

## **CHAPTER THREE: UNDERGRADUATE RESEARCH OPPORTUNITIES IN A RESEARCH I UNIVERSITY**

UC Irvine is among a small number of U.S. higher education institutions that are classified as Research I universities by the Carnegie Foundation. By definition, Research I universities offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. The major focus of these universities is *research*—faculty members conduct research, they seek outside funding for research, they provide research training for graduate students, and they share the results of research with colleagues and the wider community of scholars. The achievement of an academic position, tenure, and movement through the faculty ranks all depend on the positive assessment of the faculty member’s research accomplishments as determined by his/her department, school, and the campus at large. Research skills and research accomplishments are the very foundation of the faculty’s success as peer-reviewed scholars who pursue research and disseminate the results.

This chapter of the self-study describes how UCI encourages and supports opportunities for undergraduate students to engage in research and related inquiry-based or creative activities, and how those opportunities have expanded during the years since UCI’s last WASC review. The chapter describes:

- the size and scope of undergraduate research activities
- campuswide and school-based undergraduate research programs
- campuswide and school-based honors programs that require research or similar creative activities
- new initiatives and use of small classes to promote inquiry-based learning

- methods for recognizing excellence in teaching

## **DEFINING “RESEARCH”**

At the University of California, “research” is defined very broadly. Research is characterized by the inquiry, investigation and discovery process which often leads to the discovery of new knowledge, insights, and understandings about ourselves and our world. It includes the scientific method of hypothesis testing and experimentation as well as analytical and interpretive activities in the humanities and social sciences. It also includes creative and artistic endeavors in the arts. Results of research may take the more traditional forms of articles in scholarly journals, books and manuscripts, course materials and textbooks, or less traditional forms such as performances in the arts (in drama and dance, for example), creations of artistic expression (such as paintings and sculpture), or electronic and other multi-media materials (such as Websites, electronic journals, or hypertextbooks).

That is, the term “research” encompasses *all* of the inquiry-based activities of an active faculty member. In short, all UCI faculty members participate in some type of research and research-related scholarly and/or creative activities. And it is this set of activities that gives undergraduate education at a Research I university its uniqueness. Indeed, the Boyer Commission in *Reinventing Undergraduate Education: A Blueprint for America’s Research Universities* (1998) described the research university as a community of learners where the “shared goals of investigation and discovery” bind together students and faculty.

Like other research universities, UCI embraces the idea that undergraduate students should not only be exposed to the research process but should also be

participants in that process. Nearly a century ago, John Dewey noted that learning is based on discovery guided by mentoring, rather than on the mere transmission of information. Recent research in the neurosciences has confirmed that the most powerful learning occurs when the student is actively engaged in real-world tasks that demand higher-order thinking skills and abilities and that are undertaken in concert with other people (Marchese in *Assessing Impact: Evidence and Action* 1997). Many UCI faculty members have also turned inquiry, investigation, and discovery into the foundations of their success as teachers.

Not all undergraduate students are expected, or required, to participate in independent research projects at UCI. For some students, it will be enough to learn how research is conducted and to write research-based papers for composition courses. For all students, our aim is for them to stretch their minds, develop their critical thinking skills, and start synthesizing and begin applying what they have learned in various courses. One of the best ways to promote the development of such skills is to provide undergraduates with the opportunity to engage directly in a faculty-mentored research project or to engage in inquiry-based learning during a senior thesis or capstone course. That is, “opportunities” are emphasized rather than “requirements” that might not work for all students.

### **SIZE AND SCOPE OF UNDERGRADUATE RESEARCH ACTIVITIES**

For the purposes of this self-study, our assessment of undergraduate research and related inquiry-based activities began with data from the Office of the Registrar. To obtain an estimate of how many undergraduate students were engaged in research-related activities, the Registrar analyzed enrollments in courses numbered 195-199 (course numbers typically reserved for independent or group

research projects) for the graduating class of 1994-95. Results are presented in Table 1. For this group of students, just over half (51 percent) of those graduating with bachelors' degrees had enrolled in courses numbered 195-199; approximately one-third (34 percent) had enrolled in at least one independent study course (in the 199 series). The average number of units in 195-199 courses ranged from 6 to 13 units, depending on the academic unit (180 units required for graduation). It should be noted that the numbers presented in Table 1, while generally representative of the amount of undergraduate research at UCI, are actually underestimates. For example, these counts exclude students enrolled in research-related courses with course numbers other than 195-199 (such as Chemistry 180) and students engaged in non-credit internships or research assistantships.

**Table 1: Involvement in Undergraduate Research,  
1994-95 Graduating Class**

Academic Unit	Number Graduating	Course Numbers	Number and percent of Students Enrolled	Number of Units Taken	Mean Units Per Student
Arts	132	195-199	92 (70%)	1119.0	12.2
		199 only	67 (51%)	640.0	9.6
Biological Sciences	784	195-199	242 (31%)	1884.3	7.8
		199 only	197 (25%)	1639.3	8.3
Engineering	171	195-199	106 (62%)	764.0	7.2
		199 only	81 (47%)	453.0	5.6
Humanities	377	195-199	170 (45%)	1250.0	7.4
		199 only	107 (28%)	616.0	5.8
Information & Computer Science	95	195-199	43 (45%)	419.0	9.7
		199 only	24 (25%)	193.0	8.0
Interdisciplinary Studies	3	195-199	3 (100%)	18.0	6.0
		199 only	0 (0%)	0.0	0.0
Physical Sciences	121	195-199	24 (20%)	148.0	6.2
		199 only	14 (12%)	87.0	6.2
Social Ecology	459	195-199	450 (98%)	5877.7	13.1
		199 only	209 (46%)	2012.0	9.6
Social Sciences	837	195-199	397 (47%)	4015.0	10.1
		199 only	310 (37%)	2844.0	9.2
Total	2979	195-199	1527 (51%)	15495.0	10.1
		199 only	1009 (34%)	8484.3	8.4

Source: Registrar's Office, 5/7/96

To assess inquiry-based activities in regularly scheduled courses (excluding the ones listed in Table 1), we conducted a campuswide survey in which 12 representative departments participated. Each department was asked to complete a standardized spreadsheet querying the extent to which regularly scheduled courses between 1997 and 1999 provided opportunities for students to build their inquiry skills and their communication skills. The later half of the survey, on communication skills, was included for two reasons: first, research activities require that students be able to communicate their findings in an understandable fashion, and second, results could be used to inform the WASC self-study report on communications skills.

The instructions for completing the spreadsheet asked the faculty of each department to report on the number of courses with inquiry-based learning opportunities (such as problem sets, data analysis, group or individual labs or projects, and use of library research) and that emphasized communications skills (such as essay exams, papers and oral presentations). Summary results from the 12 departments are presented in Table 2:

**Table 2: Percentage of Undergraduate Courses Using Inquiry-Based Learning Strategies or Stressing Communication Skills, Selected Academic Units, 1997-99**

Academic Unit	# of Courses	Inquiry-Based Learning	Communication Skills
Arts			
Dance	46	41%	85%
Biological Sciences	151	88%	76%
Engineering			
Mechanical&Aerospace Engr	40	100%	58%
Humanities			
English & Comparative Literature.	148	100%	100%
History	141	64%	70%
ICS	53	94%	42%
Physical Sciences			
Chemistry	131	92%	43%
Social Ecology			
Criminology, Law & Society	60	47%	92%
Psychology & Social Behavior	117	21%	59%
Social Science			
Cognitive Science	169	41%	43%
Economics	53	96%	49%
Political Science	103	41%	100%
Total	1212	69%	68%

Source: WASC Self-Study Committee on Undergraduate Research, 2/00

Results presented in Table 2 indicate that, while various departments stress different types of learning opportunities, two-thirds of all the courses in the survey require at least one exercise that makes use of inquiry-based learning (69

percent of courses, or 63 percent of course-hours). Similarly, two-thirds of the courses surveyed require at least one exercise that emphasizes communication skills (68 percent of the courses, or 45 percent of course-hours). As might be expected, we find that inquiry-based learning is more common in the sciences and engineering, while writing or other communications-based learning is more common in the humanities and social sciences. Nevertheless, many science courses emphasize communication skills and, conversely, many courses in the humanities, arts and social sciences employ inquiry-based learning. These results indicate that faculty in all academic areas understand and reinforce the twin goals of communication skills and inquiry-based learning.

More detailed information from the survey is presented in Table 3. The table lists the percentage of courses in each department that included each of the various requirements regarding inquiry-based learning and communication skills. Please note that respondents were free to check more than one category for each course, as appropriate (i.e., a course may require a five-page paper, a group project, and library research). In the Web-based version of this table, detailed results by department may be viewed by clicking on the department name as it appears in the left-most column.

In completing the Table 3, each department was asked to list all lower-division and upper-division courses offered during 1997-98 and 1998-99. The table lists the number of courses in each department that included each of the various requirements regarding inquiry-based learning and communication skills. The total number of courses/sections considered by each department appears at the left side of the table. Respondents were free to check more than one category as appropriate (i.e., a course might require a five-page paper, group project, and

library research). “Oral Presentation” refers to a presentation of five minutes or more to the group and not just to class discussion.

**Table 3: Number of Undergraduate Courses Using Inquiry-Based Learning Strategies or Stressing Communications Skills, Selected Academic Units, 1997-99**

ACADEMIC UNIT	No. of Courses	INQUIRY BASED LEARNING				COMMUNICATION SKILLS				
		Problem Sets/ Data Analysis	Group Lab or Project	Individual Lab or Project	Library Research	3-5 Page Paper	2-5 Page Paper	5-10 Page Paper	> 10 Page Paper	> 5 min Oral Presentation
ARTS Dance	45	1	4	15	10	4	31	6	1	9
BIOLOGY	151	94	40	62	85	57	72	31	33	44
ENGINEERING Mech & Aero	40	36	13	24	15	2	7	5	9	11
HUMANITIES Engl & Comp Lit	148	1	39	146	26	82	93	82	38	50
History	141	6	3	2	36	10	46	44	23	24
I C S	53	31	15	31	7	4	10	7	8	11
PHYSICAL SCI Chemistry	131	86	24	88	49	0	48	26	23	23
SOCIAL ECOLOGY Crim Law&Soc	60	12	5	10	14	39	15	12	18	17
Psych&Soc Beh	117	4	6	18	8	7	20	20	25	12
SOCIAL SCIENCE Cognitive Sci	169	41	27	40	43	1	28	40	21	20
Economics	53	45	8	37	41	0	9	15	10	14
Political Sci	103	25	19	4	58	65	44	43	36	26
<b>Totals</b>	<b>1080</b>	<b>382</b>	<b>203</b>	<b>477</b>	<b>392</b>	<b>271</b>	<b>423</b>	<b>331</b>	<b>245</b>	<b>261</b>

### CAMPUSWIDE UNDERGRADUATE RESEARCH PROGRAMS

The interest of both faculty and students in undergraduate research and other inquiry-based projects has been considerably enhanced by the recent initiation of several campuswide programs that are open to all students. These programs include the following:

- **Undergraduate Research Opportunities Program (UROP)** which provides advising on on-campus and off-campus research opportunities, provides funds through two calls for proposals (fall and spring) each academic year, and sponsors the [Undergraduate Research Symposium](#) and

the *UCI Undergraduate Research Journal* . (Additional details are provided below.)

- **President's Undergraduate Fellowships (PUFs)** support meritorious undergraduate research projects with funds provided by the UC Office of the President. Formerly awarded by the Academic Senate Committee on Undergraduate Scholarships, Honors and Financial Aid, the PUFs are now administered by UROP.
- **Pregraduate Mentorship Program (PGMP)** helps students of diverse backgrounds to pursue graduate studies primarily in the non-sciences. Selected students participate in workshops and other activities to prepare them for graduate school. (This program was discontinued as of fall 1999.)
- **Committee on Instructional Development (CID)** funds are used by the campus to support faculty-mentored research projects. These awards are administered by UROP.
- **NSF Scholars Program** recently funded by an NSF grant, will assist academically talented, low-income, third- and fourth-year undergraduates majoring in Information and Computer Science, Engineering, or Mathematics to complete their baccalaureate degrees and to make a successful transition from college to work or to graduate school. The two-year program will support 40 students per year with scholarships of \$2,500 each. Many of these students will be involved in faculty-mentored undergraduate research projects and corporate internships. This program is being coordinated by UROP.
- **UCI Washington, D.C. Center Program** provides undergraduates the opportunity to do independent research under the guidance of a faculty member while studying in residence in the nation's capital. This year, 26

students were scheduled to participate in the first year of the program (9 in fall and 17 in spring).

- **California Alliance for Minority Participation (CAMP)** is an NSF-funded Statewide initiative that aims to support and retain undergraduates to achieve their degrees in biological sciences, physical sciences, mathematics, or engineering. UCI's CAMP program, in coordination with UROP, encourages students to engage in internships and undergraduate research opportunities and has sponsored students to present their research results at the CAMP Statewide Undergraduate Research Symposium.
- **McNair/STAR Scholars** work with faculty mentors to complete undergraduate research projects. This campuswide program, coordinated through CAMP, provides research and scholarly opportunities to prepare low-income, first-generation college students for graduate-level study.

Results from many of these undergraduate research projects have been presented as papers or posters at professional conferences and meetings. For example, at the March 2000 [UC Day in Sacramento](#) four UCI undergraduates—the largest number from any UC campus—were selected to present posters illustrating the research they are conducting, which ranged from the impact of domestic violence to non-invasive characterization of breast cancer. In the press release for this UC Alumni Association-sponsored event, UC faculty members were quoted as saying that “research benefits undergraduate education, rather than being in competition with it.” Professor Timothy Osborne, one of the UCI faculty members whose student participated in the conference, was also quoted as saying “They [the students] don't just get a research experience out of it. It's a real teaching tool.”

Other students have had their research results published. For example, several UCI engineering majors have published articles in the *California Engineer*, a student journal of the UC engineering colleges (based at UC Berkeley).

[UROP](#) is the most extensive of the campuswide programs that support undergraduate research and creative activities. Launched in 1995 as a unit within the Division of Undergraduate Education, UROP encourages and facilitates research and creative activities by undergraduates from all schools and academic disciplines at UCI. Research opportunities are available not only from every discipline, interdisciplinary program and school, but also from many outside agencies, including national laboratories, industry, and other universities. UROP offers assistance to students and faculty through all phases of the research activity: proposal writing, developing research plans, resource support, conducting the research and analyzing data, presenting results of the research at the annual spring UCI Undergraduate Research Symposium, and publishing findings in the *UCI Undergraduate Research Journal*. Projects supported by UROP must meet established academic standards and emphasize interaction between the student and faculty supervisor.

UROP is particularly noteworthy for being a comprehensive program that supports faculty-mentored undergraduate research at all stages of the research process. UROP nurtures students through the entire process, from the time a student first expresses an interest in participating in faculty-mentored research and in finding an appropriate faculty mentor, to the planning and funding of the research, to the time the student can disseminate the results.

UROP has met with great success in recent years and has received wide support from faculty including the active involvement of the [UROP Faculty Advisory](#)

**Board.** The number of student projects funded by the program has nearly tripled since its inception in 1995. In 1999-00, for example, UROP awarded approximately \$91,000 in support of 175 student projects represented each of UCI's academic units.

The following table summarizes UROP data on the amount of funding provided, number of projects supported, and the number of faculty mentors by program since 1993, as applicable.

**Table 4: UCI Undergraduate Research Opportunities Program, Number of Projects Funded, Number of Faculty Mentors, and Total Funds Awarded by Program, 1993-1999**

Year	UROP			PUF			PGMP			CID			Total		
	A (*)	B	C	A	B	C	A	B	C	A	B	C	A	B	C
99-00	175	158	\$90,944	Combined with UROP			Discontinued Fall 1999			Combined with UROP			175	158	\$90,944
98-99	173	121	\$68,314				58	43	\$60,500				231	164	\$128,814
97-98	123	85	\$61,488				56	39	\$58,750				179	124	\$120,238
96-97	99	69	\$42,032	19	20	\$25,269	63	44	\$59,381	181	133	\$126,682			
95-96	51	37	\$24,709	22	23	\$22,000	68	47	\$63,000	55	38	\$25,218	196	145	\$134,927
94-95	Launched in 1995			19	20	\$22,491	62	46	\$70,956	73	51	\$24,835	154	117	\$118,282
93-94				21	19	\$30,347	Not Available			76	53	\$25,938	97	72	\$56,285

A = number of projects funded  
 B = number of faculty mentors  
 C = total funds awarded.

UROP offers two very effective means for disseminating the results of student projects:

- The *UCI Undergraduate Research Symposium*, organized as a professional conference with keynote speakers, oral and poster presentations, student performances, roundtable discussions, and an awards ceremony. The 1999 Symposium included more than 250 student presenters and performers from every discipline. The awards ceremony

included the Chancellor's Awards for Excellence in Undergraduate Research, awarded to both students and faculty.

- The *UCI Undergraduate Research Journal*, launched in 1999, a compilation of outstanding papers submitted by undergraduate students who have been involved in faculty-mentored research projects and creative activities. Copies of the journal were sent to more than 400 high schools and community colleges throughout California and to the UC Regents.

The successes of UROP, the Undergraduate Research Symposium, and the UCI Undergraduate Research Journal, are all tributes to UCI's commitment to undergraduate research. Additional information about UROP, including a copy of last year's UCI Undergraduate Research Journal, is available on the UCI accreditation website.

#### **ACADEMIC UNIT-BASED UNDERGRADUATE RESEARCH PROGRAMS**

In addition to the campuswide undergraduate research programs listed above, UCI also has numerous departmental and school-based programs that foster undergraduate research and other creative activities. Some of these programs are restricted to majors; some may be required for graduation in a given major. Selected examples follow, and more information is available in the UCI General [Catalogue](#). In addition to those listed below, all academic units offer their majors faculty-directed independent study and honors research opportunities, primarily through courses numbered 198 and 199.

## School of the Arts

Each year more than 100 undergraduates from the [Dance](#) Department perform in the School of the Arts productions.

The [Music](#) Department provides performance opportunities for all UCI students, regardless of major. These are (1) choral and vocal opportunities such as Women's Chorus, Women's Chamber Choir and the Madrigal Dinner; (2) instrumental opportunities including the [UCI Symphony Orchestra](#), chamber music ensembles, Wind Ensemble, Jazz Big Band, and the UCI Band; and (3) music composition opportunities for composing works for performance or for reading by UCI's large performing ensembles.

## School of Biological Sciences

- [Excellence in Research Program](#): About 65 students participate each year in this program in which they develop extensive research projects, write papers, give talks, and present posters describing their research. Awards are given for the best presentations. "Excellence in Research" appears on transcripts.
- Undergraduate Biological Sciences Minority Advanced Research Training ([UBSMART](#)): Participants are given technical training in the labs to develop their research skills, plus training in data analysis, ethics, and scientific writing. They are placed in labs and when their research projects are completed, they are sent to conferences to present their data.
- Minority Biomedical Researchers Program ([MBRP](#)): Funded by the National Institutes of Health, undergraduate MBRP fellows conduct research while receiving an hourly compensation for two summers full-time, and two academic years part-time. Students are recruited in their sophomore year. After their initial training and orientation, students

conduct research in faculty laboratories in the School of Biological Sciences and the College of Medicine.

- Minority International Research Training ([MIRT](#)) program provides undergraduate and graduate biological and biomedical sciences students with international laboratory and field research experiences. Participants receive course credit, room and board, transportation, and a stipend. The UCI MIRT program has provided international research training to more than 70 minority science students on three continents under the supervision of world-known scientists. It is funded by the National Institutes of Health.
- [White Mountain Research Station Supercourse](#): Environmental Biology: Undergraduates devote an entire quarter's curriculum to this course, engaging in lectures and field training and research. About 15 students participate each year.
- NIMH Grant in Neurobiology Research: Research Experiences for Undergraduates: Under this new program, eight students per year participate in neurobiology research during the academic year and summers. They also receive training in experimental design, scientific writing, data analysis, ethics, and research seminars from experts
- in the field. They are sent to scientific meetings in addition to presenting their data to others on campus.
- Various NSF Grants: Research Experiences for Undergraduates

### **[The Henry Samueli School of Engineering](#)**

- NASA Undergraduate Scholars Awards for Research, coordinated through UROP

- Senior Design Projects for Mechanical Engineering majors (required). Projects have included cargo airplane design, the Baja Buggy, a Formula One race car, a human-powered vehicle, a portable fuel cell, devices for the disabled, and autonomous robots.
- Electrical Vehicle Project sponsored by the Electrical and Computer Engineering Department. Students design and develop an electric-powered vehicle.
- Mechanical and Aerospace Engineering 188: Design in Industry course, open to any UCI student, to work on industry-sponsored design projects.
- Environmental Engineering Field Studies
- Capstone courses in all disciplines, such as Chemical Engineering Design, Pollution Control, Design of Water and Waste Treatment Systems, and Structural Design of Buildings.
- Various NSF Grants: Research Experiences for Undergraduates

### **School of Humanities**

- **Humanities Core Course** (required of Humanities majors and open to all first-year students from any major) enrolls about a thousand students each year in a lecture/section format; sections limited to 22 students each. Students are required to complete a research paper in the spring quarter, based on a year-long series of assignments focused on methods of research in the humanities, including print, electronic, and Web-based sources. The research paper is the culmination of the curriculum in composition that is integrated into the course in all three quarters.

Research Seminar for History majors (required). Students are required to

analyze a historical problem through research in primary sources and writing an original research paper. Each seminar is offered following the History 190 Colloquium.

- Senior Essay for Concentration in Medieval Studies. Students may substitute a senior essay for one of four required upper-division courses.
- Senior Essay for Humanities majors (required). At the end of the senior year, Humanities majors prepare, under the supervision of a faculty advisor, a 40- to 50-page paper.

### **Department of Information and Computer Science**

- Project Classes – All ICS students are required to take a minimum of three upper-division project classes. Students who excel are encouraged to use these classes to engage in faculty-directed research projects. In particular, ICS offers project classes in areas such as artificial intelligence, design and analysis of algorithms, design of personal computers, operating system organization, social and organizational impacts of computing, software design and engineering, and software evolution.
- NSF Research Experiences for Undergraduates (REU) – Three undergraduate research projects are currently being sponsored by various NSF grants: (1) students design and develop a multimedia search engine for browsing and retrieving HTML documents based on their content, (2) students analyze, design, and implement a multicast video architecture for high-speed networks, and (3) students apply concepts from biology to create a new network serving architecture, called Bio-Networking.

## School of Physical Sciences

- Research Experiences for Undergraduates in **Physics**: This is a 10-week summer physics site program that has been in operation for 12 of the last 13 years, and funded for an additional 3 years. To date, 125 undergraduates have participated in the program—about one-third are UCI students and two-thirds are from other colleges and universities. Preference is given to applicants who are between their junior and senior years, who have not had previous REU experiences, and who come from schools with limited opportunities for undergraduate research.
- Chemistry 180: Undergraduate Research: The **Chemistry** Department sponsors a course in undergraduate research. Its enrollments are not captured in Table 1 (which focuses on course numbers 195-199). Chemistry reports that over 50 percent of its majors engage in undergraduate research either via Chemistry 180 or via research programs in neighboring disciplines (most frequently Biological Sciences).

## School of Social Ecology

- Naturalistic Field Research and Field Studies: Lecture course followed by studies in community settings. Students examine social-environmental problems as they occur in community settings, evaluate the merit of ideas presented in the classroom, and conduct naturalistic observations and investigations at field sites. Required of all Social Ecology majors.
- Research Seminar in Psychology and Social Behavior: Special topics research seminar and capstone research opportunity with ladder-rank faculty members.

## School of Social Sciences

- Summer Academic Enrichment Program (SAEP): Each year 18 to 20 students participate in an intense, five-week summer residential program designed to enhance their analytical and research skills and to prepare them for graduate school. It exposes students to analytical writing, statistics and numerous graduate school workshops.
- McNair/STAR: Within Social Sciences, there are over 20 McNair Scholars. These students are introduced to mentorship and are required to complete a faculty-mentored research project for the academic year. The school provides additional research workshops, mentorship, and guidance to the scholars to assure their success in the program.
- Public and Community Service is a specialization within the Social Science major in which students are required to integrate academic learning with community service activities. As a requirement, students enroll in a three-quarter class series and are placed in community internships with local community non-profit agencies. Students provide community service and conduct field research. In spring 2000, there were over 50 students in this program
- Field Studies Research/Internship Reception: Field Studies students present their research and internship experiences to an audience of faculty, students, and community visitors at the end of the academic year. The symposium allows students to learn about their peers' research and experiences at an authentic professional event. In spring 2000, 26 students participated in the program.
- Service Learning Research Internships: In support of Governor Davis' call to UC to make positive contributions to the underserved and marginalized communities of California through academic courses, the School of Social

Sciences provides out-of-class experiences to reinforce understanding of academic theory while addressing serious community concerns. With a structured curriculum having a research requirement, students explore the role of the social scientist in problem-solving activities affecting society.

- **Summer Scholar Research Program:** This program provides students avenues to explore quality summer research programs emphasizing “hands-on” research, faculty mentorships, and graduate school information. The intent is to offer undergraduates the opportunity to attend out-of-state higher education institutions to conduct research and supplement their educational experience. Approximately 10 students are participating during the 2000-01 academic year, and the goal is to have over 50 across the nation over the summer in the next three years.
- **Research Scholar Reception:** This end-of-the-year gathering, hosted by the dean, acknowledges all Social Science students conducting research funded outside the school. At this event, students come together to discuss their projects sponsored by McNair, UROP, Summer Research, and independent faculty.
- **Social Sciences Academic Resource Center Research Workshops:** The School of Social Sciences' Academic Resource Center ([ARC](#)) provides numerous research-related workshops throughout the academic year. These address the importance of research, ways to approach faculty and join their research teams, the benefits of research, and fundamental steps to conducting good research.

### **College of Medicine**

- **Pharmacology Summer Undergraduate Research Fellowship Program (1997):** With matching funds from the Society for Pharmacology and Experimental

Therapeutics, faculty members in Pharmacology created five \$2,000 summer stipends for five undergraduates to do 10 weeks of research in faculty laboratories.

### **CAMPUSWIDE HONORS PROGRAM**

One of the primary goals of the Campuswide Honors Program ([CHP](#)) a unit within the Division of Undergraduate Education, is to actively encourage honors students to engage in faculty-mentored research. From their freshman year onward, students who participate in CHP have the benefit of two educational worlds—they have the educational support and extensive faculty contact more typical of a small-college education, and the resources and facilities of a major research university where faculty members working on the cutting edge of research also teach undergraduate courses. Students selected for this program must have very strong academic records from either their high school or from a community college in the case of transfer students. The CHP is open to all qualified students, regardless of major. Commencing in 1988 with 100 students, as of fall 2000 the CHP has 155 new freshmen, in addition to its 575 or so continuing sophomores, juniors, and senior-year students.

CHP provides these outstanding UCI students with an honors curriculum including small, seminar-style classes, close interaction with peers, mentorship by UCI's top faculty, and the opportunity to participate in undergraduate research. Although a stress on inquiry-based learning is evident in all phases of the CHP curriculum, it is in the year-long senior capstone experience that students pursue original research under the supervision of faculty members, culminating in the production of a senior honors thesis, creative project, or paper of publishable quality. Their close association with faculty members has taught them how to

find interesting solutions to interesting questions. At the same time, close contact with a faculty mentor enhances the students' professional prospects by guiding their decisions about graduate and professional programs. Mentors also help students optimize the quality of their application materials so as to increase the students' chances of gaining admission to first-rate programs of their choice.

The success of CHP can be measured by the fact that approximately 90% of the students in it continue their studies after graduation from UCI at some of the most prestigious graduate and professional schools in the country. In addition, although CHP students comprise only about 3 percent of the UCI undergraduate student population, each year they make up at least 50 percent of the recipients of prestigious scholarship and fellowship awards. Similarly, a high proportion of CHP students receive Latin honors at graduation (awarded to the top 12 percent of UCI's baccalaureate recipients). Of the CHP's 96 June 2000 graduates, 69 percent received Latin honors (11 Summa Cum Laude, 25 Magna Cum Laude, and 30 Cum Laude). Overall, CHP students comprised 15 percent of those receiving Latin honors this year, including 31 percent of the Summa Cum Laude awards, 23 percent of the Magna Cum Laude awards, and 10 percent of the Cum Laude awards). These CHP graduates had a combined average GPA of 3.64 and an average of 237 course units completed (a minimum of 180 units is required for graduation).

#### **ACADEMIC UNIT-BASED HONORS PROGRAMS**

Several academic departments have honors programs for qualified juniors and seniors. The focal point of each of these programs is the development of analytical and research skills through the pursuit of research under faculty supervision. An honors-level thesis or senior essay is required in all the honors

programs listed below, except Drama (Acting, Directing, Music Theatre), which requires participation in UCI theatrical productions.

- **School of the Arts:** Honors in Acting, Honors in Directing, Honors in Music Theatre
- **School of Humanities:** Humanities Honors Program
- **Department of Information and Computer Science:** Honors Program in ICS
- **Interdisciplinary Studies:** Senior Seminar in Conflict Resolution (required); Senior Seminar in History and Philosophy of Science (required); Senior Seminar on Global Sustainability (required); Senior Seminar in Religious Studies (required)
- **School of Physical Sciences:** Honors Program in Chemistry; Honors Program in Physics
- **School of Social Ecology:** Honors Program in Social Ecology
- **School of Social Sciences:** Honors Program in Anthropology; Honors Program in Economics; Honors Program in International Studies; Honors Program in Linguistics; Honors Program in Political Science; Honors Program in Psychology; Honors Program in Social Science; and Honors Program in Sociology

#### **NEW INITIATIVES TO PROMOTE INQUIRY-BASED LEARNING**

During the 1990s, several UCI faculty development programs were initiated or enhanced to encourage the faculty to embrace new methods of teaching that emphasize inquiry-based learning. As noted in the 1998 Boyer Commission Report and elsewhere, many faculty members favor the lecture method as the

most efficient means of imparting knowledge. However, recent research in the neurosciences (as noted earlier) indicates that active learning and collaborative learning experiences can be very powerful teaching and learning tools (Marchese, 1997). That is, when the teaching and learning process changes from professor-centered to learner-centered, more powerful learning takes place.

### **The Instructional Resources Center**

The Instructional Resources Center ([IRC](#)), a unit within the Division of Undergraduate Education, has taken the lead in assisting faculty and graduate student teaching assistants (TAs) in shifting the methods of instruction from lecture-based to more student-centered strategies. One of the IRC's most important services is to provide free, confidential teaching consultations to faculty, lecturers and TAs. These consultations include mid-term student feedback and video consultation services with IRC staff members who are all experienced university-level instructors, as well as training specialists. To date, over 1,000 faculty and TAs have participated in the teaching consultation program.

Additional IRC services include departmental and school workshops on pedagogy and instructional technology for faculty and for TAs; the quarterly campuswide Teaching Colloquy for discussions and demonstrations on teaching; an on-line publication about teaching called [UCIdeas](#); and the TA Professional Development Program which is a department-specific training program for new TAs. The IRC also has established the innovative Teaching Assistant Consultants (TAC) Program, in which TACs receive extensive training in advanced pedagogy, conduct training of new TAs, and mentor other TAs in their school or department. The IRC also publishes the [TA Teaching Guide](#), a well-respected publication

requested around the country, containing short articles chock full of practical, concrete suggestions for effective teaching.

The IRC was formed in 1993 by the merger of two former offices—Instructional Development Services and Media Services. Both of these offices were originally created to provide services to faculty, one with ideas about pedagogy and one with ideas about technology. During the budget cuts of the early 1990s, a proposal was made to join the two units. The key component of that proposal was that technology stood to gain by an association with pedagogy and that pedagogy needed technology to help solve problems. As a result, IRC is now one of the campus leaders in discussions regarding the effective use of technology for the purposes of teaching and learning. During the past 10 years there has been an explosion in the use of technology for instructional purposes. UCI's Electronic Education Environment (EEE), a collaborative project of the [UCI Libraries](#), the Office of Network and Academic Computing Services (NACS), the Office of the [Registrar](#), and the [Division of Undergraduate Education](#), provides Web-based and e-mail-based course tools, electronic library services, and workshops. All UCI students receive e-mail accounts and access to the Internet and class information resources. All residence halls and dorm rooms have access to the campus network. Ninety percent of UCI's general assignment classrooms have active Internet connections. There are 10 technically enhanced classrooms (2,600 seats) and seven computer classrooms, and there are plans to convert five additional classrooms as funding permits. As of fall 1999, there were 1,080 seats available in open-access computer labs on campus. Although the topic of instructional technology could have been selected for self-study, the UCI WASC Self-Study Committee felt that the campus was already making significant progress in this area and that there were very few critical issues in instructional technology to discuss at the present time.

## **Hewlett PBL Faculty Institute**

The IRC is also providing leadership for a new program, funded by a two-year grant from the William and Flora Hewlett Foundation and other sources, that will promote a significant shift in teaching and learning by assisting faculty and TAs to become effective developers and users of pedagogies broadly described as “problem-based learning” (PBL) strategies. The two-year project includes two quarter-long Faculty PBL Institutes, on-going technical and professional support from experts in the field of PBL, campus Teaching Colloquies on the topic of PBL, plus faculty mini-grants and course release time for implementing PBL in their courses. The first Faculty PBL Institute was held in winter 2000; 10 faculty members and their TAs participated in the institute, which was led by professional staff from the IRC.

PBL is particularly appropriate for faculty members at a research university since they already participate in similar inquiry-based learning as they engage in their own research. In PBL, students actively engage in inquiry-based learning in order to solve open-ended, “real world” problems. Typically, students work together in teams on different aspects of the problem, and then share their findings with other members of the class orally or in writing. According to Barbara J. Duch of the University of Delaware, students using PBL “learn critical thinking and problem-solving skills which include the ability to find and use appropriate learning sources” (Duch, 1995).

The Hewlett PBL Project targets lower-division breadth (general education) courses. Although upper-division students frequently engage in inquiry-based education (as was exhibited in the preceding discussion of research opportunities),

lower-division students do so somewhat less often. Breadth courses, typically taken during the student's first two years, offer a unique opportunity to introduce elements of PBL that will serve as a foundation for further inquiry-based activities in upper-division courses.

## **The NSF Sciences, Mathematics, Engineering and Technology (SMET) Education Project**

In 1997 UCI received an NSF grant to support curricular reform in the sciences, mathematics, engineering and technology (SMET) education. The goals of the project were to support the development of new SMET courses, to infuse educational technology throughout the undergraduate curriculum, and to foster a change in the campus climate regarding curricular innovation and reform. The grant was led by the Dean of Undergraduate Education; the Associate Deans of Biological Sciences, Engineering, and Physical Sciences; the Chair of Information and Computer Science; other SMET faculty members; and staff from UCI Libraries and the Division of Undergraduate Education.

In the area of course development, the SMET grant supported the development of two new teacher education courses, a revised calculus course for undecided/undeclared students, revised courses and labs for introductory physics, and a [hypertext book](#) for the minor in [Global Sustainability](#). In the area of instructional technology, over \$80,000 has been awarded in the form of faculty mini-grants to support the development and use of technology in undergraduate education. Additional SMET projects include two [Faculty Summer Institutes](#) for Instructional Technology, numerous faculty workshops on topics such as “[From Word to the Web](#),” as well as technology workshops for entering students (how to use e-mail and electronic resources of the library), a SMET Website, and a quarterly [newsletter](#) on SMET education at UCI (with a circulation of 2,000 copies per issue).

During the first year of the project, the members of the SMET Advisory Board expressed interest in learning more about new teaching and learning strategies, especially problem-based learning (PBL). As a result of their interest, the Division of Undergraduate Education and other campus units began to develop ideas and programs related to PBL, which resulted in the development and subsequent award of the above-referenced Hewlett grant.

### **Faculty Mini-Grants**

Each year the Division of Undergraduate Education holds two competitions for faculty mini-grants (maximum award is \$5,000). The first of these mini-grants programs, the [Instructional Improvement Initiative](#), supports general curricular development activities related to selected themes or topics chosen by the Dean of Undergraduate Education each year; for example, the 2000-01 themes were “Improving Students’ Communication Skills” and “Introducing Significant New Elements of Inquiry-based Learning into a Course.” The second mini-grant program supports the development of new technologies for teaching and learning. Faculty members submit a narrative and budget proposal which is reviewed by a panel of faculty and staff.

Since 1997 the Division of Undergraduate Education has awarded 62 faculty mini-grants totaling just over \$190,000. Examples of funded projects include [“Inquiry-Based Computer-Interactive Homework and Student Achievement in General Chemistry,”](#) “Supporting ESL Writers Through Computer-Assisted Language Learning,” “Summer Bridge Computer Literacy Course,” and “The English County, 1500-1800: An Interactive Experience.” Additional faculty [mini-grants](#) have also been awarded through the Hewlett PBL Faculty Institute and the NSF SMET Project.

## USE OF SMALL CLASSES TO PROMOTE INQUIRY-BASED LEARNING

At a large university such as UCI, large classes are an efficient and effective method of teaching large groups of students. National research on different instructional approaches has consistently shown that lecture courses can be an effective method for the transmission of information. However, when the goal is higher-order cognitive skills such as inquiry-based learning, critical thinking, and problem solving, classroom discussions are the more effective approach (Pascarella & Terenzini, 1991).

Since classroom discussions are much more manageable in smaller-sized classes, UCI also offers many small, seminar-type courses. Some of these are stand-alone courses, such as [Freshman Seminars](#) or special discussion sections attached to larger lecture courses. Small undergraduate classes also promote interaction between students and faculty members where they can engage in meaningful dialogue and exploration and where students can learn first-hand about the research process and the new knowledge and insights that result from it.

Table 5 shows the number of fall 1999 undergraduate course sections and subsections by class size. Sections include primary course sections such as lectures and seminars; subsections include secondary course sections such as labs, discussion sections, and quiz sections. Independent study courses are not included in the statistics. According to these data, 66 percent of the primary course sections and 70 percent of the subsections had enrollments of less than 30 students in fall 1999.

### **Table 5: UCI Undergraduate Course Sections and Subsections**

**by Class Size, Fall 1999**

Class Size	Sections		Subsections	
	N	%	N	%
Under 10	255	(21%)	136	(11%)
10 to 19	246	(20%)	337	(27%)
20 to 29	307	(25%)	388	(32%)
30 to 39	70	(6%)	150	(12%)
40 to 49	47	(4%)	84	(7%)
50 to 59	131	(11%)	142	(11%)
100+	152	(13%)	8	(<1%)
<b>Total</b>	<b>1,208</b>	<b>(100%)</b>	<b>1,245</b>	<b>(100%)</b>

Source: Office of Analytical Studies, NAIMS Master  
Class File, F99, JCS, 05/04/00

Small courses are prevalent at both the upper-division and lower-division levels. For example, most of UCI's upper-division classes for undergraduate majors are small. Even at the lower-division UCI has small classes taught by ladder-rank faculty. A recent study by the Division of Undergraduate Education identified 59 lower-division courses taught in 1998-99 by ladder-rank faculty with total enrollments less than 25 students, excluding Studio Art courses taught by ladder-rank faculty (Source: Z. Soltani, Division of Undergraduate Education, 12/17/99). A total of 1,069 students were enrolled in these courses and about two-thirds of those students were freshmen and sophomores. The School of Humanities offered the largest number of such courses (18 out of 59). Students in the large [Humanities Core Course](#) also meet three hours per week in sections of twenty-two or fewer students, and part of that class-time is devoted to discussions of the research exercises described above, including the critique of scholarly sources identified by the students and, in spring quarter, strategies for integrating that research into the research paper required of every student in the course.

All UCI faculty members outside the College of Medicine and the Graduate School of Management teach undergraduate courses. When the number of undergraduates are compared to the total number of ladder-rank faculty, the ratio is 18 to 1 (Office of Analytical Studies and Information Management, fall 1999). This ratio compares very favorably to other research universities.

UCI's Freshman Seminars Program was started in 1996 to provide new freshmen the opportunity of studying with senior professors who are distinguished for their research as well as for their commitment to teaching. Since 1996, approximately 30 freshman seminars have been offered on a variety of topics from "Disease and Civilization" to "The Salem Witch Trials," some taught by distinguished senior faculty. Enrollment is limited to 15 students, and priority is normally given to freshmen not enrolled in other seminars or in courses with similarly small enrollments.

The School of the Arts also supports the use of small classes. For example, each Studio Art course is typically capped at 20 students. In addition, in 1999-00, the school added a third section of Ballet III, because those classes were becoming too crowded for teachers to be able to offer personal correction and feedback to their students. Now, with three sections of Ballet III, freshmen, in particular, get an improved and more personalized education in ballet techniques (which forms the foundation of their dance training), and their teachers are better able to track their progress.

The School of Social Ecology's year-long [Mentor/Mentee Program](#) is designed to work with new freshmen and transfer students in small groups by providing them with a faculty and student mentor.

Although UCI depends on large classes in many academic areas, especially in introductory survey courses, many departments have tried to create small classroom environments using discussion or lab sections. These sections, with enrollments of 30 or fewer students, are intended to create more interaction among students and between students and instructors. In most cases, these sections are conducted by graduate students (TAs); however, in some large courses such as the Humanities Core Course, sections for honors students are conducted by ladder-rank faculty. While in many cases, these supplemental sections are intended to review and reinforce materials from course lectures, at least in some courses, sections engage in inquiry-based study of cases related to the course topics.

For example, in 1996-97, the School of Biological Sciences added discussion sections to its core courses (Bio Sci 97, 98, and 99). One of the primary purposes of these discussion sections was to provide students with a small-group experience where they could easily ask questions, practice the use of the specialized vocabulary of the courses, apply course concepts, and have interactions with the discussion leaders who also held Ph.D. degrees in the biological sciences. In 1997-98 the Program in Film Studies, in the School of Humanities, developed a new sophomore-level core course ([Film Studies 85A-B-C](#)) which was designed with discussion sections, as well as the lecture and studio for film screening, in order to offer the advantages of a seminar with a course TA.

Peer-tutoring programs and adjunct classes offered through UCI's Learning and Academic Resource Center ([LARC](#)) also offer the opportunity for small-class environments within larger courses. Peer-tutoring sessions consist of small group sessions with an undergraduate peer tutor, meeting for 50 minutes, twice a week, and are offered in conjunction with most of the campus's large introductory

courses. These groups are intended to get students actively involved in their own learning through discussion, practice examinations, and inquiry-based study of major issues raised in the courses. Adjunct classes, with enrollments of 20 to 25 students, are conducted by professional LARC staff with advanced degrees and experience in specific disciplines. Adjunct classes focus on the development of study strategies such as note-taking, exam-preparation, reading and writing, in ways connected with the specific content of specific lecture courses.

In addition, UCI's [Summer Session](#) can provide a small-class alternative to many of the larger survey courses. Most survey courses, when offered in the summer, have enrollments one-quarter the size of those offered during the academic year. For some courses, the proportion may be nearer 10 percent, creating possibilities for student interaction and discussion far greater than those present during the academic year. Currently, all campuses in the University of California system are considering ways to expand summer sessions.

## **RECOGNIZING EXCELLENCE IN TEACHING**

To further encourage a climate that rewards faculty for teaching and mentoring undergraduates, the campus has recently increased the visibility, size and scope of teaching awards, at both the campuswide and school-based levels.

In 1994, UCI held its inaugural *Celebration of Teaching* event to recognize excellence in teaching. It is co-sponsored by the Academic Senate [Committee on Teaching](#), the Division of [Undergraduate Education](#), and the [Instructional Resources Center](#), with additional funding provided by the [Office of Graduate Studies](#) and [Network and Academic Computing Services](#). In spring 2000, the following teaching awards were presented:

**Excellence in Teaching Awards** – one faculty member and one teaching assistant from each academic unit was recognized for excellence and innovation in teaching. Awardees are selected by the respective deans. Two of the teaching assistants who receive this award are also selected by the Committee on Teaching to receive a dissertation fellowship and fee waiver for one quarter. These Outstanding TA Fellowships are sponsored by the Office of Graduate Studies.

**Teacher Innovator of the Year** (\$500 award) – one faculty member was recognized for his outstanding contributions to teaching. Nominations are made by each school and the awardee is selected by the Committee on Teaching.

**Departmental Teaching Award** (\$2,500) – begun in 1999, this award recognized the contributions of an entire department for its collective efforts to enhance the environment of teaching and learning.

**Course Website of the Year Award** (a dedicated computer modem) – the Committee on Teaching selected one faculty member whose UCI course Website exemplifies excellence in both teaching and learning. Network and Academic Computing Services provides a year's dedicated computer modem to the winner.

**TA Developer of the Year** (\$500) -- this award goes to a Senate or non-Senate faculty member for outstanding TA mentoring in teaching.

Each year UCI's Academic Senate honors faculty members for their excellence in research, teaching and service. In the area of teaching, two awards are given each year: Distinguished Faculty Lectureship Award for Teaching (started in 1988) and the Distinguished Assistant Professor Award for Teaching (started in 1994).

Recipients present invited lectures to the campus community and are featured annually in the *UCI General Catalogue*.

The UCI student body also presents annual awards for excellence in teaching. Each year the Senior Class makes teaching awards for outstanding faculty from each school. The Order of Omega, sponsored by Panhellenic and the Interfraternity Council, similarly presents awards for outstanding teaching.

Many of UCI's schools and departments also recognize excellence in teaching. Unless otherwise noted, all of the following awards are made annually. Multiple awards are noted in parentheses.

#### **School of Biological Sciences**

- Excellence in Teaching Award (2 faculty awards)
- Steinhaus Award for Excellence in Teaching by a Graduate Student (4 TA awards)

#### **The Henry Samueli School of Engineering**

- Outstanding Faculty Teaching Award
- Teacher of the Year Award (selected by the Engineering Student Council)

#### **School of Humanities**

- Humanities Associates Faculty Teaching Award
- Humanities Associates Outstanding Graduate Student Teaching Award (3-4 TA awards)
- Outstanding Teaching Assistant Award (1-2 TA awards per department)

#### **Department of Information and Computer Science**

- Golden Floppy Award (selected by ICS majors)
- Outstanding Professor in ICS (selected by graduating ICS majors)
- Teaching Innovation Award (selected by the Chair)

#### **School of Physical Sciences**

- Outstanding Contributions to Undergraduate Education (4 faculty awards)
- Outstanding Teaching Assistants (3-4 TA awards)
- Chemistry: Outstanding Teaching Assistant
- Mathematics: The Connelly Award to the Outstanding Teaching Assistant

#### **School of Social Ecology**

- Outstanding Teaching Assistants (15-25 TA awards)
- Outstanding 194W Field Research Teaching Assistants (3 TA awards)

#### **School of Social Sciences**

- Outstanding Graduate Teaching Assistant
- Sociology: Teaching Assistant Awards (2 TA awards)

In addition to awards for excellence in teaching, UCI also rewards excellence in mentoring undergraduate research. Each year, one faculty and one student from each academic receive the Chancellor's Awards for Excellence in Undergraduate Research. These awards are presented at the annual UROP Undergraduate Research Symposium.

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