

2.7 Review of Best Practices in Undergraduate Research

Early in the planning process, we reviewed existing UH undergraduate research programs as well as best practices in research-based learning at other institutions. From this review, we concluded that if our QEP is to impact a high number of students, we will need to expand both mentored and course-based research opportunities.

2.7.1 Best Practices in Mentored Research

Mentored Research at UH

Currently, the Office of Undergraduate Research administers three mentored research programs: the Senior Honors Thesis program, the Provost's Undergraduate Research Scholarship (PURS), and the Summer Undergraduate Research Fellowship (SURF). Students may also participate in mentored research through externally funded programs. Three programs support underrepresented minority student participation in undergraduate research in the sciences, technology, engineering, and mathematics (STEM) fields. These are administered by the offices of the Houston Louis Stokes Alliance for Minority Participation (H-LSAMP) and UH Alliances for Graduate Education and the Professoriate (UH-AGEP). Moreover, the Departments of Computer Science, Electrical & Computer Engineering, and Civil Engineering each host active National Science Foundation Research Experience for Undergraduates programs (NSF REU). Table 3 summarizes student participation in our existing stipend-supported programs for mentored undergraduate research in faculty laboratories. The table does not include students who 1) volunteer as research assistants, 2) are supported directly by faculty research grants, or 3) participate in independent study or other mentored research experiences for academic credit. Fifty-one students, for example, completed a Senior Honors Thesis in the 2005-2006 academic year and another 69 students are thesis candidates for 2006-2007.

Although these programs have successfully engaged students in mentored research, there are many more qualified applicants than there are fellowship positions. Since our faculty, staff, and students indicated that expanding mentored research opportunities should be one of the elements of the QEP, we reviewed best practices at other institutions to determine some possibilities for expanding and supporting mentored research at UH.



In their own words...

“One of the best parts about the SURF program was that it gave me the opportunity to work one on one with my faculty mentor, whom I admire greatly. SURF is one of the best ways for an undergraduate to be able to have this kind of experience.”

Participant

2007 Summer Undergraduate Research Fellowship (SURF) Program

Table 3

Stipend-Supported Mentored Research Opportunities on the UH Campus (2006-2007)

Mentored Research Opportunity	Administered by	Reporting ^a Period	UH Student Participation
Provost's Undergraduate Research Fellowship (PURS)	Office of Undergraduate Research	AY06-07	45
UH Summer Undergraduate Research Fellowship (SURF)	Office of Undergraduate Research	SU07	42
AGEP Summer Research Program	UH Alliances for Graduate Education and the Professoriate (UH-AGEP)	SU07	21
AGEP Summer Research Program	UH Alliances for Graduate Education and the Professoriate (UH-AGEP)	AY06-07	3
Scholars Enrichment Program (SEP)	Houston Louis Stokes Alliance for Minority Participation (H-LSAMP)	AY06-07	50
NSF REU Site: Undergraduate Research Experience in Computational Science and Cybersecurity ^b	Department of Computer Science	SU07	4
NSF REU Site: Nanotechnology at the University of Houston ^b	Department of Electrical and Computer Engineering	SU07	2

167 Total

^aAcademic Year (AY) or Summer (SU)

^bNSF REU sites are encouraged by the National Science Foundation to seek participants from other institutions across the nation.

Mentored Research at Other Institutions

The QEP Planning Committee initially reviewed eight institutions offering active undergraduate research programs: Stanford, MIT, the University of Delaware, SUNY Stony Brook, the University of Nebraska-Lincoln, the University of North Carolina at Chapel Hill, the Georgia Institute of Technology, and the University of South Florida. While each program is distinguished by its own unique features, they also share common elements such as program administration by a central office; a mechanism for matching students to faculty; research projects that are student or faculty defined; awards of stipend, course credit, or salary to the student; and a university-wide showcase for student dissemination of their research.

When we compared these best practices with existing mentored research programs at UH, we found that our programs include all of these basic elements to varying degrees. A second review of best practices at other institutions, particularly those recommended by the Council on Undergraduate Research (CUR), suggested additional programs that could further support and expand mentored research at UH (Table 4). These best practices were considered by the QEP Planning Committee and subcommittees along with the many ideas submitted by faculty, staff, and students during the data gathering process described in the Appendix C.

Table 4

Best Practices in Mentored Undergraduate Research at Other Institutions

Program or Practice	Description	Model Institution(s)
Database of Faculty-Mentored Research Opportunities	Searchable comprehensive database of faculty research interests and available projects for credit or compensation and volunteer opportunities	University of Texas (EUREKA Database)
Multi-Semester Research Experiences	Funding for multi-semester or multi-year research experiences; incoming freshmen or current students	University of Nebraska - Lincoln Rice University
Research Work-Study	Listing of research assistantship among available work-study jobs; funded by faculty member or research program office	Harvard College
Mini-Grant Program for Travel or Research Supplies	Funding for student travel to present their work at regional and national conferences; funding for student research materials and supplies	SUNY Stony Brook
University Showcase of Student Research and Creative Activity	Annual campus-wide event featuring student poster and oral presentations, performances, project demonstrations, and art exhibits; also includes competitions and challenges	Carnegie Mellon (Meeting of the Minds)
Journal of Undergraduate Research	Compilation of student abstracts and/or research papers	Multiple Institutions; listing available at http://www.cur.org/ugjournal.html

2.7.2 Best Practices in Research-Based Courses

The QEP Planning Committee realized early in its process that expansion of mentored research opportunities alone would not impact student learning for the broader UH student population. Given approximately 900 tenured and tenure-track faculty on campus, it would not be feasible for each of the 27,400 undergraduates to participate in mentored research in faculty laboratories. The Committee sought a broad-based solution for engaging students in the research process. Thus, the idea of supporting the development of a research-supportive curriculum began to emerge. Moreover, as was shown in Table 3, there are fewer stipend-supported mentored research opportunities in the humanities compared to those in the sciences. This highlighted the need to utilize research-based courses as a way of addressing this difference.

Enhancing student learning through a research-based curriculum was advocated by the Boyer Commission's 1998 report and has been successfully implemented at various institutions. We reviewed best practices as summarized in two Council on Undergraduate Research (CUR) publications, *Reinvigorating the Undergraduate Experience: Successful Models Supported by NSF's AIRE/RAIRE Program* (2004) and *Developing & Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices* (2007). Following is a summary of these research-supportive curricular approaches:

- **Problem-Based Instruction** – Students, working in cooperative groups, are given a problem or case study to address that reflects complex, real-world situations. Students learn to analyze the problem, find appropriate resources and locate needed information, share their findings, and formulate and evaluate possible solutions. Research-focused variations for problem-based instruction include using classic published research papers as sources for problems.
- **Project-Oriented Laboratory** – Students, working in cooperative lab groups, are given an open-ended problem to solve. Over the course of the semester, students review literature, design experiments within material and equipment constraints provided by the instructor, perform the experiments, collect the data, analyze the results, and write a research laboratory report formatted as a scientific paper. An extension of this concept is an interdisciplinary investigative laboratory course that allows students from different majors to collaborate on projects.
- **Writing-Intensive Instruction** – Students learn to write according to the stylistic conventions and contexts of a particular subject area in order to communicate effectively in a manner appropriate to the discipline. Research-related writing assignments usually require at least 3,000. Students at the junior and senior level may also be involved in grant proposal development for research projects.
- **Research Methods** – Students learn about research methods used in a particular field or discipline. Research methods courses in the sciences may include computational data analysis, statistics and experimental design. In the social sciences, a research methods course might involve students developing their own research projects - selecting a research topic and writing a research proposal. Once the proposal is approved by the institutional review board, students will then collect and analyze the data, write a paper, and present the results.

- **Culminating Experience** – Research-based capstone or culminating experiences involve seniors in independent research with a faculty mentor. As in an honors thesis project, students can develop their own research questions or undertake a project in their mentors' laboratory.

The QEP Planning Committee and its subcommittees considered the above best practices in conjunction with ideas proposed by faculty, staff, and students during the data gathering process described in the Appendix C.

2.7.3 Best Practices Conferences

To learn more about best practices and assessment strategies for the QEP, members of the QEP Planning Committee also participated in three conferences:

- The SACS Commission on Colleges 112th annual meeting in New Orleans, LA, December 9-11, 2007.
- An audioconference hosted by Inside Higher Education on December 12, 2007 featured Dr. Kerry Karukstis, professor of chemistry at Harvey Mudd College and president of the Council on Undergraduate Research, who presented a seminar and hosted a question-and-answer session on "Promoting an Undergraduate Research Culture."
- The CUR/NSF regional workshop on "Institutionalizing Undergraduate Research" in El Paso, TX, January 18-20, 2008.

