initiatives demonstrate several key strengths of *COEUR*: 1) the character and success of undergraduate research efforts are grounded in each unique institutional mission; 2) characteristics of excellence of undergraduate research are nonetheless ubiquitous, offering innumerable opportunities for cross-disciplinary and cross-institutional exchange and learning; and 3) a universal goal is to continually advance the comprehensiveness of and access to undergraduate research programs and thereby the transformational power and imperative of undergraduate education. *COEUR* builds upon and will surely extend CUR’s long history of advancing undergraduate research on and across campuses, for the benefit of many generations of students (our future citizens and leaders) to come.

COEUR: A Comprehensive Framework for Institutional Self-Assessment

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More than ever before, institutions of higher learning are embracing undergraduate research (UR) for its ability to engage students, reinforce critical thinking, promote problem-solving skills, encourage team work, and develop effective communication skills. Research experiences help undergraduates connect theory to practice and also can increase their self-efficacy and motivation, thereby increasing their persistence in the face of academic challenges (e.g., Seymour et al. 2004, Lopatto 2004). When our institutions work to build cultures and structures that not only embrace, but also promote and support UR programs on our campuses, we rely on shared experiences and learn from examples of effective programs. Practitioners of undergraduate research and the administrators who support it learn from the successes and failures of others, historically through CUR meetings, workshops, and publications, and increasingly as UR has become more generally accepted as a high-impact practice, through venues such as academic societies and professional networks that support college administrators and others in non-faculty roles.

This wealth of shared experience has been largely anecdotal: We share our institutional stories and look for ways to apply new ideas on our own campuses. Fortunately, however, research on undergraduate research is quickly coming into its own as a scholarly discipline. This, together with our shared experiences, is allowing us to better understand the types of skills and attributes UR experiences promote, and what types of UR experiences are particularly effective and for whom. And now we have a document, CUR's *Characteristics of Excellence in Undergraduate Research*, that provides a comprehensive framework for the ongoing institutional self-assessment that is vital if we are to make the most of this emerging body of knowledge.

Even as UR is embraced as a catalytic activity by more and more academic disciplines and by institutions of all types, we still are just learning what it takes to systemically support UR at the institutional level. Here again, we have a number of case studies to guide our efforts, primarily stories of varying degrees of success in building institutional cultures and infrastructures to support UR. CUR's Institute for Institutionalizing Undergraduate Research and its institutional-review services have provided dozens, if not hundreds, of institutions with information and expert consultation regarding effective institutional practices. But those services are designed to catalyze UR efforts and to provide periodic *external* feedback on them. It is incumbent on institutions to engage in authentic, ongoing formative assessment of their own UR programs in order to ensure continued progress, which the COEUR framework will now facilitate.



Our own institution, Bradley University, is a mid-sized comprehensive university with a College of Liberal Arts and Sciences, a College of Communication and Fine Arts, and three professional undergraduate colleges covering engineering, education and health sciences, and business, plus a graduate school. Undergraduate research is framed broadly as student/faculty collaborative engagement in the discipline. The approach has been a declared focus of emphasis for our two most recent accreditation cycles (1990-2000 and 2001-2010), and it was a component of university- and college-level strategic plans over the same time periods. Undergraduate research continues to be a special focus for our next accreditation cycle and is a component of our newly adopted five-year strategic plan.

As we embark on our most recent strategic plan and accreditation cycle, we have new leadership in several key administrative positions, including our provost and vice president for academic affairs, new deans in three of our six colleges, a newly created position of assistant dean for research and sponsored programs, and are currently searching for a new director for our Office for Teaching Excellence and Faculty Development. We have several newly created centers, including the Center for STEM Education, the Center for Collaborative Brain Research, the Institute for Principled Leadership, and Pre-Law and Pre-Health Professions Advisory Centers. We also are developing other centers of excellence in collaborative research areas, including an Engineering-Business Convergence Center. Each of these centers supports our institutional mission of promoting and sustaining high quality student/faculty collaborative engagement in the discipline. In addition, the new university strategic plan calls for a comprehensive review and potential revision of our core (general education) curriculum.

Bradley has a deep commitment to UR, and we continue to analyze, re-forge, and improve all of the systems that contribute to a vibrant campus undergraduate research culture. This includes hiring new, energetic faculty who are gifted researchers, enhancing our sponsored programs office, continuing financial support by university administrators for scholarly collaborations between students and faculty mentors, improving our infrastructure, and revisiting and potentially revising our general education requirements.

Before we move forward with a collective vision on how to best to achieve our UR goals, we need to take a step back and assess where we are and where we need to go. We need an institutional self-study centered on our undergraduate research culture, programs, and outcomes. We plan to use the *COEUR* document to guide that self-study and to set specific goals for next five years.

Pursuing Characteristics of Excellence in Undergraduate Research

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At Monmouth University (MU), the School of Science places great value on high-quality undergraduate-faculty collaborative research, believing it to be mutually beneficial for advancing faculty scholarship and for preparing students as developing scientists, engineers, and mathematicians. *COEUR* will provide a framework for informing faculty, administrators, and the School of Science's community about best practices in undergraduate research; serve to provide suggestions for improving practices already in place; and help us work to implement new improvements to our undergraduate research culture and programs.

1 *Campus Mission and Culture*

The recently revised mission statement for the School of Science acknowledges the importance of research experiences for our students. Faculty and students in all departments in the school (Biology, Chemistry, Computer Science and Software Engineering, and Mathematics) and two Centers of Distinction (Rapid Response Institute, Urban Coast Institute) are actively involved in undergraduate research. The school will continue to place great emphasis on hiring full-time faculty committed to supporting undergraduate research. Since moving from college to university status in 1995, MU has pursued a teacher-scholar model, but undergraduate research is not institutionalized on campus. An institutional member of CUR since 2008, the university became an enhanced institutional member of CUR in 2011. Faculty outside of the School of Science are showing an increasing interest in CUR and in participating in CUR programs. Through the Honors School and other opportunities, we will seek to promote greater awareness of the value of undergraduate research and to improve the campus culture for supporting undergraduate research as a high-impact practice.

2 *Administrative Support*

Generally, administrative and intramural support for undergraduate research at MU is solid and involves a range of support structures, including start-up budgets for faculty, an instrumentation budget for the School of Science, reduced faculty teaching loads for scholarship, intramural support from lab fees and other sources to support faculty-student research, an institutional review board, institutional animal care and use committee, Office of Grants and Contracts, and budget support for student travel to present at conferences. Improved support from the grants office, such as hiring proposal writers, continued support of University Advancement to cultivate prospective donors for support of undergraduate research, and recovery of indirect costs are among priorities for improvement. We also envision seeking greater involvement of postdoctoral teaching fellows, particularly for faculty supported by external funding.



3 Research Infrastructure

Improving the research infrastructure at MU is the most critical need for the School of Science, and the university has made renovation and expansion of science facilities a top capital priority. Faculty and administrators have participated in Project Kaleidoscope (PKAL) planning sessions, and over the past year, the School of Science completed a detailed facility planning study and review with the help of a campus facilities planning team. A phased-in plan for renovation and expansion of science facilities will be implemented. In the near future, technical support for instrumentation for departments increasingly may become a challenge that will need to be addressed.

4 Faculty Professional Development Opportunities

The university offers generous support for sabbaticals and summer mini-sabbaticals, release time, and travel to conferences (research and non-research meetings). In following the principles of *COEUR*, we will seek greater involvement of faculty in CUR training opportunities (e.g., proposal writing institute, institute on developing an undergraduate research program), and professional development of faculty through PKAL, Science Education for New Civic Engagements and Responsibilities (SENCER), Association of American Colleges and Universities, and other organizations. In support of faculty professional development and reputation building, we will continue to encourage greater participation of faculty on grant proposal review panels and in leadership roles in regional and national professional organizations.

5 Recognition

Our definitions of scholarship for faculty tenure and promotion review value involvement of undergraduate students in research as appropriate, depending on the type of research being carried out, and the criteria encourage student co-authorship and dissemination of research through presentations. We will continue to publicize undergraduate research programs through media and in our print and electronic marketing materials, and recognize student researchers with the Deans Award for Excellence in Undergraduate Research, awarded at our annual student research conference. The School of Science Advisory Council is creating a science-student leadership scholarship for a rising senior and involvement in undergraduate research will be one of the qualifying criteria.

6 External Funding

The university has an Office of Grants and Contracts to help faculty find funding opportunities and prepare proposals. Encouraging faculty to be more active in proposal writing and supporting faculty grant development (sending faculty to conferences on proposal preparation, hiring proposal writers, and seeking external reviews of draft proposals) will continue to be a priority for the School of Science. The dean's office, together with University Advancement, will continue to seek corporate and individual donor support for student-faculty research.

7 Dissemination

For the past ten years, the School of Science has organized an annual student research conference each spring, and this will continue, as will a poster session colloquium as part of our summer research program. Students increasingly are co-authoring publications with faculty and presenting research at local, regional, national, and international conferences. The school and its departments provide support for student travel to research conferences.

8 Student-centered Issues

In the future we plan to pursue greater integration and coordination of our student research experiences with other ongoing high-impact practices, such as student advising, peer mentoring, and student career development. In support of improving campus culture and intellectual discourse, we are interested in having more regularly scheduled informal outlets for students and faculty to discuss research.

9 Curriculum

Monmouth University values research and teaching as complementary activities. Curricular integration of undergraduate research primarily occurs through research courses, independent study, and experiential education; honors students do an honors proposal and thesis. We will be placing a greater emphasis on integration of research experiences in the curriculum through classroom experiences, standardizing lab safety training for students, and improving awareness of science and research ethics.

10 Summer Research Program

Four years ago we established the School of Science Summer Research Program, a 12-week program that has involved some 80 students and 13 to 15 faculty members each summer. The program is supported by internal and external funding. High-school and college students from Monmouth and other colleges participate. The program also provides opportunities for non-tenure track, full-time faculty (lecturers) to maintain scholarly engagement and mentor students in undergraduate research. In support of the summer program, we will seek greater involvement of first-year students in order to provide them with early and sustained exposure to research experiences, and we will also pursue increased support from individual and industrial donors and help faculty find other sources of external grants.

12 Assessment Activities

For the 2011 summer research program, we used the *SURE III* survey to assess the program, to inform participating faculty about student perceptions of the experience and to help us with appropriate improvements to the program. In recognition of *COEUR*'s guidance, we will improve systematic assessment of research experiences throughout the year.

13 Strategic Planning

The 2010-15 School of Science Strategic Plan includes many priorities and goals for enhancing the teacher-scholar environment, including support for excellence in undergraduate research. *COEUR* will serve as a guiding document for considering best practices in undergraduate research as we review and modify the strategic plan.



Fostering Undergraduate Research at the University of San Diego Through *COEUR*

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The University of San Diego (USD) is a Roman Catholic institution committed to advancing academic excellence, expanding liberal and professional knowledge, creating a diverse and inclusive community, and preparing leaders dedicated to ethical conduct and compassionate service. The university enrolls more than 8,200 students, including 5,400 undergraduates with majors in arts and sciences, business, and engineering. Our goal is to provide opportunities for undergraduate research to all of these students and in all disciplines.

Some disciplines at USD, such as the biological and physical sciences, are quite advanced in their undergraduate research capacity and experience. Other disciplines, such as the humanities and arts, are at an initial stage. Students in the honors program must complete a senior thesis, and some majors in the sciences require undergraduate research. *COEUR* will be an effective tool in enhancing and broadening undergraduate research at USD, particularly in differentiating the needs among different disciplines at varying stages of development in their undergraduate research offerings.

COEUR identifies the need to develop a strategic plan, which will provide a comprehensive approach to address the various lacunae in our current offerings. *COEUR* also notes the importance of assessment regarding undergraduate research. Mechanisms for assessment should be in place at the very beginning of new offerings and should be used to evaluate the success of current practices. It is key that assessment move beyond collecting data regarding participation toward collecting direct evidence of the achievement of student goals and learning outcomes.

USD currently has in place many of the components that *COEUR* identifies as being best practices that support and sustain undergraduate research. For example, USD recently opened an Office of Undergraduate Research, with a full-time director. The office is responsible for the coordination of all undergraduate research activities, including an annual campus-wide symposium of student presentations. The unit also is responsible for building a comprehensive, integrated model of undergraduate research. USD also offers a reduced housing rate for summer undergraduate researchers and engages in fundraising to support undergraduate research. Students participating in various summer undergraduate research programs, including McNair Scholars and those supported by internal or external funds, participate in joint professional development opportunities and other events. We embrace the teacher-scholar model and discuss with faculty candidates their capacity and interest in mentoring undergraduate researchers.

Much of USD's current undergraduate research activities are aligned with traditional practices in the sciences, such as summer research opportunities. As we expand our programs to provide all students and all disciplines with opportunities in undergraduate research, *COEUR* will help to identify new models for student-faculty engagement, as well as needed institutional sup-

port and infrastructure. *COEUR* discusses curricular opportunities as a strategy to engage more undergraduate students in research, through the incorporation of authentic research in a laboratory course or as a module within a lab course. *COEUR* reminds us that faculty must be compensated for their efforts in mentoring undergraduate researchers, and we are at a preliminary stage of determining faculty load credit for such mentoring.

As our undergraduate research opportunities continue to expand to new disciplines, we must consider their specific needs. The apprenticeship model traditionally practiced in the sciences, as well as the dominant summer undergraduate research model, does not always align well with other disciplines, particularly those in the humanities. The Office of Undergraduate Research will work with faculty in the arts and humanities to devise support and programs that better meet their needs. Expansion of our honors program thesis model to other students is one avenue identified by *COEUR* that will allow us to respond to these emerging disciplines.

In summary, *COEUR* provides institutions interested in fostering undergraduate research with an overview of best practices. Its recommendations are useful to institutions at an early stage of undergraduate research offerings, as well as to institutions that seek to expand their practices.



Advancing Undergraduate Research at Community Colleges

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The national college completion agenda has placed a spotlight on community colleges that they had not previously enjoyed. The United States is developing a greater awareness of the important role that community colleges play in our nation's future. The national completion agenda grew from the realization that in the 21st century gainful employment will require a postsecondary credential. It is clear that community colleges are essential to achieving the national goal of five million more college graduates by 2020.

This greater awareness of the value of community college education is a great opportunity for this sector of American education, but it is also a tremendous challenge. How will we do our part to ensure that America has a highly educated workforce able to compete in a global economy? Many initiatives are under way, data are being collected, and effective practices are being shared at conferences and in publications. At William Rainey Harper College in Palatine, Illinois, we know that we must graduate an additional 10,604 graduates in the next ten years to do our part. We are reviewing all of our practices and processes, and we are piloting many new initiatives to see what will help students succeed. One initiative that has proven very successful is undergraduate research.

I first encountered the idea of undergraduate research at community colleges seven years ago when I attended a workshop sponsored by the Council on Undergraduate Research (CUR). Since community colleges are teaching rather than research institutions, I had never given research much thought, but I left the workshop intrigued. Chemistry faculty at Harper College were also intrigued and subsequently joined with other Chicago-area community colleges to carry out a National Science Foundation grant to support undergraduate research.

The results have been significant. Seventy-four Harper students have participated in undergraduate research in chemistry. The average number of credit hours in which these students enroll is 60 and their average GPA is 3.47. The Harper graduation rate is also nine percentage points higher for students involved with undergraduate research than it is for non-participants.

The NSF grant ended several years ago, but Harper has continued its undergraduate research program in chemistry at a cost of about \$25,000 per year. As a community college provost managing a tight budget, I find that this cost is more than justified by the benefits to the students and that it is offset by participants' likelihood of enrolling in additional courses at the college. In fact, I am interested in expanding undergraduate research into other disciplines.

CUR has developed the *Characteristics of Excellence in Undergraduate Research (COEUR)* document to aid institutions wishing to develop excellent undergraduate research programs. This document can provide guidance to community college administrators as they consider initiating an undergraduate research program at their institutions.

First, it is important that undergraduate research be seen as part of the institutional mission. Students are more likely to persist and achieve their academic goals if they are engaged personally with someone at the college, whether through a student activity, club, or with a professor. Such a

program thus directly fits with the mission of student success and completion. It also serves to link research, information literacy, and both written and oral communication skills into a holistic picture. These are general education skills needed for any career. Further, undergraduate research can provide a career focus for undecided students and help them see a clear career path for their academic goals. All of these benefits clearly fit with the community college mission.

Administrative support is essential to almost any successful initiative, and undergraduate research is no different. While faculty commitment is paramount, without administrative support for funding, time, space, and travel for both students and faculty members, an undergraduate research program cannot reach its full potential. Grant funding may be sought to provide dollars for start-up costs such as needed instrumentation or studio supplies.

Adequate library resources are needed for literature reviews as freshmen and sophomores undertake all of the components of authentic research. Faculty members need support to travel to conferences to collaborate with colleagues and engage in scholarly discourse. Students should also have opportunities to present their research outcomes at poster sessions and conferences. Visiting with Harper students at one such poster session was an experience that solidified my support and commitment to undergraduate research. As I viewed the posters and inquired about the research, all the students I spoke with eagerly and clearly described their hypotheses, their methods, and the results of their research. I was impressed by the quality of their work and their ability to explain what they had accomplished. I walked away knowing that undergraduate research was important for Harper College's commitment to help more students achieve their academic goals.

Recognition and compensation for those faculty who spend time and energy to mentor students is necessary, to encourage others and to validate the important outcomes of this work. We have found that faculty members engaged in undergraduate research often improve the curriculum in their traditional college courses with strategies learned while mentoring research students. The experience keeps faculty fresh in their disciplines and improves their professional development.

Undergraduate research opportunities can also provide a wonderful marketing opportunity for community colleges as they highlight the advantages for students able to work one-on-one with an expert in a field of study. Students apply to Harper's research program and are chosen by professors, based not on their academic accomplishments but rather based on their interest and willingness to commit 10 hours per week to research for one year. This program is an example of community colleges truly providing the best in freshman and sophomore education.

Community colleges are teaching institutions. Undergraduate research is teaching, and teaching is research. Although it may at first seem non-traditional, an undergraduate research program can be an important component of the community college mission. It can provide focus to students' academic goals and lead to program completion, career opportunities, and advanced degrees. The *COEUR* publication provides a roadmap that can be used by community colleges to create a quality research program that will benefit the institution, the faculty, and most importantly, students.



Faculty-driven and Student-centered: A Formula for Undergraduate Research during the New Normal

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“This New Normal is a reality. And it is a reality that everyone seeking to improve education must grapple with. Yet, there are productive and unproductive ways to meet this challenge of doing more with less.”
—Arne Duncan (2010)

I often comment to colleagues that they can count on two phenomena in higher education today. The first is that state-appropriated funds devoted to public colleges and universities will decline and, secondly, that accountability for the expenditure of these funds will increase. Any conscientious group of campus administrators therefore recognizes that this trend has the potential to impact the implementation of high-impact learning practices (Kuh 2008) such as undergraduate research, even though accreditation bodies may recognize them as being important to advancing student learning outcomes.

Doing more with less and doing so with increasing scrutiny are the conditions that the U.S. Secretary of Education has termed the “new normal.” This perfect storm is more evident than ever from the perspective of a dean whose job it is to facilitate the faculty-student interactions that drive undergraduate research. How do we best support these important interactions under the current circumstances? Below I review the ways our institution has used CUR’s *Characteristics of Excellence in Undergraduate Research* to encourage this high-impact practice in an era of declining budgets.

Doing More with Less. Thriving under the conditions of the new normal requires greater focus on limited resources, with a stronger sense of *campus mission and culture*. My own institution has advanced a six-part initiative (known as Transformative Learning) that has become a part of our strategic-planning process. As a result, as the *COEUR* document recommends, our campus has developed strong administrative support, including an office of research and grants that actively supports undergraduate research while performing a role in our *assessment* activities as well. Our university also finds ways to recognize faculty members through a generous indirect-cost-sharing policy, as well as through merit credit (a peer-approved funding allotment that supports teaching, scholarship and/or service) and awards for excellence in mentoring. In support of our university’s mission, our college chose to advance research in science, technology, engineering, and mathematics (STEM) fields through a center designed to encourage an investment in undergraduate research.

Leveraging Resources for Students. In the fall of 2008 we formally focused on *student-centered issues* in research with the initiation of the Center for Undergraduate Research and Educa-

tion in STEM. In combination with a new office of sponsored programs, we have been able to contribute toward a stronger student-centered *research infrastructure* in our college. Complementing components of our university mission, the center was structured to directly encourage faculty to work with students through faculty professional development opportunities, as *COEUR* discusses. To this end, the center provides faculty mentors with reassignment time and a modest budget for travel, student salaries, and supplies. Among these benefits, reassignment time is critical since we are a predominantly undergraduate institution with faculty teaching loads that commonly involve 12 or more credit hours per semester. The center now provides more adequate time to plan, write, and submit a minimum of one grant proposal per year for one in five faculty members in our college.

Since we developed the center, external grant applications have increased in all seven departments of our college and the level of *external funding* from grants has more than doubled. At least three of our current federal grants revolve around a summer research program, creating a synergy of resources. Funds allocated by the university for travel by faculty are now nearly matched by travel funding produced from external grants, and student wages paid for by grants far exceed those provided by the university to our college. Concomitantly, and perhaps most importantly, the number of poster presentations at our state's annual faculty-student research conference have nearly doubled since the center was initiated.

Communicating the Change. We have found that it is the integration of student learning and faculty development that provides the most compelling argument for advancing undergraduate research in an era of declining resources. When faculty members are rewarded for pursuing research with students, products of their collaboration soon emerge (Elgren 2004). In the new normal, these products can enhance both the educational and fiscal health of an institution. A thoughtful institutional plan, one that is supportive of both faculty and student interests, is therefore critical for aligning high-impact learning practices such as undergraduate research with the fiscal reality of a modern college or university campus.

Our experience demonstrates the importance of *COEUR's* emphasis on the *dissemination* of ideas as vital to developing a culture that embraces undergraduate research. Faculty presentation and publication with students should be commonplace whenever possible, as this type of collaboration helps everyone to recognize that student learning objectives can parallel faculty research objectives for purposes of tenure and promotion. Our own campus has begun directly addressing this aspect of its tenure and promotion policy, but the informal process of encouraging research with students through faculty development practices may be the critical precursor to institutionalizing undergraduate research. In addition, and as described in the *COEUR* volume, the expansion of a research-supportive *curriculum*, including capstone courses, provides an effective and potentially cost-effective avenue to develop research experiences for our students.

Encouraging academic discourse is essential to a transparent and productive discussion of change that involves student learning objectives. We employ an active college seminar series to bring in faculty members from other institutions to talk about how institutional change has occurred on their campuses, another strategy identified in *COEUR*. Regular in-house discussions also allow the more detailed deliberations that are often required to achieve faculty consensus around a common goal. In addition, budgetary discussions should be transparent to faculty in order to show how investment priorities align with the mission and vision of the institution.

Finally, faculty members who teach, serve, and demonstrate engagement in their disciplines are critical to the future of undergraduate research in our colleges and universities; invest in faculty and you invest in your students as well. The key to creating a balance between faculty development and student learning is to reward faculty-driven programs that are student-centered in nature. Keeping *COEUR's* principles in mind—despite the modern dynamics of funding and

assessment practices—can help stimulate excellent undergraduate research programs for your college or university just as they have for other institutions documented in the volume.

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CSU San Marcos looks at *COEUR*

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At California State University San Marcos, CUR programs have provided a springboard to crystallize undergraduate research as a campus priority. For example, a CUR Institute helped our campus to develop an action plan to institutionalize undergraduate research. The *COEUR* survey findings offer a roadmap of 12 “best practices” for supporting and sustaining undergraduate research. As described below, we look toward the *COEUR* findings as potential goals and benchmarks for our campus, enabling us to deepen our commitment to make undergraduate research one of our best-known campus identities.

1. Campus mission and culture

COEUR will help our university broaden access and the participation of faculty and students in undergraduate research and creative activities. Among our activities will be promoting undergraduate research as one of our campus’s “high impact” practices. In addition, we intend to utilize our success in undergraduate research to attract and recruit students and faculty.

2. Administrative support

COEUR recommends that faculty be given sufficient credit for undergraduate research activities. For example, consideration must be given to faculty workload for these efforts. Without these supports, undergraduate research may not be sustainable. Our university administrative leadership supports faculty for supervising undergraduate research. To elevate our support, our campus is exploring the establishment of a centralized campus-wide unit for undergraduate research. The unit will have dedicated personnel, space, and resources to support, coordinate, and sustain undergraduate research activities.

3. Research infrastructure

COEUR reveals that a strong research infrastructure is instrumental in the success of undergraduate research. We agree that a robust research environment promotes high-quality faculty and student research. Our campus is working toward strengthening our research infrastructure by pursuing appropriate levels of personnel, space, equipment, and library resources. These goals are challenging because of significant state budget constraints. However, we will explore all avenues of internal and external funding to support our objectives.

4. Faculty professional development opportunities

COEUR suggests that faculty professional development should include opportunities for faculty members to sharpen their skills in teaching, research, and mentoring. Our campus offers faculty professional development programs that contribute to the success of our undergraduates, and we are also pursuing ways to enhance professional development for our graduate students. As a result, more graduate students can serve as research mentors in our undergraduate research endeavors.



5. Recognition

Our university recognizes and rewards faculty for engaging in research. We celebrate faculty scholarship through various venues in which faculty present their research (e.g., an annual celebration event and faculty colloquia). Our current campus promotion and tenure policies do not explicitly state that faculty must participate in undergraduate research. However, our campus has initiated a dialogue aimed at clarifying these policies in order to encourage faculty participation in such research. We have undertaken steps to enhance the profile of faculty and undergraduate research through publicity on our campus website, publications sent to alumni, and press releases. Faculty research is also prominently displayed on our library's website (e.g., ResearchForge). Our campus offers several awards for faculty excellence in the domains of teaching, research, and service. As suggested by *COEUR*, a faculty award for excellence in mentoring undergraduate research can be considered.

6. External funding

As recommended by *COEUR*, our campus actively supports faculty and staff who pursue external funding for undergraduate research. Our faculty also can apply for internal funds to support their research, as well as for seed money to develop extramural grant applications. We also commit internal funding to support undergraduate research projects and students' travel to present their research. Given limited state budgets, it is increasingly important to secure external funding in order to advance our undergraduate research programs.

7. Dissemination

COEUR reports that dissemination of high-quality undergraduate research is crucial for students to succeed in pursuing competitive graduate programs and professions. We offer our undergraduates opportunities to present at on-campus research symposia, exhibitions, and performances. Most importantly, students are encouraged and supported to present their work at professional, scientific, and student research conferences. Our campus is participating in efforts to implement an undergraduate student journal for the California State University System.

8. Student-centered issues

COEUR recommends that students have early and sustained involvement in undergraduate research. Our campus offers "hands-on learning" opportunities for individual and collaborative undergraduate research. We also provide opportunities for integrating hands-on learning with service-learning activities. Through various programs, we are expanding opportunities to engage middle-, high-school, and first-year and second-year community college, and lower-division students in research. These experiences provide bridges for young students to the university.

9. Curriculum

In accord with *COEUR*, our campus seeks to develop a research-supportive curriculum. High-quality faculty research can inform teaching and classroom activities. We are building on our commitment to the teacher-scholar model by offering workshops and peer mentoring on best practices to help us develop a curriculum more supportive of research. By and large, research and teaching are inseparable. However, this is not always clearly outlined in course syllabi or course expectations. Thus, faculty should provide clear research expectations for students in their syllabi, student learning outcomes, and degree requirements.

10. *Summer research program*

As recommended by *COEUR*, our campus seeks to expand a summer research training program to develop future leaders, faculty, and researchers. Our summer research program will include a student research symposium, and we also will work to better integrate faculty into summer research and research training activities.

11. *Assessment activities*

COEUR provides a framework to assess the progress we have made on our undergraduate research initiative. Our campus has gaps in its capacity to evaluate the relationship between undergraduate research and student learning outcomes. We are exploring a system to define and track data on student learning outcomes that will help assess the impact of undergraduate research. Among the outcomes to be tracked are retention and graduation rates, acceptance rates to graduate schools, and the development of skills attractive to prospective employers.

12. *Strategic Planning*

COEUR offers an opportunity to more clearly align our action plan for undergraduate research with our campus's strategic goals. Moreover, *COEUR* can inform our university's strategic planning process, allowing us to formulate a clearer campus identity for undergraduate research.

In sum, *COEUR* provides guideposts for developing and sustaining "best practices" for undergraduate research. *Coeur* translates as "heart" in French. *COEUR* gives us heart that we will succeed in our undergraduate research endeavors.



CUR's *COEUR* as a Resource for Institutional Change

Janice DeCosmo
Associate Dean, Undergraduate Academic Affairs
University of Washington

During the past decade, undergraduates' participation in research in the U.S. has grown dramatically as faculty have recognized the power of such work both as a pedagogical approach that enhances students' engagement in learning and as a strategy to increase their own research productivity and the development of students as scholars. At the University of Washington (UW), undergraduate research has also emerged as an innovative practice that allows for a more personalized education for students who tackle authentic scholarly investigations closely guided by faculty who share their interests, effectively complementing the classroom experience at a large university.

While we are able to observe the positive effect that participation in scholarly work has on individual students, and the numbers of participating students and faculty are clearly increasing, we often find ourselves asking more-nuanced questions about improving our practice, such as: How can we best ensure that both faculty and students gain the most favorable outcomes from undergraduate research? What are the most important factors in ensuring the success of mentored research activities for students? If we have a small amount of new funding to invest in support of undergraduate research, what is the most effective way of deploying those funds? What tools are available to assess the learning outcomes, both short term and longer term, for student-researchers? How does the activity at our university compare to that at our peer institutions? How do we evaluate the quality of our programs?

We see the collective experience of CUR members summarized in the new *Characteristics of Excellence in Undergraduate Research (COEUR)* as a rich resource for the UW as we seek to assess and improve our practice and develop plans for new initiatives. *COEUR* offers tools we can utilize to answer many of the questions posed above, drawing on the success of undergraduate research activities nationwide. Rather than viewing *COEUR* as a checklist for evaluating institutional programs, we see it as providing a set of strategies for the implementation of undergraduate research in a wide variety of types of campuses and disciplinary contexts. *COEUR* summarizes specific information about approaches that have worked in these different settings, essentially providing advice for programs both new and well-established on topics ranging from support of faculty engagement in undergraduate research to institutionalizing undergraduate research as an integral part of the student experience.

For institutions such as the UW, where the Undergraduate Research Program is campus-wide, *COEUR* provides advice and evidence that we can draw upon to support our efforts at expansion, program evaluation, assessment of student learning, faculty engagement, and increasing institutional investment in our program. Further, *COEUR* suggests first steps at developing new initiatives, as well as confirmation that in some cases our practice is in excellent alignment with the best practices of our colleagues at other CUR universities and colleges. By placing the characteristics of excellence that have proven effective at other institutions in the context of the opportunities and challenges at the UW, we can reference them in grant and institutional propos-

als that extend our current work, as well as in annual reports that put our accomplishments into a national context.

On our campus, undergraduate research is a pedagogical approach that leverages the university's research enterprise in the service of student learning, making it a powerful strategy—some might say a “no brainer”—for a research university to adopt. However, institutionalizing the practice of undergraduate research requires re-evaluating some of the university's most cherished (and conservative) institutional processes, such as the orientation, annual review, and promotion and tenure processes for faculty. *COEUR* provides a series of recommendations that we may use in conversations with our administration, department chairs, and faculty-senate colleagues to help persuade them to adopt changes in these processes that have proven effective at other colleges and universities and allow us to better serve our students. As we continue to transform the UW undergraduate experience through greater student participation in authentic research and scholarship, we will draw on *COEUR* in many ways to assist us in changing the culture of the university to support this goal.



Advancing High-Impact Learning Experiences

Elizabeth L. Ambos

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California State University*

As an administrator within the system office of the 23-campus California State University (CSU), one of the largest comprehensive university systems in the country, I believe the *Characteristics of Excellence in Undergraduate Research (COEUR)* document can be very helpful to our institution as we strive to provide high-quality learning experiences to large numbers of students. Over the last decade, various studies of the importance of high-impact educational practices to undergraduates' success have been published, but few interest groups or disciplines have synthesized and analyzed groups of studies to provide straightforward, well-organized manuals of practice. The *COEUR* document, in contrast, is exactly the type of document that is most needed. It presents a well-reasoned primer on undergraduate research practice and institutionalization, without being a checklist of programmatic attributes (and it's worthwhile to note that undergraduate *research* is presented as a general concept that includes all disciplines' research, scholarship, and creative endeavors).

COEUR is easy to read, and it presents the topic of undergraduate research from the vantage points of multiple stakeholder groups and various functional offices within academic institutions, effectively providing a blueprint for creating and sustaining undergraduate research programs. The document provides clear explanations as to why specific core attributes of undergraduate research programs are necessary, and how they connect to other aspects of institutional missions and functions. Further, by connecting institutional missions and values with highly specific recommendations and helpful hints, *COEUR* could be used in connection with institutional strategic planning and with program review and accreditation activities.

Several themes throughout the *COEUR* document particularly resonate with the mission and practice of institutions such as the CSU. First, the importance of the “whole institution” commitment to undergraduate research is emphasized in *COEUR*. This core theme encourages institutions to take an “ecosystem” approach to understanding all of the components of a successful institutional approach to undergraduate research, which is a vitally important concept for large institutions, in which operations—and cultures—are too often segregated and reside in silos. Undergraduate research is presented in the context of a range of high-impact educational practices, and *COEUR* maintains that undergraduate research efforts must always connect and support other high-impact activities. This is all to the good. It is important to foster an ethos of collaboration and synergy with other efforts that seek to promote and sustain student achievement within the academy. Too often, various educational approaches are operated as separate offices within an institution and do not easily connect and support each other.

Second, *COEUR* emphasizes that undergraduate research should be accessible to all undergraduates, and the document presents very helpful suggestions on how to “ladder” and orchestrate undergraduate research activities through curricular progressions, thus fostering a developmental arc for students embarking on their undergraduate research journey. This is an important theme, and one that is relevant to social justice concerns, particularly for institutions that are under strin-

gent fiscal constraints and that have deep concerns as to whether undergraduate research can be presented as an option for most students, rather than just for a favored few in grant-funded programs.

Third, the *COEUR* document takes pains to present deliberate and well-reasoned connections between student achievement in undergraduate research and the need for extensive faculty research and scholarly practice. This theme—which could be parsed as the belief that investment in faculty research leads to better student success—is often proclaimed. But the *COEUR* document provides more-concrete reasons why faculty time for research should be protected and fostered in teaching institutions than those found in many other documents I’ve read (and written!) over the past few years.

The authors are to be congratulated: They have done a masterful job in assembling so much information in a compact and readable format. The *COEUR* document is timely and will likely prove a durable—and well-used—addition to the canon of literature on undergraduate research.



Leveraging Consortium Expertise

Bill Spellman

Director

Council of Public Liberal Arts Colleges

Since the adoption of a new strategic plan in 2008, the twenty-six member institutions of the Council of Public Liberal Arts Colleges (COPLAC) have identified undergraduate research as a priority “high impact” educational practice and a distinguishing feature of campus life. A consortium-wide survey undertaken in the fall of 2010 found that institutional commitment to undergraduate research (Characteristic 1.1) ranks at the top of the high impact practices recognized by the Association of American Colleges and University’s LEAP initiative. The majority of COPLAC campuses have mature undergraduate research programs in place, including a designated office of undergraduate research staffed by a full-time faculty member (Characteristic 2.5.1). Other, newer member institutions are at the capacity building stage of strengthening undergraduate research opportunities and will find the administrative support section of the Characteristics of Excellence document a useful guide. Over the past two years our consortium has been more intentional about leveraging its collective assets to advance undergraduate research on every campus. In its work COPLAC has endeavored to align itself with many of the Characteristics of Excellence articulated by CUR.

As a North American consortium with institutions in twenty-four states and one Canadian province, our small to medium-sized colleges and universities have begun to share best practices through a dedicated undergraduate research program link on the COPLAC website and more recently through the development of action plans to “institutionalize undergraduate research” on every campus. The action plans, drafted at a 2011 CUR-led workshop, are made available to all member institutions through a password protected link on the COPLAC website. Progress on the plans is also posted periodically and a follow-up meeting of team leaders will take place in the summer of 2012.

COPLAC’s most ambitious effort to enhance undergraduate research opportunities involves a plan to pilot “distance mentoring” using computer mediated technology. With support from the Teagle Foundation, the goal of the pilot project will be to expand the number and kind of undergraduate research opportunities available to students by leveraging the distributed faculty expertise of the consortium. We believe distance mentoring, both one-on-one and small group, has the potential to open up multiple areas of disciplinary expertise that are not available to undergraduate researchers on individual COPLAC campuses. Collaboration in this area would provide our students the range of faculty expertise more commonly associated with a large research university and deepen the culture of institutional commitment to quality undergraduate research experiences.

Once the pilot is underway, a key part of the overall project will involve a study of the faculty work dimensions of distance mentoring. We will begin with an inventory of current practice on COPLAC campuses, including policies regarding startup funding for new faculty, load credit and-or reassigned time, and the relationship between mentoring and tenure and promotion at predominantly undergraduate public liberal arts colleges. Sharing this information will enable member campuses to evaluate their commitment to the culture of undergraduate research in light of CUR’s “Characteristics of Excellence” and provide an essential starting point for consortium-

wide discussion. A project steering committee composed of chief academic officers, directors of undergraduate research and faculty involved in the distance mentoring pilot will meet at six-month intervals over two years to develop a COPLAC template for best practices in the area of administrative support for and recognition of research mentoring. This is where the Characteristics of Excellence guidelines on faculty load credit for supervising undergraduate research (2.3), reassigned time for research related tasks (2.4), research infrastructure (3), faculty professional development opportunities (4), and perhaps most importantly, recognition (5) will be essential to a successful outcome.

In the area of disseminating research results, COPLAC strives to follow the best practices recommended by the Characteristics of Excellence. Member campuses in the northeast and southeast now host annual student research conferences (7.2), and plans are underway to pilot a mid-Atlantic regional. A decentralized, campus-based selection process is used, and disciplines across humanities, social sciences and natural sciences are represented at every conference. In addition to students and their faculty mentors, key administrators have been attending the regional conferences, affirming institutional commitment to undergraduate research while allowing provosts and deans to meet and plan for collaborations in other areas. COPLAC has inaugurated a peer-reviewed electronic undergraduate research journal (7.2) and solicits student work from across the disciplines. Since its founding in 2010, the journal has published an average of 18 papers per semester from approximately half the member campuses. Following the Characteristics of Excellence, COPLAC hopes to expand participation to every member campus.

As liberal arts colleges in the public sector, COPLAC recognizes that each of its member institutions operate under fiscal constraints that demand careful planning to achieve desired student learning outcomes. The Characteristics of Excellence in Undergraduate Research, together with the sharing of best practices consortium-wide and collaborative efforts to disseminate outstanding student work, helps sustain a campus culture of continuous improvement even in times of economic uncertainty.



Applying *COEUR* Broadly: Advancing Undergraduate Research Across a Consortium

Simon J. M. Gray
Program Officer
Great Lakes Colleges Association

The academic and developmental benefits of a good undergraduate research (UR) experience have long been recognized. With guidance and encouragement from the Council on Undergraduate Research and other organizations, undergraduate research has moved from a self-selected educational opportunity at a few institutions to an integral part of an undergraduate's experience at many colleges and universities across the U.S. (and increasingly outside the U.S.).

Based on years of experience, CUR's *Characteristics of Excellence in Undergraduate Research (COEUR)* provides a composite picture of what successful programs look like. Institutions in the early stages of developing a UR program will use *COEUR* to understand the mix of policies, resources, and campus culture that are necessary to effectively support UR. Institutions with an established UR program will already be familiar with these issues. This is the case among the thirteen private liberal arts colleges of the Great Lakes Colleges Association (GLCA), where undergraduate research is well-established, particularly within the sciences.

COEUR describes an ideal, which none of our schools fully realize. Rather, our experience is that UR programs evolve differently, responding to such institutional influences as administrator and faculty buy-in, student response, curricular support, and availability of financial and material resources. Thus there are many possible paths and a diversity of successful models. Importantly, we also understand that not of all our institutions have the resources necessary to pursue all of *COEUR*'s best practices.

The question for the GLCA is how we can initiate conversations among colleges with different financial and cultural environments that will help them be more effective with the resources available to them. In this context, *COEUR*'s value to the GLCA is as a focal point for generating conversations about UR that are clarifying and reaffirming, while identifying opportunities for improvement. We would approach this by converting each section of the *COEUR* guide into a set of prompts to create a UR self-study document that each campus could adapt or adopt according to its individual needs.

This self-study could be used at the departmental, divisional, and/or institutional levels to articulate what UR means locally, to produce a shared understanding of the educational and developmental benefits of UR and how those connect to departmental and institutional goals, to discuss how UR is "done" at the institution, including staffing and curricular support, and to discuss how UR is assessed and how that assessment is used to guide change. The responses to these questions would provide a description of the current state of undergraduate research on each campus, which could be used to improve or expand UR opportunities.

Beyond seeking improvements, it is valuable to have these conversations periodically as thinking can drift over time with changes in faculty and staff; as programs are added, removed, or changed; and as availability of resources changes. Such conversations would play a re-centering and a reaffirming role, and could uncover valuable synergies with other “high impact” efforts.

A few examples illustrate what such a self-study might include. A natural starting point is CUR’s definition of undergraduate research “as an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline”. Relevant questions include:

- How do our departments define “undergraduate research”?
- Is it important to have a common definition across departments?
- Are “original” and “contribution to the field” requirements for us?

Discussion based on these questions naturally overlap with a set of questions derived from Section 1.1 on Institutional Commitment, including:

- Are students and faculty aware of what the literature has to say on the learning and developmental benefits of UR?
- Are we clear on how supporting undergraduate research helps achieve our institutional mission? Where/how is that articulated?
- What kinds of UR opportunities do we provide and do we know what kinds of students take advantage of them?
- What are the key challenges we face in providing UR opportunities among the student population generally and among underrepresented students in particular? What would we like to improve?
- What are we doing now to address this or other UR-related challenges? How are these efforts funded?
- Are there challenges associated with educating in some disciplines that are unique or in need of greater attention than others?
- Is there a way of thinking about these issues that would result in a distinctly liberal arts approach to the challenges and opportunities?

In turn, conversations about what UR looks like on each campus necessarily leads to issues in how it is supported in terms of faculty and curricular resources. Combining portions of Section 1 on Campus Mission and Culture, Section 4 on Faculty Professional Development Opportunities, and Section 9 on Curriculum, we might ask:

- What professional development opportunities do we provide our faculty, especially to prepare them to mentor undergraduates?
- What is the relationship between faculty scholarship/research and the quality of a faculty member’s teaching and his or her ability to mentor UR?
- How do we review or evaluate the quality of faculty mentoring?
- How does the institutional reward structure credit professional development, scholarly activity, and research? How are efforts to improve pedagogy, including incorporating research-based methods into courses rewarded?
- What skills do students need to participate in UR? How do these differ by discipline?
- Where in the curriculum do students develop these skills?

Assessment is an essential component that can serve as both catalyst and glue for these conversations, requiring clarification of the reasons UR is supported and asking how well it is actually

done, leading to suggestions for improvements. Thus from Section 111 on Assessment Activities, we should ask:

- Do we have clearly stated learning objectives for UR experiences?
- How do we assess UR experiences?
- How do we make use of the data we collect?
- What does this data tell us about the preparation our students receive?

The GLCA has been very successful in bringing together communities of interest to discuss and act on areas of mutual benefit. In fall 2010, GLCA program officers visited each GLCA campus to lead a discussion about the challenges to undergraduate STEM (Science, Technology, Engineering, and Mathematics) education (using some of the prompts above). This was followed by a meeting of STEM faculty from across the consortium to share their experiences and suggestions for dealing with these challenges. A similar effort focused on STEM undergraduate research led to a successful proposal to host CUR's National Science Foundation-funded Workshop Program on Institutionalizing Undergraduate Research for Consortia. Again, what emerged from these conversations is that while undergraduate research is highly valued and supported on each of our campuses, there are important differences in the programs that reflect local culture, leadership, and availability of resources, leading to a range of challenges and needs. The value of the consortium has been in bringing together faculty, administrators and assessment support to have these conversations; the value of *COEUR* is in providing the framework that makes these conversations fruitful.

COEUR's Connection to Undergraduate Research at Zayed University

Maher Khelifa

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Zayed University, United Arab Emirates*

Zayed University (ZU) is one of the few higher education institutions in the Arabian Gulf region that promotes and supports undergraduate student research and scholarship. Some of ZU's activities align well with the *Characteristics of Excellence in Undergraduate Research (COEUR)* published by the Council on Undergraduate Research (CUR). The institution, however, still needs to address certain challenges to fully espouse the spirit of the suggested COEUR guidelines.

Since opening in fall 1998, ZU has lent importance to undergraduate research by requiring all graduates to produce an original research or creative capstone project. On average, ZU students enroll in from two to four courses in their majors aimed at forging their research skills. The culture of celebrating undergraduate research began in May 2002 when ZU graduated its first cohort and celebrated its First Annual Capstone Symposium. The symposium was a real showcase of outstanding student research and creative outcomes and a recognition of undergraduates' achievements. The symposium is now an institutional tradition staged at the end of every academic year.

In summer 2010, ZU launched a new program known as the Undergraduate Research Scholars Program (URSP). It is an institutional effort to align ZU with the United Arab Emirates' national strategic goal of preparing citizens for a competitive knowledge economy through the promotion of innovation, research, and development. The program was conceived to provide undergraduate students with an opportunity for an early and sustained involvement in research. Essentially the effort aims to develop the research capacity of a select number of students who show research potential through a carefully designed five-semester program. The components include classroom instruction in theoretical and applied research, lectures and seminars by experienced researchers in various fields, research-related field trips, work with faculty mentors as research assistants, design and completion of an original research study, and presentation of research findings at national and international conferences. Students in the program are also encouraged to publish their original work in undergraduate or peer-reviewed journals.

In April 2011, ZU undergraduate research scholars celebrated CUR's Undergraduate Research Week by producing research posters and presenting exhibitions of their research work on campus. They also produced a documentary highlighting the extent of ZU undergraduates' understanding of research concepts and the importance of research for undergraduates. The scholars also organized, in conjunction with faculty mentors, a successful session on the value of mentorship for acquiring research skills. In elaborating on their own experiences with their research mentors, the students provided strong and convincing arguments for the importance of research mentorship to undergraduates' growth in research ability and other skills.

The institutional commitment to undergraduate research is clear from the support ZU continues to lend to its young researchers through several initiatives that cannot all be listed in this

brief report. However, given the youth of the university, it is not surprising that there are still areas in need of further development and growth. In reviewing the list of guidelines in *Characteristics of Excellence in Undergraduate Research*, areas in need of further development include the establishment of an undergraduate research office to better promote undergraduate research and to facilitate better management, support, and oversight of undergraduate research activities and developments. There is also a need for administrative support, including dedicated personnel, space, funding, and more investment in research infrastructure, equipment, and instrumentation. Further, more investment is needed to increase the library holdings available to students and faculty.

While the institution has adequate computer capability to develop its undergraduate research programs, it needs to purchase more statistical software licenses, such as SPSS for Macintosh, as undergraduates increasingly seem to use and favor this platform over PCs, which the university supports. The university also needs to purchase qualitative-analysis software licenses for faculty and students and provide more training sessions for their use. Many international workshops are available to train faculty and student researchers in the use of applications for qualitative research analysis. ZU could offer opportunities for faculty and students to attend and learn from these hands-on workshops.

The university may also need to contemplate the possibility of offering year-long paid sabbatical leaves for research and scholarly-related purposes for long-serving and junior faculty with demonstrated history of research accomplishments. Beyond supporting faculty and students to present at national, regional, and international conferences, the institution may also need to support other professional development opportunities, such as increased attendance at conferences, workshops, short courses, and research training camps.

As described in *COEUR*, one way to encourage the institutionalization of undergraduate research is through university recognition of faculty members' work in supporting and promoting undergraduate research, which can be done through promotion guidelines, salary reviews, and merit pay increases. ZU may need to reconsider its current guidelines and offer more incentives for faculty to value and support mentorship and supervision of undergraduates' research. The creation of an award for faculty members demonstrating exemplary performance and support for undergraduate research may contribute to increased support for undergraduate research and higher visibility for faculty mentorship efforts.

As ZU engages in renewing its regional accreditation in the U.S., this could be a golden opportunity to re-examine whether the current curriculum is properly aligned with the university's desire for a research-supportive curriculum. Embedding the development of research skills as early as possible into the curriculum may lead to the strengthening of a discovery-based education and may help support ZU in its quest to popularize undergraduate research among its students and establish a real undergraduate research culture in the institution.

Using *COEUR* at an Australian University

Angela Brew
Professor
Macquarie University

My institution, Macquarie University, is a large research-intensive university in Sydney, Australia, and like many Australian universities it has established some undergraduate research programs over the last five to eight years. Opportunities for students to engage in research, develop research skills, and carry out independent projects exist within many curricula, particularly at the higher levels. While there are a number of private companies that supply funding for research internships, no designated government funds for undergraduate research exist. However, there is growing acceptance of undergraduate research as an important contributor to student engagement across the sector, and *Characteristics of Excellence in Undergraduate Research (COEUR)* can help further the spread of undergraduate research at Macquarie.

Campus mission and culture At Macquarie there is growing commitment among both faculty members and administrators to providing high-quality research experiences to students. The Academic Plan 2010-2014 aims to enhance understanding of current practice in equipping students with research skills and critical thinking through exposure to research problems and realistic environments. Faculty are expected to be active scholars as well as teachers, but there is still work to be done to explore how best to incorporate undergraduate research into teaching and research. *COEUR* is helpful in specifying components of this work.

Administrative support In 2011, an internal Teaching and Learning Priority Grant was awarded to develop undergraduates' awareness of, and engagement in, research. This funding supported investigations of existing practice and implementation of a range of professional development strategies for faculty. A university-wide working group consisting of departmental representatives was established to develop understanding and practice, but thus far administrators have not yet grappled with the full implications of the administrative support needed for an extensive undergraduate research program. *COEUR* provides convincing evidence regarding the support needed, and discussion of this in the working group should be helpful in developing understanding of what is required.

Research infrastructure

Macquarie aspires to have the highest possible levels of research engagement among its faculty members, and indeed seeks to establish a pervasive research culture at all academic levels. Macquarie receives significant research funding, which places it as a leading research university in Australia. There are 14 National Research Centres located at Macquarie, with a further 18 Concentrations of Research Excellence (COREs), these are existing and emerging areas of research strength that can be demonstrated to be world class, and a further 48 university- and school-based centres. Internal funding available to academics includes provision for research fellowships, research development grants, the Vice Chancellor's Innovation Fellowships, and a Research Centres Scheme. In recent years new spaces for student research have been created, including new



science laboratories and the new university library. *COEUR* provides a useful checklist of the necessary infrastructure for an effective undergraduate research program, which will be of use in discussions of requirements for both undergraduate and graduate research students.

Faculty professional development opportunities

Numerous opportunities exist within the Macquarie for faculty members to maintain currency and develop their own skills in research, for example through sabbaticals, research workshops, mentoring, and funds for conference attendance. Professional development at central and departmental levels is viewed as essential if faculty are to gain the skills and knowledge necessary to implement effectively research within the undergraduate curriculum. The internal Teaching and Learning Priority Grant mentioned above provides a staff development program comprising the university-wide working group; paper-based and online resources, video media, and website; and workshops, discussions, and special events. *COEUR* draws attention to the importance of including graduate students and post-docs in professional development, and this is something we can usefully take on board.

Recognition

COEUR recommends that faculty involvement in undergraduate research be recognized and rewarded by the institution. Macquarie rewards excellence in teaching and in research and encourages their integration through its faculty promotions procedures. It also rewards scholarship in teaching and learning through a fund indexed to key performance indicators. In addition there is a series of awards for outstanding contributions to student learning, excellence in teaching, and in research supervision. These awards encourage and reward innovation and research-based learning. *COEUR* helpfully suggests awards and publicity for student research, which we need to consider.

External funding

COEUR suggests that external funding is essential for the development of a successful undergraduate research environment. A number of Australian businesses and charitable organizations currently fund undergraduate research, and some research is funded from academics' research grants. Designated funds from Australian research councils and from government have not been forthcoming, however. We are drawing faculty attention to existing opportunities for external funding through our website and the working group. *COEUR* will be helpful when lobbying at a national level to highlight the importance of undergraduate research and its need for external funding.

Dissemination

COEUR stresses the importance of providing opportunities for the dissemination of student research through publication, meetings, and conferences, etc. Some students on our campus are encouraged to present their work nationally and internationally alongside faculty, and there are numerous opportunities for presentations of various kinds within departments. Discussions about the possibility of mounting an Australasian undergraduate research conference have been held with a colleague in New Zealand, but there currently is no source of funding to support this. *COEUR* can usefully be featured in the newsletter *Undergraduate Research News Australia*, which is produced twice yearly to alert interested faculty across the country to developments in undergraduate research.

Student-centered issues

COEUR recommends that attention be paid to a range of issues related to student engagement, participation, and assessment. These issues also are central to our university's mission. Its

curriculum-renewal strategy over the past five years or so has encouraged some radical changes. These include an emphasis on the first-year experience, requirements for each student to engage in a capstone course and to have a community-based learning experience, and the encouragement of research-based learning across the curriculum. *COEUR* recommends establishing clear expectations of students in terms of undergraduate research, and this is something our working group could usefully take forward.

Curriculum

COEUR recommends that the curriculum be designed to expose students to a broad range of research skills. Many Macquarie students have opportunities within the curriculum to develop research skills appropriate to the discipline. In addition, faculty are encouraged to consider community-based research as a way of fulfilling the university's requirement that students engage in a "participation and community engagement" unit, and workshops have been held to encourage the integration of research within capstones. However, practice appears to be patchy, and more could be done to introduce students to research earlier in their degree programs. The working group has been asked to audit units of study (subjects) to explore the extent of students' exposure to research within the curriculum. This will provide a baseline for measuring progress.

Summer research program

COEUR advocates the establishment of a summer research program for undergraduates. While a number of small summer programs exist within departments, a proposal to establish a university-wide program that gives faculty members the flexibility either to offer scholarships to students to engage in research on a part-time basis throughout the academic year or full-time during a vacation period has recently been shelved through lack of funds. The groundwork has been laid for this, and *COEUR* will be useful in ensuring that attention is paid to the idea when funds become available in the future.

Assessment activities

Our working group is using the *Theory of Change* approach to assessing the effectiveness of its work. This involves clarifying the outcomes, specifying how they will be addressed in different areas and carrying out research to examine progress. To provide a baseline for measuring change, audit strategies are determining students' awareness of faculty research, the visibility of staff and student research across campus, barriers to implementation, etc. *COEUR* provides a useful list of evaluations that need to be carried out as we go forward, and the working group will be well placed to ensure that these are implemented. We also need to think more about ways in which student learning from research can be assessed.

Strategic Planning

COEUR draws attention to the need to develop a strategic plan for undergraduate research. The establishment of the working group is the first step in this process. The group is well placed to draft a plan that can be forwarded to the university's Academic Senate for its approval.



The American Association of Physics Teachers' Support of Undergraduate Research in Physics

Beth A. Cunningham
Executive Officer
American Association of Physics Teachers

One might ask how CUR's *Characteristics of Excellence in Undergraduate Research (COEUR)* can be used by disciplinary societies in ways that support students, faculty, and campus administrations. Here I outline the ways in which the American Association of Physics Teachers (AAPT) is supporting undergraduate research in the physics community. AAPT is a professional disciplinary membership association of scientists dedicated to enhancing the understanding and appreciation of physics through teaching. As with any disciplinary society, AAPT's programs and activities are shaped by its members and their needs.

Endorsing statements like *COEUR* on issues that affect an organization's members is just one step in indicating an organization's commitment to important issues such as undergraduate research. The Executive Board of AAPT has recognized the value of undergraduate research in the undergraduate physics curriculum, and it recently approved a statement that "urges that every physics and astronomy department provide its majors and potential physics majors with the opportunities and encouragement to engage in a meaningful and appropriate undergraduate research experience." (See <http://www.aapt.org/Resources/policy/ugresearch.cfm> for information about the statement, including a rationale.)

A public statement by a disciplinary society is important, sets the standards for the profession, and creates the appropriate culture among physics faculty. However, it is the responsibility of any disciplinary society to follow through with opportunities for members to learn how their colleagues have successfully engaged in undergraduate research. That is, disciplinary societies must provide a forum for discussing undergraduate research and providing guidance at the departmental level for incorporating undergraduate research into the curriculum. AAPT provides such a forum for members to discuss undergraduate research in the curriculum through its national meetings, where physics educators and experts in physics education research present their findings in formal sessions and participants have the opportunity to speak about their experiences in less formal roundtables ("crackerbarrels"). CUR's *COEUR* will certainly be included in future presentations and crackerbarrels.

In addition, the AAPT tradition is to start each national meeting with a poster session for undergraduates, sponsored by the Society of Physics Students. Located next to the exhibit hall and occurring during the opening reception, the poster session is one of the highlights of the meeting. Finally, the national meetings allow physics educators with common interests to connect during many informal occasions, such as breaks, meals, and in the hallways between sessions.

AAPT sponsors a number of awards relevant to undergraduate research, including the David Halliday and Robert Resnick Award for Excellence in Undergraduate Teaching. All of the award recipients are model physics faculty, and most have been honored not only for their achievements


in teaching but also for their mentoring of undergraduate researchers. These awards provide a public opportunity to recognize exemplars in undergraduate research, an important characteristic of excellence noted in *COEUR*.

Another way that AAPT provides a venue for disseminating information about undergraduate research in physics is through its two peer-reviewed publications, the *American Journal of Physics* (AJP) and *The Physics Teacher* (TPT). Physicists have been discussing how to involve undergraduates in research since the early 1960's, and many articles have been published describing the status of undergraduate research in physics departments, what works, and how to conduct such research. A number of articles in these journals describe the development of research skills and content knowledge for specific projects, thus providing faculty with information necessary to engage students in research and enabling them to be better mentors. This is particularly critical given the competing responsibilities that faculty have for their time. *COEUR* can be used as a framework for future articles on undergraduate research in physics that appear in *AJP* and *TPT*.

AAPT also sponsors studies and provides a number of resources for physics departments that offer advice about incorporating undergraduate research into the curriculum. One particularly important study, "Strategic Programs for Innovations in Undergraduate Physics (SPIN-UP)," was conducted by the National Task Force on Undergraduate Physics. It found a number of key characteristics of thriving physics departments. Physics departments that had increasing numbers of bachelor's degrees awarded in physics or that maintained a number of such degrees much higher than the national average for their type of institution—that is, "thriving" programs—were found to have a "challenging, but supportive and encouraging undergraduate program that includes a well-developed curriculum, advising and mentoring, an undergraduate research participation program, and many opportunities for informal student-faculty interactions, enhanced by a strong sense of community among the students and faculty." The study provides a number of resources and case studies that can be used by physics departments and university administrators to improve their undergraduate programs. See <http://www.aapt.org/Programs/projects/spinup/upload/report-sum.pdf> for the complete study. The results of this study were developed into a guide for physics departments to use in reviewing their undergraduate programs (<http://www.aapt.org/Resources/ugguidelines.cfm>). Furthermore, a number of departmental reviews have been conducted using the advice from the SPIN-UP report as a benchmark for undergraduate physics programs. AAPT will continue to provide leadership in developing resources based on disciplinary standards for undergraduate research in physics and will draw on the *COEUR* guidelines.

AAPT also provides a faculty development workshop aimed at new faculty, co-sponsored by the American Physical Society and the American Astronomical Society, and funded by the National Science Foundation. This workshop introduces faculty in the first few years of a tenure-track position to research-based pedagogies for teaching a wide range of courses. Included in the workshop is a discussion of undergraduate research, which is focused on different institutional types and led by seasoned faculty. *COEUR* echoes many of these discussions and can be included in future workshops. By reaching out to new faculty, this workshop has the potential to facilitate institutional change as these faculty members implement new teaching practices and incorporate mentoring skills into a department's culture.

Finally, AAPT provides a forum where a community of like-minded physics educators can discuss issues important to enhancing the understanding and teaching of physics. AAPT's members, many of whom are well-established experts, are critical to the development of physics education programs and projects, including those for undergraduate research. AAPT will continue to support this community by providing the resources and platform for supporting undergraduate research. We've made a commitment to do this, and it is in our mission statement.



A Model for Professional Societies to Use in Advancing Undergraduate Research

Amy L. Chang
Education Director
American Society for Microbiology

The American Society for Microbiology (ASM) is committed to supporting research experiences for undergraduate students. About 60 percent of the society's 38,000 members come from colleges and universities, necessitating close partnerships between ASM and higher education institutions and policymakers; collaborations with educators spanning the gamut of elementary, high school, undergraduate, and postgraduate education; and programming that advances excellence in STEM (science, technology, engineering, and mathematics) education. These and other activities are sponsored by the ASM Education Board, established in the mid-1970s to address the educational needs of the society's members. As ASM's director of education, it is my privilege to work closely with the volunteers who make up the board.

ASM has a long history of supporting its members in all facets of their involvement in undergraduate research. The most pertinent programs for CUR readers include our fellowship fund, undergraduate research fellowship, undergraduate research capstone, and annual conference for undergraduate students. Specifically:

- The ASM Fellowship Fund was established in 1993 to support students in research, education, and public policy. Each year, the fund sponsors approximately 70 students, of whom more than half are undergraduates.
- The ASM Undergraduate Research Fellowship Program supports students who conduct summer research under the tutelage of a research adviser and then present their findings at the society's annual meeting.
- The ASM Undergraduate Research Capstone focuses on the latter portion of the undergraduate research experience—preparing and submitting abstracts for meeting presentations, presenting research and answering questions, and networking with scientists in the discipline.
- The Annual Biomedical Research Conference for Minority Students (ABRCMS) offers a venue for undergraduates to develop presentation and networking skills, demonstrate scientific expertise, and immerse themselves in the scientific community.

Thus ASM's programs for students cover the entire spectrum of scientific research, from identifying a research question, designing a research plan, and conducting research, to presenting findings at large scientific meetings and networking among members of the scientific community. In addition, the programs support *faculty advisers* by providing increased research productivity through work conducted by talented, vetted students; visibility and feedback from the scientific community; access to potential research collaborations; and opportunities to help mentees acquire new knowledge and skills.

ASM's success with regard to these programs affirms the effectiveness of the guidelines in CUR's *Characteristics of Excellence in Undergraduate Research (COEUR)*. *COEUR* guidelines describe best practices that anyone committed to sustaining and enhancing undergraduate research will want to consult before implementing new strategies or evaluating existing initiatives relative to the field. Although ASM did not have a go-to publication like *COEUR* during the planning phases for the projects outlined above, we have implemented many of its practices, e.g., providing students with summer research programs, offering professional development opportunities to students and faculty, and making available means for recognition, external funding, or venues to disseminate research findings.

COEUR guidelines will affect how ASM conducts its programs in the future. First, ASM can encourage members to adopt the guidelines as standards of performance and measures of quality for undergraduate programs. Second, ASM can be more explicit about the ways its programs currently align with *COEUR* standards and follow its guidelines. Third, ASM can measure its programs against the guidelines as an additional benchmark for self-evaluation and a source of recommendations for program improvement.

By disseminating the guidelines put forth by *COEUR*, helping our members adopt its standards, and assisting members in adhering to best practices, ASM and other disciplinary societies can help CUR standardize practices and establish a new benchmark for undergraduate research across higher education. In turn, we all will become models of excellence in scientific research, carving a pathway for the future.

For more information about the relevant ASM programs, visit the following links:

- ASM student programs at www.asm.org/students
- The *ASM Fellowship Report: A Look Back at 30 Years (1980-2010)* <http://www.asm.org/images/StudentReports/comprehensive%20of%20fellowship%20report%201980-2010.pdf>
- The Annual Biomedical Research Conference for Minority Students www.abrcms.org

Biographies

LINDA BLOCKUS, PhD is the director of the Office of Undergraduate Research at the University of Missouri. She directs undergraduate research programs funded by NSF, NIH, and the university itself. She served as the chair of the Undergraduate Research Program Directors Division in CUR (2009-2011) and was a fellow at the Center for Advancing Science and Engineering Capacity at the American Association for the Advancement of Science (2008-2009). With Joyce Kinkead (Utah State University), Dr. Blockus is co-editing *Undergraduate Research Offices and Programs: Models and Practices*, to be published by CUR in 2012.

SUSAN LARSON joined the faculty at Concordia College in Moorhead, Minnesota in 1998. She is an associate professor of psychology and in 2009 she was appointed the college's first director of Undergraduate Research, Scholarship and National Fellowships. Her work as a councilor in the Psychology Division of the Council on Undergraduate Research has helped prepare her for this new role. Larson is currently chair of the Psychology Division of CUR and serves on CUR's Executive Board. Larson regularly teaches Research Methods, Learning and Behavior, Drugs and Behavior, and Senior Capstone in psychology. She is a contributing member of the women's studies program and teaches a course on the experiences of women in science. She was instrumental in the development of a neuroscience minor at Concordia. Larson maintains an active research program with undergraduates as collaborators. Working with three to six students each year, her laboratory investigates behavioral and cognitive changes associated with immune system activation. She and her collaborator were recently funded by the Lupus Foundation of Minnesota to evaluate the behavior and gene expression of lupus prone mice.

ROGER ROWLETT serves as the Gordon & Dorothy Kline Professor of Chemistry at Colgate University. His research, in which undergraduate students are integral, focuses on the structural and functional characterization of enzymes using a broad array of methods, including X-ray crystallography, stopped-flow spectrophotometry isotope exchange kinetics, and site-directed mutagenesis. In his 30 years at Colgate, Rowlett has supervised the research of over 100 undergraduates in his laboratory, many of whom have been co-authors of peer-reviewed articles in *Biochemistry*, the *Journal of Biological Chemistry*, and many other scientific journals. He has been a member of the Council of Undergraduate Research since 1984, where he has served as chemistry councilor since 2000, and chair of the Division of Chemistry and member of the Executive Board (2009-2011).



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