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An Annotated Bibliography of Faculty Mentoring of Undergraduate Research

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Faculty mentoring is a vital component of undergraduate research programs. There is a great deal of literature on undergraduate research; however, only a small portion of that focuses expressly on mentoring. The goal of this annotated bibliography is to help guide faculty members and others who mentor undergraduate students formally in research, in administration of programs, or in conducting research on this topic. By using some of the resources identified here, they may gain knowledge and draw from the experiences of others. A diversity of approaches and disciplines is reflected.

The annotated bibliography covers works that specifically address faculty-student mentoring. It does not include general works on undergraduate research or mentoring unless they are especially noteworthy or important for particular purposes. Therefore, there are a few entries for general works on undergraduate research that, though not focusing on mentoring, address significantly the relationship between faculty and student researchers. Though useful, a guide to the larger literature of undergraduate research or mentoring would be necessarily much more extensive, and beyond the scope of this guide. Users interested in further study on these topics may search library catalogs and online journal databases. Some of the most useful databases are: *Academic Search Elite*, *Education Full Text*, *ERIC*, *JSTOR*, and *Project Muse*, as well as databases more specific to applicable disciplines, such as the sciences. They also should consult issues of the *Council on Undergraduate Research Quarterly*.

Most of the literature on mentoring undergraduate researchers is in the form of articles in scholarly and professional journals. Book-length works related to the topic tend to be too general for the scope of this bibliography, with the exception of CUR's own *How to Mentor Undergraduate Researchers*, described in detail below. There are 30 entries in this bibliography, appearing in alphabetical order by author last name. Annotations are brief and descriptive, written according to the purpose of this tool, and intended to inform the user of how the item might be of interest or use. Annotations reflect the focus of undergraduate research mentoring, and stress those aspects of the works included.

From this literature, a few general statements can be made:

- Because faculty mentors and undergraduate researchers are active in many disciplines, the literature on mentoring undergraduate research is interdisciplinary and somewhat fragmented. The literature cited below represents several

disciplines, including: sciences, engineering, social sciences, nursing, humanities, and business.

- Most authors depict mentoring of undergraduate researchers as both a research and teaching activity. Consequently, the literature reflects benefits for both mentors and students.
- Descriptive accounts of undergraduate research programs, with examples of projects, comprise about half of this literature. The other half is made up of reports of studies at individual and multiple institutions, mostly using surveys and interviews. Much of the literature discusses benefits of programs and their approaches, and offers recommendations for mentors.
- Some of the literature suggests particular benefits for female and minority students, for example, with regard to connections with faculty members and recruitment into graduate programs and certain professions.
- Taken as a whole, this literature presents a picture of the state of faculty mentoring of undergraduate research. There is a diversity of approaches, and programs and projects can take a variety of forms. Experienced and potential mentors may benefit from the collected experience represented in this literature, gleaned valuable advice.

Abdel-Qader, I. (2004). An undergraduate research mentoring model in digital signal and image processing. *International Journal of Electrical Engineering Education*, 41(2), 146-157.

This article describes a model for research mentoring in digital signal and image processing (DSIP) developed at Western Michigan University. The model was developed with support from the National Science Foundation (NSF), with a Research Experiences for Undergraduates (REU) supplemental grant. The authors discuss independent undergraduate research as a method of teaching concepts to undergraduate students. Goals and objectives of the program emphasize faculty-student interaction.

Abudayyeh, O. (2003). Undergraduate research mentoring model in construction engineering and management. *Journal of Construction Engineering and Management*, 129(1), 65-69.

This article describes a Research Experience for Undergraduates (REU) summer training program focused on construction engineering and management at Western Michigan University. The program was the first construction program in the U.S. to be funded with an REU grant.

In the program, faculty and/or graduate students mentor undergraduate students in independent research projects. The author describes the program design, which includes both research and professional development activities. Abstracts of three projects and references to resultant publications are included as examples of student research. The author discusses participant recruitment and program evaluation and assessment.

Baenninger, M., & Hakim, T. (1999). Undergraduate research as a curricular element: Multidisciplinary courses at The College of New Jersey. *Council on Undergraduate Research Quarterly*, 20(1), 8-13.

This article describes an initiative at The College of New Jersey to integrate into the curriculum collaborative research with faculty and undergraduate students. The Faculty-Student Research course was developed to provide better opportunities for faculty to collaborate with students on research projects. The course is open to students and faculty from any discipline, and provides a structured opportunity for students to learn and apply various aspects of research. The main goals are to promote student-faculty collaborative research as part of teaching, provide research-related interaction between faculty and students, provide faculty more equitable compensation for their teaching time, and develop an experience appropriate for all faculty and students. The article describes the inception and goals of the course, gives examples of faculty-student research projects completed for the course, and briefly presents some results of faculty and student interviews about the course.

Blockus, L., Kardash, C. M., Blair, M., & Wallace, M. (1997). Undergraduate internship program evaluation: A comprehensive approach at a research university. *Council on Undergraduate Research Quarterly*, 18(2), 60-63, 91.

This article describes the development of a program for evaluating an undergraduate research internship program at the University of Missouri-Columbia. The evaluation program measures interns' perceptions with surveys and interviews; assesses interns' career interests with the Strong Interest Inventory; and collects qualitative data from interns' Events Journals. Evaluation also compares interns' and faculty mentors' beliefs and attitudes about science careers and the goals of the internship program.

Bowman, M. H., & Stage, F. K. (2002). Personalizing the goals of undergraduate research: Confronting the challenge of drawing minorities

into graduate computer programs at Florida A&M University. *Journal of College Science Teaching*, 32(2), 120-125.

This article discusses a personalized approach for educators in setting goals for undergraduate research programs and experiences in the sciences. The authors divide program goals into three categories: concept and skill mastery, disciplinary socialization, and student self-identity. They briefly discuss each goal and suggest strategies for implementation that are more personal than traditional strategies. They provide examples, including some that enhance student-faculty interactions and relationships.

Boyer Commission on Educating Undergraduates in the Research University. (1998). *Reinventing undergraduate education: A blueprint for America's research universities*. Stony Brook, NY: State University of New York at Stony Brook for the Carnegie Foundation for the Advancement of Teaching.

This report makes several recommendations for improving undergraduate education at research universities, and is frequently cited as influential in current thinking on undergraduate research and mentoring programs, as well as program design. Some of the recommendations focus on inquiry-based learning that includes undergraduate research and faculty mentoring of students. It includes some examples of undergraduate research and mentoring programs.

Campbell, A., & Skoog, G. (2004). Preparing undergraduate women for science careers: Facilitating success in professional research. *Journal of College Science Teaching*, 33(5), 24-26.

This article reports briefly on a survey study of the effect of an undergraduate research program on the preparation of female students for careers in the sciences. Data are from 57 questionnaires and seven interviews of female graduates of the Texas Tech University/Howard Hughes Medical Institute (TTU/HHMI) Undergraduate Biological Sciences Education program. The study found that female students' research experiences, relationships with mentors, and opportunities to present papers at professional meetings were factors that facilitated their entrance into graduate and professional studies and science and research-related positions. More than 90% of the students pursued careers in science. The student relationship with the mentor was one of several influential factors. The program promoted the success and increased representation of women in science, thus addressing the gender gap in science.

Coker, J. S., & Davies, E. (2002). Involvement of plant biologists in undergraduate and high school student research. *Journal of Natural Resources and Life Sciences Education*, 31, 44-47.

This article reports on a study of the participation of plant biologist researchers in mentoring undergraduate and high school students in research. It reports the findings of an email survey of 531 members of the American Society of Plant Biologists (ASPB). Respondents reported whether they had supported undergraduate or high school researchers, whether they found the experience rewarding, and if they would like more information about becoming involved with such training. The majority of respondents reported having supported undergraduate researchers and finding the experiences rewarding. Among many advantages mentioned by mentors involved in research training were several specific personal and intellectual rewards. The majority of disadvantages reported concerned time consumption. The authors conclude that the ASPB membership supports, and is active in, research training.

Cortinas, J. V., Jr., Straka, J. M., Beasley, W. H., Schneider, J. M., & Machacek, C. M. (1996). The research experiences for undergraduates program: The 1995 program at the Oklahoma Weather Center. *Bulletin of the American Meteorological Society*, 77(12), 2925-2936.

This article describes the planning, implementation, and evaluation of a National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program at the Oklahoma Weather Center. Students participated in the 1995 Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX) program. The authors discuss selection and matching of mentors and students and elements of the program, including student-mentor activities and interactions. They provide summaries of individual projects as examples. The program was evaluated using student questionnaires. Significant commitment and involvement of mentors were key factors in the program's success.

Crawford, I., Suarez-Balcazar, Y., Figert, A., Nyden, P., & Reich, J. (1996). The use of research participation for mentoring prospective minority graduate students. *Teaching Sociology*, 24(3), 256-263.

This article describes a Social Science Research Opportunity Program (SSROP), funded by the U.S. Department of Education for 40 undergraduate university students. Authors discuss the goals for the program, selection of participants, and the learning and mentoring process. Exit interviews and focus groups were used to evaluate the

program. The authors make concluding recommendations regarding the benefits of such programs for better representation of traditionally underrepresented students in graduate programs and careers in the social sciences.

Einarson, M. K., & Clarkberg, M. E. (2004, November 5). *Understanding faculty out-of-class interaction with undergraduate students at a research university*. Paper presented at the Annual Meeting of the Association for the Study of Higher Education, Kansas City, MO.

This paper reports findings of a survey of 901 university faculty members about their involvement in out-of-class interactions with undergraduate students at their institutions. The authors distinguished between research-based interactions and other, informal out-of-class interactions. They discuss various factors influencing faculty engagement in out-of-class interaction with students.

Frierson, H. T., Jr., Hargrove, B. K., & Lewis, N. R. (1994). Black summer research students' perceptions related to research mentors' race and gender. *Journal of College Student Development*, 35, 475-480.

This article reports a study of the effects of race and gender on the mentoring process of undergraduate research students in a summer research program. The authors interviewed 18 African-American students at one university, from social and behavioral sciences, humanities, and sciences. Interviews focused on students' attitudes toward research and perceptions about the research environment, interactions with mentors, and specific research experiences. The researchers found that perceptions of all students were generally positive; however, students had more positive perceptions of African-American and female mentors.

Gmelch, G., & Gmelch, S. (1999). An ethnographic field school: What students do and learn. *Anthropology & Education Quarterly*, 30(2), 220-227.

This article describes an ethnographic field school in Barbados, offered by Union College's Anthropology Department. The authors discuss how students are recruited and prepared for the program, and what they do and learn. Through mentored fieldwork on various topics, faculty guide undergraduate students in collecting data, writing, and other aspects of independent ethnographic research. Outcomes for students include: learning about cultural difference, personal development, positive attitudes toward their own education, and development of interpersonal skills.

Gueldner, S. H., Clayton, G. M., Bramlett, M. H., & Boettcher, J. H. (1993). The undergraduate student as research assistant. *Nurse Educator, 18*(3), 18-21.

This article discusses two cases of undergraduate student participation in research teams with nursing faculty researchers. In one case, students were hired and trained as paid research assistants; in the other students gained academic credit for participation in faculty-directed research teams.

Hakim, T. (1998). Soft assessment of undergraduate research: Reactions and student perspectives. *Council on Undergraduate Research Quarterly, 18*(4), 189-192.

This article presents findings of 25 informal interviews of undergraduate student researchers at Jacksonville University. Interviews included a question about student relationships with their faculty research mentors. The author concludes that student perceptions of their experience in the program match and reinforce expectations of their research supervisors.

Hathaway, R. S., Nagda, B. A., & Gregerman, S. R. (2002). The relationship of undergraduate research participation to graduate and professional education pursuit: An empirical study. *Journal of College Student Development, 43*(5), 614-631.

This article reports the findings of a study that investigated the impact of undergraduate research participation on graduate education and activities. The authors surveyed 291 University of Michigan alumni, including former students who had participated in the Undergraduate Research Opportunities Program (UROP). Results were categorized into three groups: students who had participated in UROP, students who participated in other undergraduate research, and students who did not participate in undergraduate research. Findings show a positive influence of research participation on pursuit of graduate and professional education, post undergraduate research activity, and use of faculty for job recommendations. The authors suggest that faculty-student interaction is a factor in this relationship, and recommend future research on its effect on student experience.

Holbrook, J. M., Tibbs, N. H., Lowell, G. R., & Snowden, J. O. (1995). Facilitating voluntary undergraduate research with a group-oriented early research apprenticeship program. *Journal of Geological Education, 43*, 404-407.

This article describes the Early Research Apprenticeship (ERA) Program

in the Department of Geosciences at Southeast Missouri State University. The program consists of an informal seminar, a required one-credit-hour Introduction to Research course, and a voluntary senior thesis project. The ERA Program has resulted in an increased undergraduate participation in research, which the authors attribute partly to increased opportunities for faculty-student research interaction.

Ishiyama, J. (2002). Does early participation in undergraduate research benefit social science and humanities students? *College Student Journal, 36*(3), 380-386.

This article presents a study that examined the effects of early undergraduate participation in collaborative research with faculty on the development of certain student skills. The study was based on Truman State University student responses on the College Student Experiences Questionnaire (CSEQ). The sample consisted of 156 declared social sciences and humanities majors. The author found that freshman and sophomore students' early participation in collaborative research with a faculty member is positively related to gains in analytic and independent learning skills. Such participation is particularly beneficial to first-generation college students.

Landrum, R. E., & Nelsen, L. R. (2002). The undergraduate research assistantship: An analysis of the benefits. *Teaching of Psychology, 29*(1), 15-19.

This article presents the results of a study that examined faculty perceptions of the benefits of undergraduate students serving as research assistants. In a national survey of 211 undergraduate psychology educators, respondents rated 40 potential benefits, skills, and abilities attained by research assistants, as well as responded to two open-ended questions. Analysis of the ratings found two major themes: technical skills and interpersonal benefits. Open-ended responses described mentoring models used by instructors.

Lopatto, D. (2003). The essential features of undergraduate research. *Council on Undergraduate Research Quarterly, 23*(3), 139-142.

This article presents the results of an informal survey of science faculties at three institutions regarding essential features and benefits of successful undergraduate research experience. The author also conducted a follow-up survey of 249 students in summer undergraduate research programs at four institutions. Results of both surveys are presented and analyzed. Faculty and student responses were compared. The author categorizes response into structure items and

consideration items, and hypothesizes that students value consideration more than structure. Benefits that students value are a result of student-mentor relationships and interactions.

Lopatto, D. (2004). Survey of Undergraduate Research Experiences (SURE): First findings. *Cell Biology Education*, 3(4), 270-277.

This article reports the findings of a national online survey of students on the benefits of undergraduate research experiences. The sample consisted of 1,135 undergraduate students from 41 colleges and universities, who responded to the online Survey of Undergraduate Research Experiences (SURE). Respondents answered questions about 20 specific learning gains, as well as five general questions about their experience. The majority of respondents rated their research supervisors as above average or outstanding. Most indicated that they began or planned postgraduate education in the sciences.

Mabrouk, P. A., & Peters, K. (2000). Student perspectives on undergraduate research experiences in chemistry and biology. *Council on Undergraduate Research Quarterly*, 21(1), 25-33.

This article reports the findings of a study of the perspectives of students on undergraduate research. Data were collected using an 80-item web-based survey of 126 students from several institutions. Some findings were that the majority of students became involved in research through active effort of faculty, and that faculty at all ranks served as research mentors. Findings also indicate that faculty mentors created a welcoming environment for student researchers. From students' perspectives, the most valuable traits in research mentors were project knowledge, enthusiasm, availability, and patience. The authors conclude with several suggestions for undergraduate research advisors.

Merkel, C. A., & Baker, S. M. (2002). *How to mentor undergraduate researchers*. Washington, DC: Council on Undergraduate Research.

This booklet is a basic handbook for mentoring undergraduate students in research. It is short and practical, outlining the mentoring process and offering advice to mentors. The authors focus on science; however, the reader can generalize the information to other fields and researchers. The intended audience is mentors and potential mentors, whether faculty or independent researchers. The authors provide real examples from a variety of people and places.

Mogk, D. W. (1993). Undergraduate research experiences as preparation for graduate study in geology. *Journal of Geological Education*, 41, 126-128.

This article describes the author's experience supervising directed research projects with undergraduate geology students. It describes the process of student work on senior thesis projects and the author's supervision and mentoring of the participants. The author concludes that undergraduate research experience motivates and prepares students for graduate study in the discipline.

National Academy of Sciences, National Academy of Engineering, Institute of Medicine. (1997). *Adviser, teacher, role model, friend: On being a mentor to students in science and engineering*. Washington, DC: National Academy Press.

This is a guide for mentoring students in science and engineering. It discusses mentoring in general as well as mentoring of different levels of students and junior faculty. The section on mentoring undergraduate students includes a discussion of mentoring undergraduate research. The guide includes lists of tips on improving mentoring, and examples, profiles, and chapter summary points. There also are summary recommendations for institutions to improve mentoring programs, and a list of print and internet resources.

O'Clock, P. M., & Rooney, C. J. (1996). Exposing undergraduates to research through a mentoring program. *Journal of Accounting Education*, 14(3), 331-346.

This article describes an undergraduate research program in which a business student, professor, and business professional collaborate on a research project. In this program, the undergraduate student researcher is linked to both a mentor professor and a business practitioner mentor. The authors describe the program and give examples of past projects. They also discuss program evaluation, which was based on 21 completed questionnaires from participants of eight completed projects. Findings indicate that participants valued relationships they developed with others. Students had more frequent interactions with professor mentors than with practitioner mentors, and indicated strong relationships with them. The authors found many benefits associated with mentoring.

Ravert, P., Boyer, B., Harmon, K., & Scoffield, H. (2004). Learning nursing research through faculty-mentored projects. *Nurse Educator*, 29(4), 170-174.

This article describes a faculty-mentored undergraduate nursing research project at Brigham Young University, in which students work as research assistants in a faculty research project using a human

patient simulator (HPS). Faculty mentored research assistants in the collection, coding, and management of data, and eventually in disseminating it in a presentation at a national conference for undergraduate research. The authors list several suggestions to facilitate faculty mentors working with research assistants on projects.

Seymour, E., Hunter, A., & Laursen, S. L. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88(4), 493-534.

This article reports findings from a study of undergraduate research experiences at four liberal arts colleges. Data were from interviews with 76 students. Findings indicate that students were positive about their experiences and reported several benefits of participation in the program, including opportunities to develop collegial working relationships with faculty research mentors.

Shellito, C., Shea, K., Mueller-Solger, A., & Davis, W. (2001). Successful mentoring of undergraduate researchers: Tips for creating positive student research experiences. *Journal of College Science Teaching*, 30(7), 460-464.

This article reports on a study of undergraduate researchers' attitudes about characteristics of a good faculty research mentor, and faculty members' perspectives on what constitutes a successful undergraduate research program. Data were from a survey of 107 undergraduate researchers and interviews with faculty mentors at the University of California, Davis. The authors report results of the student survey and compiled a list of mentoring tips based on results of the survey and faculty mentor interviews. Mentoring tips fell into three categories: managing time and resources, establishing relationships with students, and offering continued student guidance. Several mentor comments supporting these tips are included.

Wallace, J. M. (1999). Special reflections from the field: Mentoring apprentice ethnographers through field schools. *Anthropology & Education Quarterly*, 30(2), 210-219.

This article introduces a special section of an issue of the journal, focusing on using field schools to mentor students in ethnographic research. The author discusses the mentor-student interaction process as the key factor in the popularity and success of such field school programs. It includes a general discussion of structure and goals of ethnographic field school programs.

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