

**Self-study Report on
Undergraduate Involvement in Research at Dartmouth**

“I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.”

Sir Isaac Newton (1642-1727)

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Undergraduate Involvement in Research

I. Introduction

Dartmouth College has achieved prominence in American higher education by combining a liberal arts college's focus on undergraduate education with a major university's comprehensive curriculum and sophisticated research facilities. Dartmouth is strongly committed both to liberal education and to the creation of knowledge, a mission that requires the commitment of all faculty to the crucial enterprise of engaging undergraduates in the challenges and excitement of learning. *U.S. News and World Report* ranked Dartmouth eleventh overall among national universities in 1999 and first in faculty commitment to undergraduate teaching in a 1995 survey of college presidents, provosts, and deans of admission. Dartmouth enrolls approximately 4,200 undergraduates, 700 students pursuing graduate professional degrees in business administration, engineering, and medicine, and more than 350 students seeking masters and doctoral degrees, primarily in the sciences. Dartmouth's professional schools and graduate programs complement the undergraduate arts and sciences in ways that promote excellence throughout the institution.

The Committee on Undergraduate Involvement in Research was charged with evaluating research opportunities at Dartmouth and with projecting what more needs to be done to ensure that all Dartmouth students have the opportunity to participate in the research process. The information we have presented below provides a baseline to which the institution should continue to add. Most importantly, we hope it will facilitate an ongoing analysis of how well we are preparing our students for the challenges that they will undertake after they graduate. Ten years ago, the institution set out to place an increased emphasis on undergraduate scholarship and we are happy to report that twice as many students are now participating in research as were doing so in 1989. We need to continue to improve this number until ideally no one will need to examine the question because undergraduate research will have become part of the fabric of every Dartmouth student's intellectual life.

II. Description of opportunities for undergraduate research

A. College-wide Opportunities

1. Research for Academic Credit

Many students carry out research projects for academic credit by enrolling in an independent study course. Tables 1A and 1B provide data on the number of independent study courses elected by students over the last ten years. Independent study courses may be required by some departments, either in fulfillment of the culminating experience and/or as part of an honors program (Table 1B). For example, in the Studio Art department, all the senior majors must undertake two terms of independent study (Studio Art 76 and 77). The students meet once a week in a seminar format, but the rest of the time is spent in their "studios" creating their art. Departments with large numbers of majors usually do not require independent study, but often list it as one of several ways to fulfill the culminating experience requirement. Thus, the number of students electing independent study courses reflects departmental requirements as well as student interest in pursuing such courses. As such, spotting trends in the numbers of independent study enrollments over the last ten years is not entirely straightforward. Honors students may take anywhere from none to three terms of honors research for credit, depending on scheduling and departmental requirements. Therefore, the numbers of students enrolled in honors courses each year is not equal to the number of honors majors. If you examine the number of honors majors by division, 24% of the science majors completed an honors degree in 1989, compared to 9% in the Social Sciences and 16% in the humanities. In 1998, these percentages were 26%, 12% and 24%, respectively. We clearly need to examine why participation in the social sciences is one half that of the other divisions.

Table 1A. Enrollments in independent study courses that do not lead to honors

	89	90	91	92	93	94	95	96	97	98
HUMANITIES										
Art History	1	1	5	1	4	1		2		2
AMEL		20	17	23	20	20	10	6	4	
Classics			2	2	10	1	11	5	5	11
Drama	19	15	56	23	18	13	30	14	13	24
English	13	8	10		9					
Film Studies	17	13	11	15	17	16	11	14	10	16
French & Italian	10	8	9	12	12	14	10	11	10	5
German	4	5	6	1	6	5	9	6	5	6
Linguistics & Cognitive Science				10		2	3	7	3	6
Music						2	3	4	1	
Philosophy	1	2	1	2	19	1	4		1	3
Religion	11		2		7	12	6	3	4	11
Russian				3			12			
Spanish & Portuguese	3	2	5	6	3	4	7	7	4	
Studio Art	17	10	14	21	16	27	17	15	9	8
Women's Studies	2	5	3	2	8		5	7	4	6
Totals	98	89	141	121	149	118	138	101	73	98
SOCIAL SCIENCES										
Anthropology	7	5	4	5	5	7	9	5	5	6
Asian Studies	7							6	9	6
Economics	4	10	1	9	5	4	9	9	13	13
Education	33	54	28	25	29	38	20	30	29	27
Geography	6	3	6	12	7	10	11	20	5	0
Government	41	24	33	11	37	22	26	25	17	30
History	22	20	37	38	37	43	31	33	36	24
Latin American, Latino & Caribbean Studies							3		1	7
Native American Studies	6	4	4	6	4	10	7	7	5	6
Psychology	5	8	10	10	13	13	16	28	29	11
Sociology	9	15	16	15	12	14	21	31	20	13
Totals	140	143	139	131	149	161	153	194	169	143
SCIENCES										
Biochemistry	6	4	12	10	5					
Biology	19	12	25	21	27	36	25	19	26	31
Chemistry	14	13	21	23	38	33	44	46	24	33
Computer Science		2	7	11	7	7	8	15		
Earth Sciences		3	4	2	2	3	4	5	8	3
Engineering Sciences		8		16	2	7	8	7	15	7
Environmental Studies	3	14	21	17	11	8	6	4	13	15
Mathematics		1	1	3	3		1		2	4
Physics	8	2	3	2	8	4	6	5	8	8
Totals	50	59	94	105	103	98	102	101	96	101
GRAND TOTALS	288	291	374	357	401	377	393	396	338	342

Table 1B. Enrollments in honors-related independent study courses

	89	90	91	92	93	94	95	96	97	98
HUMANITIES										
AAAS										1
Art History	3		1	3			2		1	
AMEL		6		9	8	7	1	1	2	2
Classics	3	2		2	6	5	2	3	3	5
Comparative Literature	4	10	5	8	4	7	5	2	9	8
Drama	2	10	2	8	3			4	7	14
English	60	42	36	45	53	41	46	40	36	33
Film Studies	4	4	10	4	5	5	7	4	8	2
French & Italian	6	2	2	4	3	2	2	3	1	
German	2	1		3	2	1		3	2	5
Linguistics & Cognitive Science				2	4	1		3		2
Music				4	4	4	5	3	5	2
Philosophy	1	3	4	6	2	6	6	10	6	11
Religion	9	8	10	2	4	6	10	2		5
Russian	3	6	2	4	6	5	11	3	2	1
Spanish & Portuguese	1	2	2	4	5	5	6	7	8	4
Studio Art	6	3	4	8	7	5	9	5	7	8
Women's Studies							2	2	6	5
Totals	104	99	78	116	116	100	114	95	103	108
SOCIAL SCIENCES										
Anthropology	3	2	1	3	8	3	5	3	3	4
Asian Studies	3		2						2	4
Economics	2	6	1	5	3	3	2	3	4	4
Geography	6	10	6	4	20	6	8	6	6	16
Government	15	10	28	19	19	17	15	18	17	20
History	52	47	53	51	51	54	55	81	47	29
Latin American, Latino & Caribbean Studies							1	3	2	2
Psychology	24	26	12	24	28	25	17	22	30	17
Sociology	2	9	14	2	2	4	16	6	3	9
Totals	107	110	117	108	131	112	119	142	114	105
SCIENCES										
Biology	19	12	24	20	25	22	44	27	35	45
Chemistry	5	6	8	7	15	10	12	24	7	12
Computer Science									12	27
Earth Sciences	21	12	17	16	22	13	18	14	27	39
Engineering Sciences		13	16		12		13	7	9	12
Environmental Studies										4
Mathematics	1	1	0	4	2	0	2	3	1	2
Physics	4	1	1	1	4	3	3	2	2	3
Totals	50	45	66	48	80	48	92	77	93	144
GRAND TOTALS	261	254	261	272	327	260	325	314	310	357

2. Dartmouth-sponsored Undergraduate Research Programs

Since the last NEASC review, Dartmouth has increased its emphasis on undergraduate scholarship, a commitment that extends across the institution. This can clearly be seen by the number of new programs that have been developed in the last ten years, such as the Presidential Scholars Program, the Women in Science Project, and the E.E. Just Internship Program. These and other Dartmouth-sponsored undergraduate research programs provide faculty mentors and extensive support to more than 300 students annually (Table 2), a doubling since 1989 of the number of students who are actively engaged in research. These numbers do not include independent research for academic credit. Moreover, there are inevitably some undergraduates whose research endeavors are not captured by these statistics. Through these programs, Dartmouth communicates to students the value of creative scholarship, both for its intrinsic pleasure and challenge and for the many ways in which it contributes to the development of those qualities of mind and person that this institution values most highly in its graduates.

- **The First-Year Summer Research Project** gives approximately ten students a year an opportunity to pursue independent research in the summer following their first year of study. Under the supervision of a Dartmouth faculty member, a student may research a topic related to an intended major or pursue an interest in an entirely unrelated field of study. The First Year Office sponsors this program. Started in 1992, this program has supported student projects undertaken in the local Hanover area and as far away as Peru and Finland.
- **The Presidential Scholars Program** pairs over 100 talented and motivated juniors with faculty mentors annually. Paid internships over two terms introduce students to the intellectual rigors of their major discipline. These opportunities are available to students in every academic department (Table 3). The program is designed to encourage students to continue their research into their senior year and to write an honors thesis. Participating students who elect to complete an honors thesis or Senior Fellowship project are designated Presidential Scholars at Commencement. Currently, approximately 40% of the students entering the Presidential Scholars Program go on to complete an Honors thesis. Participation by science majors in the Presidential Scholars Program is higher than that of either humanities or social science majors. This most likely reflects the opportunities in the sciences for undergraduates to become part of a research team that includes graduate students and postdoctoral fellows as well as the faculty mentor.
- **Waterhouse Grants**, administered by the Dean of the Faculty Office, assist students undertaking independent leave-term research projects. Waterhouse Independent Research grants fund research projects in a student's major field of study, with preference given to sophomores and juniors. The projects are not given academic credit, but may be used as preliminary research for a senior honors thesis.
- **Senior Fellowships** allow 10 seniors to undertake year-long independent research projects outside the curriculum. Fellows are chosen by members of the Senior Fellowship Committee, based on proposals written by the students, letters of recommendation from faculty, and interviews with the candidates. Recent projects completed by Senior Fellows have included writing an opera, studying dolphin behavior in the waters off Australia, creating an animated film, carrying out a cultural anthropology project on Hong Kong architecture, and writing a set of short plays.
- The Dean of the Faculty Office administers **the Richter Senior Honors Thesis Research Grant Program**, which provides up to \$1,500 for research costs associated with senior thesis projects. Although this grant may fund laboratory supplies for science majors or art supplies for Studio Arts majors, it is also frequently used to finance visits to research sites or archives distant

Table 2. Student Participation in Dartmouth-based Research Programs

	Class of	Class of	Class of	Class of	Class of	Class of	Class of	Class of	Class of	Class of
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Honors Thesis	145	134	191	195	163	200	169	166	195	184
Presidential Scholar Research Assistantship			82	82	81	115	114	108	125	114
WISP internship					43	45	71	93	95	86
Waterhouse grant	25	20	18	6	12	18	9	8	14	12
Richter Honors Thesis Grant	24	35	30	38	41	36	35	38	41	38
Reynolds Expedition Grant	1	3	2	2	2	3	3	3	2	4
Senior Scholar Grant from ORL	13	13	19	10	21	15	15	16	11	18
Hughes internship for science research	1	10	8	6	7	9	15	13	20	18
McGuire Research Grant	1	1		2	2	2	1	1	1	3
EE Just internship for science research			1	5	4	8	11	8	13	9
Mellon grant for environmental research						5			6	8
Senior Fellowship	6	11	8	8	6	5	6	6	5	9
First Year Office Research Grant						6	14	11	11	5
Completed Mellon Fellowship		5	4	5	5	5	5	5	4	
Spoor Grant-Public Service	1	2	1		2		4			
Total # of opportunities	217	234	364	359	389	472	472	476	543	508
# of students involved in research	165	170	255	249	247	304	327	306	332	327

Table 3. Distribution of Presidential Scholars by Department

	Class of 92	Class of 93	Class of 94	Class of 95	Class of 96	Class of 97	Class of 98	Class of 99
Humanities								
Art History	1	1	1	1	1	1		2
Asian Studies	4	2	2	3	4	2	2	2
Classics	2	1	3	1	1		4	2
Drama						1	1	2
English	8	3	4	4	5	8	8	6
Film Studies							1	
French/Italian	3	2	1	3	2	3	4	4
German	3		1		2	1	1	1
Music					1	1		1
Philosophy	2	1	3	3	3	2	1	2
Religion				2	1	3	3	
Russian		3	1	2	1	1	2	1
Spanish/Port	2	1		2		1	1	3
Studio Art	1	2	1				1	
Women's Studies				1	1	1		
Sub Totals	26	16	17	22	22	25	29	26
Social Sciences								
Anthropology		2	1		4	2	3	2
Cog Sci								1
Economics	5	7	4	1	9	5	5	7
Education		1	1	3	1	2	1	
Geography	2	2	4	4	2	3		1
Government	5	6	9	8	7	12	10	14
History	7	7	8	10	8	5	9	9
LACS				2			1	
MSS								1
NAS				1				1
Psychology	3	5	4	6	7	10	8	9
Sociology	1	1		3	1	2	1	3
Sub Totals	23	31	31	38	39	41	38	48
Sciences								
Anesthesiology	1	1			2		1	
Biochemistry	1	2	1	4	1	4	5	1
Biology	9	4	11	12	10	10	12	9
Chemistry	6	8	6	7	16	5	9	6
Computer Science				1	3	2	6	4
Earth Sciences	1			1	1	1	1	1
Endocrinology								1
Engineering	5	6	6	7	6	9	3	7
ENVS			1	2			2	
Mathematics					2	2	1	
Math/CS	7	3	3	7		4		
Medicine		1		2		1	2	1
Microbiology								1
Pharm/Tox		1		2	1		1	1
Physics/Astronomy	3	5	4	4	3	2	2	3
Physiology		4	1	6	8	1	10	5
Psychiatry						1	2	
Sub Totals	33	35	33	55	53	42	57	40
Grand Totals	82	82	81	115	114	108	124	114

from the campus. In the past, for example, students have used this grant to observe the roles of religious leaders in Senegal, interview writers in Paris, obtain soil samples in Colorado, and collect oral histories in New York City.

- **The Senior Scholars Program**, co-sponsored by the Class of 1939 and the Office of Residential Life, provides honors thesis grants to as many as 15 seniors living in college residence halls. One unique feature of this program is the requirement that Senior Scholars must give a presentation about their research to the residents of their hall at some point during their senior year.

B. Programs with a Targeted Audience

- Dartmouth is a charter member of the **Leadership Alliance** (<http://www.leadership-alliance.org/>), a consortium of 27 institutions of higher learning, including all of the Ivy League schools, 10 historically black colleges and universities, and the entire University of Puerto Rico system. In addition, the Alliance is affiliated with Montana State University and the seven tribal colleges in Montana through The American Indian Research Opportunities program (AIRO), based at Montana State. The Alliance seeks to develop a generation of outstanding minority leaders and role models not only in higher education, but in the public and private sectors as well. Each summer for the last six years, Leadership Alliance students from other colleges have worked fulltime on a research project at Dartmouth during the summer term. Since 1993, Dartmouth has hosted 77 visiting student researchers, 45 of whom were members of underrepresented groups.
- **Mellon Minority Undergraduate Fellowships** allow minority students interested in academic careers to complete research and honors thesis projects in preparation for graduate school. Eligible fields of study include the “core humanities,” anthropology, mathematics, physics, geology, ecology, and earth sciences.
- **The Women in Science Project** (<http://www.dartmouth.edu/~wisp/about.html>) sponsors first-year internships that enable 70 to 80 women annually to work closely with a science, engineering, or medical faculty member at Dartmouth or a research scientist at the Veterans Administration Research Center, the Montshire Museum of Science, or the U.S. Army Cold Regions Research and Engineering Laboratory. Dartmouth College established the Women in Science Project (WISP) in 1990 to address the historical under-representation of women in science, mathematics, and engineering. WISP is a national model among initiatives to increase the number of women scientists and engineers. More than 350 women have held first-year internships (Table 1). Since WISP’s inception, the proportion of women majoring in science has increased from twelve percent in the Class of 1990 to more than 20 percent in each of the last five years. Women account for 46 percent of science majors and 64 percent of Biology majors in the Class of 1998, compared to 24 percent of science majors and 46 percent of Biology majors in the Class of 1990.
- **E. E. Just Internships** have allowed over 50 African-American students to participate in a full-time or a part-time internship in their junior year. The E.E. Just Program was initiated in January, 1992 under the auspices of the Faculty of Arts and Sciences with additional support from the GTE Foundation’s Focus Program. Professor of Biology George Langford, Dartmouth’s E.E. Just Professor of the Natural Sciences, directs the program. The E.E. Just Program is designed to address two national needs: America’s growing shortage of scientists and teachers with Ph.D. degrees in science and the historical under-representation of African Americans in science.
- One-term **internships at three different Max Planck Institutes** are available annually to Dartmouth students. Undergraduates with a strong interest and an appropriate background in **biology or chemistry and German** can combine their interest in science and their language

skills by working in an outstanding research institution abroad, developing individual research projects in preparation for their senior thesis at Dartmouth. Through the initiative of Leonard Jones '91, students can carry out research at the Max Planck Institute for Psychiatry in Martinsried. The second opportunity, set up by Jon Kull '90, allows a student to work at the Max Planck Institute for Medical Research in Heidelberg and the third such opportunity has been set up at the Max Planck Institute in Jena (Ian Baldwin '80) for students interested in ecology and evolution. The Dickey Institute for International Understanding on campus provides travel funds, and the Max Planck institutes fund all living expenses.

- Ten years of support from the **Howard Hughes Medical Institute** have allowed over 150 juniors and seniors with interests in science to work full-time with a faculty sponsor during a leave term. Funds have also been used to purchase new equipment for Chemistry and Biology undergraduate teaching labs. Much of this equipment is available for use by students carrying out independent study projects and honors thesis research.
- A newly awarded three year grant from the **National Science Foundation's Research Experience for Undergraduates Program** provides 10 students the opportunity to work full-time during the summer term on a research project in Molecular Materials at Dartmouth. The Molecular Materials Group draws faculty from Chemistry, Physics and Engineering and takes an interdisciplinary approach to the understanding and design of material properties via studies at the molecular level. Students will work with a group of experimentalists and theoreticians from different disciplines.
- The **Beckman Scholars Program**, begun in the summer of 1999, is designed to help stimulate, encourage and support research activities by exceptionally talented undergraduate students who are pursuing their studies at accredited universities and four-year colleges in the United States. Three students will be able to undertake projects at Dartmouth in chemistry, biochemistry, the biological and medical sciences or some combination of these subjects. In addition to providing stipend support, this program will also provide travel funds for both student and mentor to attend a Symposium of Beckman Scholars to be held in the spring.
- **Hood Museum of Art Internships** allow five students a year to apprentice with members of the museum staff. These internships are designed to provide interns with an overview of the work of the museum. Students work fall, winter and spring terms, completing an independent project under the supervision of a member of the museum staff during the spring term. Students must also write a ten-page paper and give a brief presentation to museum staff on their independent projects at the end of the spring term. Projects completed by previous interns include: hand-labeling a large collection of Netsuke and Native American material, researching Melanesian suspension hooks, and helping catalogue a large loan of bronze medals and plaques. Independent projects have included co-organizing exhibitions on representations of Greek and Roman myth, photographs of the Crow Indian tribe, and American Regionalist prints.

III. Undergraduate Research at Dartmouth's Professional Schools

Dartmouth has three professional schools, the Tuck Business School, the Thayer School of Engineering, and the Dartmouth Medical School (DMS). Tuck's principal focus is on its Masters in Business Administration (MBA) degree program. It does not currently participate in undergraduate research to any appreciable degree. At present, undergraduate students are not permitted to work with Tuck faculty as Presidential Scholars because there is no mechanism for such students to continue their work for their honors theses. The exception would be a student who finds an "in house" advisor in one of the Arts and Sciences departments. The "in house" advisor model has worked well for students wishing to carry out honors research projects with faculty mentors in the DMS and could easily be expanded as appropriate to allow Tuck faculty to serve as mentors.

The Thayer School of Engineering offers both an undergraduate curriculum in engineering and a graduate program. Its undergraduate majors participate in research opportunities through the same programs available to the rest of the College, and its faculty also actively participate in undergraduate research. Data on undergraduate participation for Thayer are therefore listed with the other College departments, and the issues related to undergraduate research opportunities at the Thayer School are essentially the same as those of the Arts & Sciences faculty and students.

DMS plays a significant role in providing undergraduate research opportunities. Dartmouth is one of only a handful of universities in the country with a strong, biomedical research-oriented medical school still physically located on the same campus as its undergraduate programs. There are approximately 140 tenure-track research faculty in seven basic research departments, i.e., Anatomy, Biochemistry, Medicine, Microbiology, Pathology, Pharmacology & Toxicology, and Physiology. The Board of Trustees has recently approved the formation of a new Department of Genetics at DMS. Members of the new department will also participate in undergraduate teaching and mentoring. Many of the additional 400 or more clinical faculty from other departments also conduct basic and clinical research and have participated in undergraduate research. As a result, the researchers in the DMS collectively account for the majority of biomedical research opportunities available to Dartmouth undergraduates. Medical School faculty teach undergraduate courses in a number of departments, including Biology, Chemistry and Environmental Studies. The location and close ties between the Medical School and the College of Arts and Sciences are viewed as a great strength, but one that has probably been under-utilized.

IV. How well do we support undergraduate research on campus and how well do we recognize achievements in undergraduate research on campus?

Financial support. Although some of the programs listed above have secure funding (e.g. the Presidential Scholars Program has recently been endowed), funding for others comes through nationwide competitions (e.g. the Beckman Scholars Program) and as such, are subject to availability of outside funds. A small number of departments do have endowments that specifically cover student research expenses. Earth Sciences has over \$80,000/year available for field research by its majors. Unfortunately, Earth Sciences is more the exception than the rule; many departments have no source of endowed funds to support undergraduate research.

Other Support. Dartmouth supports undergraduate researchers with a wide range of activities, such as symposia, poster sessions, and seminars that help to promote learning and develop a strong community. Such activities help students develop presentation skills and learn about graduate school and career opportunities in science. The Karen Wetterhahn Science Symposium, held annually, features a keynote address by an academic or industrial scientist, the Christopher Reed Science Competition sponsored by the Dartmouth Chapter of Sigma Xi for senior honors students in the sciences, and posters highlighting work by all undergraduate science researchers during the academic year. A national model for initiatives to increase the number of women scientists and engineers, the Women in Science Project at Dartmouth College encompasses peer, faculty, and industrial mentoring programs, faculty panels, career workshops, and visiting scientist seminars that provide information and support to women throughout their academic careers. An electronic newsletter distributed biweekly to 1,200 students provides information about WISP programs; internship, employment, and scholarship opportunities; and the experiences of women in science. WISP's pilot electronic mentoring program has attracted significant attention as the model for MentorNet, a national electronic mentoring program planned by the Women in Engineering Program Advocates Network. MentorNet currently involves 27 universities, including the California Institute of Technology, Carnegie-Mellon University, Cornell University, Stanford University, and the University of Michigan, as well as many corporations and professional societies.

The E.E. Just Program in Science also sponsors visiting scientist seminars, informal discussion groups, and quarterly science forums. E.E. Just interns interact with minority role models and learn about career opportunities, graduate programs, and recent developments in science. Each summer the E.E. Just Program sponsors a two-day science forum at the Marine Biological Laboratory in Woods Hole, Massachusetts for Howard Hughes Medical Institute-sponsored undergraduate research interns and minority students interested in the sciences. The summer science forum includes a tour of the Marine Biological Laboratory, a poster session, and lectures.

Dartmouth organizes an annual Life Sciences Symposium in addition to the activities sponsored by the E.E. Just Program and WISP. The Life Sciences Symposium is attended by the entire Dartmouth life sciences community and over 200 visiting scientists and undergraduate and graduate students from all over New England and Quebec. Each symposium covers a different topic and features five to six seminars, a luncheon, and a poster session highlighting the work of scientists from Dartmouth and other institutions. Recent symposium topics have included protein targeting and trafficking, cell signaling, and regulation of gene expression.

The most recent initiative for promoting undergraduate research at Dartmouth has come from the students themselves. Working with a group of faculty advisors, students wrote a proposal to fund the *Dartmouth Undergraduate Journal of Science*. The inaugural issue appeared in Summer 1999. This journal is an effort to promote the discussion of scientific thought through the dissemination of undergraduate research. It joins an impressive list of student-run publications on campus that highlight student creativity and scholarship.

Many departments recognize student research by awarding prizes at graduation for the best senior theses.

V. What role do graduate students play in providing research opportunities for undergraduate students?

In order to see how graduate students felt about their involvement as mentors for undergraduates carrying out research, 292 graduate students were polled and 75 replied (26% return). 45% of the respondents reported having served as mentors, planning, designing and helping undergraduates with their research while 17% played no role at all. The remaining 33% did not act as mentors *per se* but were actively involved in helping undergraduates when they needed assistance. Most of the graduate students felt that mentoring is beneficial to both the undergraduate and the graduate student. The graduate students have set up an undergraduate-graduate network (UGN) to foster communication between graduate students and undergraduates in the same field of study. The UGN hopes to acquaint the undergraduates with many different aspects of graduate life and to help them make informed decisions about their future career paths.

VI. How does the Dartmouth faculty view the research opportunities now available to students?

As previously mentioned, the number of students who have availed themselves of an opportunity to carry out research has nearly doubled in the last ten years (Table 2). This is clearly due to a number of new programs initiated in this period, including the Presidential Scholars Program, WISP and the E.E. Just Program. To help determine whether such growth can continue or whether we have reached a steady state – both in terms of student interest and faculty willingness to sponsor projects - department chairs were surveyed. We also held discussions with Arts and Sciences department chairs at each of the divisional council meetings. While we have separated our summaries into those from the Arts and Sciences faculty and those from DMS faculty, many faculty members raised similar issues regardless of their primary affiliation. For example, many faculty feel that a single term of research is not of great value to either the student or the mentor. The Dartmouth quarter terms are so brief and the requisite mentor training is so

long and intensive that the student is often just getting started on the actual project by the end of the first term. The most successful collaborations require several consecutive terms, preferably with at least one term of full-time (off term) research. There are numerous examples of women who started in a lab as a WISP intern and ended with a Senior Honors Thesis in the same lab. These long-term students are often working at essentially a graduate student level of research by the end of their projects, and develop a deep understanding of the project.

Arts and Sciences

Several department chairs in the social sciences and humanities, some of whom discussed the matter with their department faculties, suspected that Dartmouth might have reached its capacity for involving undergraduates in research. While this is less clear for the sciences, most science chairs feel that further progress could be made in the sciences, if additional opportunities (i.e., funding) were made available to students; this would be desirable from the faculty's perspective. Science faculty would especially like to see more funding available for students to work during the summer term. Despite this difference among divisions, there seemed to be broad consensus across divisions about the two principal obstacles that may limit further progress.

Student research skills: Although most chairs believed that involving undergraduates in research is beneficial for the student, they reported that the faculty's experience working with undergraduates in a research context is more variable, particularly when the student is supposed to become involved in the faculty member's own research, such as through the Presidential Scholars Program. Faculty across divisions report that students frequently arrive on their door steps without the full complement of skills necessary for them to carry out a research project, and so the faculty person has to provide training for the student in laboratory techniques, statistical analysis, methodology and the like in order to bring the student up to speed. Where foreign language competency is required, such as in cross-national comparative work in the social sciences and some fields in the humanities, it is difficult, if not impossible, to engage students in the faculty person's research because students typically do not have the necessary language skills. Part of the problem is that, in the social sciences and some humanities, the Dartmouth Plan makes it difficult to ensure that students receive the necessary training in statistics and/or methodology early enough in their careers. On the other hand, the D-Plan allows students to undertake a foreign study program in preparation for completing an honors thesis in their major. For example, all the students on the history department's FSP program carry out independent research projects.

Faculty enthusiasm: Chairs across divisions reported that some of their faculty are not as enthusiastic as they might be to assume additional responsibilities for supervising independent student research projects, such as independent studies, senior theses and other projects that are not directly part of the faculty person's own research agenda. This problem may be especially acute for departments with high majors-to-faculty ratios, that is; where the student demand for such projects relative to the availability of faculty supervisors is highest.

DMS Faculty

The DMS faculty (and their undergraduates) view the vast majority of their undergraduate research experiences as having been quite positive. Faculty members ranked personal satisfaction with participating in undergraduate education as the greatest benefit of these experiences. In addition, in most cases it was noted that most of these research collaborations resulted in significant accomplishments in the laboratory as well, often resulting in co-authorship on peer-reviewed scientific publications (see Section IX). The majority of the students who do research in DMS laboratories initially identify themselves as "pre-med," and many continue on to medical school. However, many students become seriously interested in biomedical research as a result of their research experience. In some cases they are led to alter their career course either toward graduate school rather than medical school, or toward a combined M.D./Ph.D. Conversely, a few

students decide as a result of their experience that they do not like research (or medicine). These are all viewed as useful and expected educational outcomes.

Several specific mechanical concerns were raised:

- A number of faculty whose laboratories are in the Borwell Building or elsewhere in the Lebanon Medical Center campus noted the lack of adequate transportation for students to and from the main Hanover campus. This is viewed as a serious obstacle in recruiting undergraduates or establishing successful research projects. This is part of a larger commuting problem between the two campuses, but it probably impacts undergraduates more than other segments of the institution due to other constraints on their time and, often, the absence of a car. Improving the shuttle bus system is therefore deemed a high priority for those faculty members.
- A second problem for some DMS faculty has been in identifying an “in house” Arts and Sciences faculty advisor for undergraduates doing honors theses in a DMS department. It has been suggested that the College consider allowing DMS faculty to serve directly as thesis advisors for these students, rather than having students find a faculty member within their major department. This latter group is already heavily taxed with their own students or may not be familiar enough with the student’s research area to provide useful mentoring. The caveat is that DMS faculty are not familiar with undergraduate requirements/
- Several of the clinical faculty who have participated in undergraduate research stated that the most serious impediments to doing so more frequently were (a) lack of adequate time to mentor due to heavy clinical responsibilities, and (b) lack of recognition and support for these activities by their home departments. One suggestion was to develop clinical faculty “fellowships” to underwrite a portion of their time that could be used for undergraduate mentorship. The presence of a strong clinical research and teaching enterprise associated with Dartmouth is also a strength that has been under-utilized. Many undergraduates express a strong interest in being involved in clinically-based research, and so the possibility of better supporting these research opportunities should be carefully considered.

VII. How do research opportunities at Dartmouth compare to those at other schools?

In order to answer this question, we examined the undergraduate research opportunities at Brown, Princeton and Yale Universities and Williams, Haverford and Swarthmore Colleges. In general, Dartmouth compared quite favorably.

Similar Programs: Dartmouth offers a wide variety of programs that encourage undergraduate research that are similar to those at other schools. For example, our own innovative Women in Science Project has served as a model for Brown’s Women in Science and Engineering Program and Yale’s Rising Stars Program that encourage women to engage in research in the sciences early in their undergraduate careers. All the Ivy League schools participate with Dartmouth in the Leadership Alliance, which seeks to encourage minority students to participate in various research projects in many disciplines. Dartmouth also participates in a consortium of schools that offer Mellon Minority Undergraduate Fellowships. In fact, except for Williams, it appears that Dartmouth offers at least as many – and sometimes considerably more – of these opportunities, particularly in the natural sciences, as any school we examined. Of course, like most schools, Dartmouth also provides opportunities for undergraduate research through senior theses and independent study.

Unique Opportunities at Dartmouth: Dartmouth offers additional opportunities that appear to be unique. First, none of the schools we investigated has anything similar to Dartmouth’s Presidential Scholars Program that now provides well over 100 students per year a chance to participate directly in a faculty member’s research for two terms in any discipline on campus.

Second, Dartmouth offers a relatively large number of opportunities for undergraduates to engage in research in the sciences during the first two years of their college careers. For instance, although at Haverford senior science majors must complete a senior lab project, opportunities for independent research prior to the senior year are rather limited, with nothing equivalent to Dartmouth's Presidential Scholars Program, WISP, or the E. E. Just Program. Third, Dartmouth's culminating experience seems to provide a more flexible set of research opportunities for seniors than many schools that require a similar experience, except perhaps Yale, where students can often choose to write senior theses of either one or two terms in duration, or take a senior seminar that involves a research paper. Although it varies across departments, the culminating experience at Dartmouth may involve a senior thesis, special independent study, group research project, or senior seminar, all of which may involve the student in independent research. Departments frequently offer multiple options. Finally, Dartmouth seems to do as well as any school we examined in providing students access to information about the available undergraduate research opportunities on and off campus through its career services home page. Except for departmental offerings targeted at juniors and seniors, Princeton does not advertise such opportunities. Nor does Brown, where there are no catalogs or formal descriptions of potential research projects or lists of faculty willing to take on undergraduates in their research. Of course, this is in keeping with Brown's overall philosophy that students should design their own majors and make their own opportunities.

Possibilities for Innovation: There are some things that other schools do differently than Dartmouth that might warrant consideration for facilitating more undergraduate research at Dartmouth. At the department level, senior theses at many schools are often year-long projects while at Dartmouth they are frequently only two terms in duration – at least officially. Of course, some Dartmouth students begin working unofficially toward their thesis project earlier, such as through a regular independent study or simply by pursuing the topic in a preliminary way on their own during the summer following their junior year, or in some cases, even earlier. Furthermore, relatively few Dartmouth seniors actually do a senior thesis (18% between 1994 and 1998) compared to other schools, notably Princeton where a thesis is required of all seniors.

At Princeton some departments require junior majors to take a faculty research seminar in which faculty members present their own research and each student is required to write three papers based on the work of three of the faculty presenters. The idea is that students will eventually undertake senior year work with one of these three faculty members. Similarly, in order to develop research interests in the natural sciences, Yale offers a Perspectives on Science Program that consists of a special lecture and discussion course designed to encourage first-year students with exceptional mathematics and science backgrounds.

Several schools have developed institution-wide forums for undergraduates to present their research-in-progress to audiences of faculty and peers in order to solicit feedback and constructive criticism, and to provide a generally supportive environment for undergraduate researchers. For instance, Brown runs its Royce Fellowship Program, which awards fellowships to distinguished undergraduates for support of student-initiated research. Recipients become members of the Society of Royce Fellows, which meets at monthly luncheons to present students' research work to each other. Yale's Mellon Senior Forums are comparable insofar as the university provides money to host dinners in the various residential colleges at which seniors present their senior essays to faculty and other seniors. Although Dartmouth's Senior Scholars Program requires the fifteen or so recipients each year to present their research to members of their residence halls, this requirement appears to be more extensive at Yale and more inclusive of faculty at both Yale and Brown.

We can also use data from a survey conducted by a group of 26 selective colleges and universities, including Dartmouth. Forty six percent of the respondents had taken an independent study course or had participated in a research project for credit, essentially the same as the participation

percentage as that for Dartmouth students (45%). Almost one quarter of the seniors surveyed had done research with a faculty member not for credit (36% at Dartmouth) and 13 percent (11% at Dartmouth) had published or presented a paper off campus. The higher percentage of students doing research with a faculty member at Dartmouth may be a direct result of the Presidential Scholars Program. The proportion of natural science majors that said they had worked on a faculty member's research for credit was 40% for the sciences but only 6% for the social sciences and 3% for the humanities. Using the participation figures for students in our Presidential Scholars program, 10% of the humanities majors participated in the program in 1998 compared to 9% for social sciences majors and 15% for science majors.

VIII. Do research opportunities change the undergraduates' experience at Dartmouth and do they influence career choices?

A. A more detailed look at undergraduate research in Biology and Chemistry

Because a significant percentage of the students carrying out research projects do so in biology, biomedical or chemistry laboratories, an evaluation of how successful these endeavors have been is provided below.

1. Quality of Undergraduate Research Activities (1993-98). The quality and range of Dartmouth's Biology and Chemistry undergraduate research programs is indicated in part by the number of NSF graduate pre-doctoral fellowships awarded to recent alumni, and by the number of student-faculty co-authored journal articles and conference abstracts. Since 1990, 31 Biology and Chemistry graduates have received NSF graduate pre-doctoral fellowships. Since 1993, honors students in Biology and Chemistry have co-authored more than 100 peer-reviewed articles that have appeared or are scheduled to appear in a variety of publications including *Brain Research*, *Biochemistry Journal*, *Ecology*, *Endocrinology*, *Genetics*, *Inorganic Chemistry*, *Journal of Biological Chemistry*, *Journal of Chemical Physics*, *Journal of Neuroscience*, *Journal of Organic Chemistry*, *Oecologia*, and *The Plant Cell*. These students have also co-authored abstracts presented at more than 40 professional conferences and meetings in the United States and Europe. They collaborated on these articles and abstracts with Dartmouth College faculty in Anthropology, Biology, Chemistry, and Earth Sciences and with DMS faculty in Anesthesiology, Biochemistry, Pharmacology and Toxicology, Physiology, and Surgery. Undergraduates are the lead author for about 25% of these papers, a clear indication that undergraduates are true collaborators and not simply lab assistants.

2. Record of Admission to Graduate and Professional Schools. Dartmouth graduated 735 Biology and Chemistry majors during the past five years. More than 400 Dartmouth Biology and Chemistry majors (including alumni who graduated in earlier years) applied to medical and graduate professional degree programs during this period. Medical schools accepted two-thirds of the 365 Dartmouth Biology and Chemistry majors who applied. Each year two or three seniors are accepted to veterinary school. The acceptance rate for students applying to Ph.D. programs is nearly 100 percent, reflecting the fact that Dartmouth's strongest students pursue graduate degrees. During the past five years, over 50 Biology majors entered graduate programs at schools such as Harvard, MIT, Stanford, and the University of California-San Francisco. This number includes eight students who enrolled in M.D./Ph.D. programs at schools such as Cornell, Duke, Albert Einstein Medical College, and Columbia. In the same period, 35 Chemistry majors entered graduate programs at institutions such as the California Institute of Technology, Duke, Harvard, MIT, Princeton, the University of California-Berkeley, Stanford, and Yale. According to a recent study reported by Chemical and Engineering News, Dartmouth was one of the top sources of students who go on to pursue a Ph.D. in Chemistry (see below).

B. Dartmouth College as a Source of Ph.D.s.

According to the 8th edition of *Franklin & Marshall Baccalaureate Origins Report* for the period 1986-95, Dartmouth ranks 2nd among the 82 private research and doctoral universities in being the baccalaureate institution for Earth Sciences Ph.D.s., 7th for foreign languages Ph.D.s., 12th for Political Science and International Relations Ph.D.s., 14th for other humanities and other social sciences Ph.D.s., 15th for Computer Science and for Mathematics Ph.D.s., 17th for English Ph.D.s., 20th for Chemistry, History and Anthropology Ph.D.s., 21st for Physics Ph.D.s., and 24th for Life Sciences and Economics Ph.D.s. This places Dartmouth in the top 25 “source” schools among private research and doctoral institutions for all fields except Psychology and Engineering (where we ranked 37th and 40th respectively). The rankings do not take into account the large number of graduates who receive medical, law and other professional, non-doctoral degrees. It is also important to note that the data in the Franklin and Marshall Report are not normalized on the basis of institutional size. When one takes the size of our undergraduate body into consideration, it is clear that a significant number of our graduates are going on to earn a Ph.D. It is also important to note the time lag involved: students receiving Ph.D.s in the period 1986-1995 would have been undergraduates at Dartmouth in the late 1970s and in the 1980s. We hope that the increased emphasis on undergraduate research in the last ten years will indeed translate into higher numbers of students choosing to pursue higher degrees.

Another source of information on the careers Dartmouth graduates choose after graduation is the National Science Foundation’s 1995 report on “Undergraduate Origins of Recent (1991-1995) Science and Engineering Doctorate Recipients.” Dartmouth ranked 4th among 111 doctoral institutions (doctoral institution as defined by the 1994 Carnegie Classification) in being the baccalaureate institution of 1991-95 science and engineering doctorate recipients (includes Physical Sciences, Mathematics, Computer Science, Biological Sciences, Agricultural Sciences, Psychology and Social Sciences). There were only three liberal arts (i.e. Baccalaureate) colleges that graduated more students who went on to earn science and engineering doctorates than did Dartmouth: Oberlin, Carleton and Swarthmore Colleges, with 266, 260 and 248 graduates, respectively, compared to 233 for Dartmouth. To put these numbers in perspective, the undergraduate study body is 4200 at Dartmouth, 2900 at Oberlin, 1880 at Carleton and 1350 at Swarthmore. But how does Dartmouth compare to research universities that have a similar-sized undergraduate student body and to whom Dartmouth often compares itself? Harvard University is the baccalaureate origin for 752 1991-95 degree recipients, Princeton University for 544, Stanford University for 519, Yale University for 495, Brown University for 469, and Duke University for 399, compared to 233 for Dartmouth. Although it is clear that Dartmouth graduates choose to pursue a Ph.D. degree in science and engineering half as often as students at these peer institutions, the reasons for this difference is not clear. Taking the time lag into consideration, we may anticipate an increase in the future in the number of Dartmouth graduates who choose to pursue a Ph.D. as the number of science majors has increased over the last ten years. For example, Biology majors have almost tripled from 47 graduating seniors in 1989 to 122 graduating seniors in 1999.

C. WISP Alumnae Connections Survey on Undergraduate Research (See Appendix for a complete copy of the report)

In fall 1997, the Women in Science Project embarked on a major research effort, the Dartmouth Women in Science Alumnae Survey, as part of a broader Alumnae Connections initiative. The focus was on women in the twenty-four graduating classes of 1973 through 1996 who majored in science, mathematics, and engineering. The three major research questions for the study were:

- Did these women persist in science after graduating from Dartmouth?

- What factors in their college experience encouraged or discouraged them in their pursuit of careers and advanced studies in the sciences?
- What recommendations do alumnae have about how to best prepare women in science?
- For the purposes of this self-study, the WISP survey was particularly helpful in addressing two main questions:
- What is the quality of the undergraduates' experiences in the opportunities that currently exist and how might their quality be enhanced?
- Do such opportunities change the undergraduates' academic experience at Dartmouth, and if so, how?

Major Findings

- A sizable proportion of respondents reported participation in undergraduate research opportunities. Of the 724 women who responded to the AC survey, 385 (53%) reported that they had participated in research opportunities as an undergraduate; 198 of these women were from the classes of 1990-96. Fifty-two women reported being a WISP intern (33% of respondents from the classes of '94-'96, the only classes in this study in which WISP first-year internships were available).
- Many women regarded research experiences as positively influencing their interest and desire to pursue a career in the sciences. Respondents rated their undergraduate research opportunities quite favorably, with perceived levels of positive influence increasing gradually over the last three decades of Dartmouth classes. Evaluations of the respondents who participated in WISP internships were similarly positive.

Twenty-four percent of respondents spontaneously listed undergraduate research opportunities as one of the most significant aspects of their Dartmouth undergraduate experience, in *enhancing* their interest and/or desire to pursue further studies or a career in the sciences. Women discussed the value of apprenticing with a faculty member as a research assistant/intern, as well as of conducting one's own independent research, such as doing a senior thesis. Women discussed a range of benefits received from engaging in research opportunities, such as acquiring an interest in and commitment to doing research, increased understanding of the real world applications of science, and a sense of belonging to a scientific community.

- A small number of women regarded research opportunities, or lack thereof, as having an adverse effect on their interest and desire to pursue a career in the sciences. About 5% spontaneously listed undergraduate research opportunities, or lack thereof, as one of the most significant aspects in *diminishing* their interest and/or desire to pursue further studies or a career in science. Almost half of these responses indicated the positive value of a research experience. They felt it informed their career decisions not to go into a research field but rather redirected their science focus. They wished that research had been required of them as an undergraduate, or expressed a desire that there had been a greater number of research opportunities available, either in general, or in their particular major.

More critical responses concerned women's view that the process of obtaining a research opportunity was too highly selective and competitive, expressing disappointment at having been rejected as a research intern or assistant. Others felt that the range of research opportunities had been too narrow and heavily skewed towards academic research and medicine.

- Women who participated in WISP first-year internships were more likely to report having participated in research opportunities, more generally. Of the 52 women who reported taking part in WISP internships, 50 reported general research opportunities as well. A number of women described how they continued to conduct research with their WISP sponsor beyond their first year, or how the WISP internship was the first of a number of different research opportunities in which they participated.
- Women who participated in undergraduate research opportunities were more likely to report having a mentor in science while in college. Women participating in undergraduate research opportunities more generally, and in WISP internships more specifically, were more likely to report having a mentor in science than their peers who had not participated in research. Respondents described many specific ways they felt mentors had offered support and guidance, such as overseeing their thesis work, providing encouragement and advice, helping with professional networking, providing positive role models, and recognizing potential in their students.
- Women who participated in undergraduate research opportunities were more likely to go on and obtain doctoral degrees, than their counterparts who did not participate in undergraduate research opportunities.
- Women who participated in undergraduate research opportunities were more likely to remain in a career in the sciences. Of the 469 women who reported current/most recent employment in the science field, almost 60% had participated in undergraduate research opportunities. For the women who are not currently employed in a science field, about 35% had participated in undergraduate research opportunities.
- Undergraduate research opportunities were cited by women as one of the most important program initiatives for Dartmouth to prepare their undergraduate women for a career in the sciences. When asked for the *one* recommendation they would make to Dartmouth College to best prepare their female undergraduates for a career in the sciences, 12% specifically mentioned the provision of undergraduate research. More specifically, women recommended that:
 - It is essential to provide undergraduate research opportunities to students interested in careers in the sciences, to afford a realistic sense of future fields and positions, and to build skills, knowledge and experience that are critical to graduate study and future careers in science.
 - Research opportunities should be available early on in one's undergraduate career. At the same time, research opportunities should be made available throughout various points in one's college years, either to build upon previous research experiences, or to newly enter the research field.
 - Having a mentoring relationship with a faculty member and feeling part of a scientific research community constitute important parts of research opportunities.
 - The types of research opportunities available should be expanded beyond academic scientific research and positions in medicine, into positions in industry, business, education, and other fields.

The Alumnae Connections survey provides strong, supportive data that clearly indicate the value of providing research opportunities to undergraduates. Alumnae majoring in the sciences rated such experiences as positively enhancing their interest and desire to pursue a career in the sciences, and described many of the benefits they felt they received through these experiences, particularly by acquiring a strong mentoring relationship with a faculty member. These views were

further supported by the findings that undergraduate research experience significantly increased the likelihood of obtaining a doctoral degree and remaining in a science, math or engineering career.

D. Outside fellowships

Many of the students who apply for outside fellowships have carried out research while at Dartmouth. For example, of the 14 students who received Rhodes, Fulbright or Truman Fellowships in 1998 and 1999, six had written an Honors thesis, five had carried out independent research projects with a faculty member, one had completed an independent study course and two had completed internships off campus. All three Goldwater winners are Presidential Scholars and two had completed WISP internships. Whether their research experiences directly contributed to their desire to compete for such fellowships or to their ultimate success in obtaining such scholarships is hard to quantify. Although Dartmouth has been moderately successful with Fullbright, Goldwater and NSF scholarships, we have been less successful with the more visible ones, such as the Rhodes and Marshall Scholarships (Table 4). Lack of faculty involvement as well as the D-Plan have been cited as factors that make it difficult for students to submit competitive applications. The D-Plan often means that students are not on campus during the spring of their junior year and because Dartmouth students return just before applications are due Senior Fall, they often do not have enough time to solicit input on their essays. The Committee on Intellectual Life will recommend that oversight for these national fellowships be moved from the Career Services office to the Dean of the Faculty Office to allow for more faculty oversight (see below). We wonder whether other institutions are identifying students earlier and whether they are providing more guidance to the students as they work their way through the process of applying

IX. Summary: What needs attention and suggestions for improvement

- There are clearly some gaps in the types of research opportunities available to students. The two most obvious are a lack of an organized program for first-year men to gain research experience and the lack of funding opportunities for second-year students to carry out research projects. Data from the ongoing analysis of WISP provide strong support for offering a first year experience. The Boyer Report also recommended that research opportunities should be available beginning in the first year. Despite this, some faculty members feel that first year students do not have enough background to carry out meaningful research projects; many of these faculty members currently do not participate in WISP. One suggestion is to make it possible for students to do a WISP internship in either their first or second year. This would allow some students to strengthen their science backgrounds and adjust to the pace of college life while participating in all the other activities sponsored by WISP. Allowing some students to complete their internships in their second year would also help with the problem of there being a lack of opportunities in the second year. Similarly, some students are ready as sophomores to undertake Presidential Scholar internships and we recommend that second year students who have demonstrated academic excellence be allowed to apply for Presidential Scholar internships. Serious consideration should be given to expanding first year research opportunities to include both men and women and to include areas outside of the sciences.

- Another “hole” that impedes some students from availing themselves of research opportunities is the lack of a formal advising system for second-year students. First-year students are paired with a faculty advisor, but the advisor fades rapidly from the picture, especially when they are in a different discipline from one of interest to the student. Students do not declare their majors until the end of their fifth term in residence, at which time they acquire a major advisor. Given the general student dissatisfaction with the advising system currently in place, Dartmouth should consider completely re-vamping its advising system.

- There is an urgent need to do a better job organizing information on research opportunities at Dartmouth. The students should be able to go to one Web site and find descriptions (or links) to

Table 4. Outside fellowships awarded to Dartmouth students

Award	88	89	90	91	92	93	94	95	96	97	98	99	
Rhodes	18/1	23/0	15/1	17/1	14/1	8/0	8/1	14/1	12/0	11/0	9/1	12/0	
Marshall	16/0	15/0	12/0	13/0	11/0	4/1	5/0	6/0	8/0	7/0	5/0	7/0	
Keasbey	21/2		14/2				?	3/0		9/3/2			
Fulbright	11/4	19/4	19/5	9/3	?	3	9/4	15/1	11/5	16/4	11/6	12/5	17/5
DAAD			?	?	3/2	1/0	3/1	1/0	2/2	0/0	1/0	1/1	
Churchill	2/2/0	2/2/1	2/2/0			2/1/0	0/0/0	0/0/0	2/2/0	0/0/0	1/0	0/0/0	
Truman	23/?/1	11/?/1	9/?/1	?	?	4/4/0	2/2/0	5/3/1	2/2/1	4/3/1	2/1	1/1/0	
Goldwater			?	?	?	7/6/2	9/6/1	12/4/2	7/4/2	8/4/0	4/0	8/4/3	
Luce	5/0	1/0	1/0	?	?	0/0	0/0	1/1	1/0	1/0	1/1	3/0	
Beinecke	3/1/0	3/1/0	5/1/1	?		6/1/1			5/1/0	1/1/0	2/2/0	4/1/0	
NSF predoctoral	6*	5	4	13	9	9	14	11	7	11	8		
Udall											2/2/0	2/1/0	
Dartmouth Awards													
Reynolds	31/5	35/5	23/5	?	?	30/5	35/5	27/5	27/5	18/4	18/5	30/5	
General	40/11	28/15	33/13	?		35/6	28/11	19/14	46/15	21/11	23/7	28/15	
Woodbury/Scribner	12/2	13/3	6/3	?	10/3	8/3	8/3	?	15/3	6/2	?	9/3	
McGorrian								4/1	17/1	7/1	?	12/1	
Priest	9/2	8/2	5/2	?	4/1	?	?	4/1	14/2	3/1	?	6/1	

Number of Applicants/Number of Students or Alumni Nominated/Number of Recipients

* Only numbered awarded is listed

all the opportunities for carrying out research at Dartmouth. There should also be an electronic registry of senior honor theses so students can see the types of projects that have been completed. The students should also be readily able to access a description of each faculty member's research. The student-run Nathan Smith Society (pre-medical society) is interested in helping to improve access to faculty research profiles to make it easier for students to identify potential mentors (see <http://www.dartmouth.edu/~nss/nav/pages/jobs.html>). Some departments have done an excellent job with their Web pages; others need a lot of work. Undergraduate research should be a highly visible part of Dartmouth's Web page so visitors can see that the institution places great value on such research. Although an excellent Web site is no substitute for a strong faculty advising system, well-organized information about all the research opportunities at Dartmouth would greatly aid advisors as well as their advisees. One office should be responsible for coordinating all the undergraduate research opportunities on campus. At the present time, most such activities are overseen by Sandy Gregg, an Assistant Dean of the Faculty.

- We recommend that Sandy Gregg's office in the Dean of the Faculty area be expanded to also include oversight of applications for outside fellowships. Oversight currently resides in Career Services. This will require more staff. Besides offering the advantage that everything would be centralized, it will also reinforce the idea that carrying out independent research and applying for outside fellowships are intellectual activities that go hand in hand.
- Programs currently in place could be strengthened by providing more resources to those faculty who are willing to sponsor a research project. According to statistics kept by the WISP program, 155 different Dartmouth faculty have participated as mentors since the program's inception. Notably, 50 sponsors have participated for at least 5 years or have sponsored at least five interns. A review of faculty who sponsor other interns and honors students also suggest a core group of faculty who are involved. It is not clear that more resources will draw more sponsors, but it would reward those faculty who value mentoring research students. A better effort should be made to educate the faculty on how students might carry out independent study under their direction as part of the Presidential Scholars Program.
- Ensuring that all departments have endowments for supporting undergraduate research should be a high priority. Earth Sciences, the one department that does have significant endowment resources for this purpose, is an excellent example of the impact such funding can have: Dartmouth ranks second among the 82 private research and doctoral universities surveyed in the Franklin and Marshall Report as the baccalaureate source of Earth Sciences Ph.D.s.
- We suggest that a Faculty Mentor Award be instituted. There are awards here at Dartmouth that recognize excellence in teaching and excellence in research, but we feel that faculty efforts in providing students with a meaningful research experience should also be recognized. Seniors currently have an opportunity to nominate faculty for a teaching award given out on Class Day. Nominations for "Mentor of the Year" should be solicited from students as well as from department chairs.
- We need to encourage our best students to attend national and international meetings of professional societies. This will, of course, require making funds available for registration, travel, and per diem. Science students would also be able to present their work at such meetings, most likely in poster format. A number of societies, including the American Chemical Society, the American Society for Microbiology and the American Association for Cancer Research, have actively sought undergraduate participation at their annual meetings and sponsor sessions and activities aimed at undergraduates. A number of regional societies, such as the Eastern Sociological Society, also encourage undergraduates to attend. Attendance at such meetings introduces the student to a larger community of scholars and allows the student to see how information is exchanged. This year, for example, a senior honors major in Art History used

Richter funds to attend a meeting in Atlanta on “Shifting Frontiers in Late Antiquity,” and a Biology major was selected to present her honors thesis research on Capitol Hill in a poster session sponsored by the Council for Undergraduate Research. The Rockefeller Center has been providing funds for three to five students a year to attend various meetings, but it does not have a formal program in place to routinely provide such funds.

- More research opportunities should be developed that are linked to FSP programs. For example, approximately 25% of the students on the Environmental Studies Foreign Studies Program take advantage of going to Africa by staying on for an additional term to carry out some type of research. The three fellowships currently available to work at a Max Planck Institute in Germany could certainly be used in the term following the German Studies FSP. All departments that currently offer FSP programs should be asked to explore opportunities for student research abroad.

- Students’ research lives should be more highly connected to their residential lives. The Senior Scholars program is a small step towards this goal. We suggest hosting dinners in the various residential halls at which seniors living in those dorms could present their research to other residents as well as to their faculty mentors. These would be informal and meant to foster lively discussion.

- More space needs to be provided for both undergraduate and graduate students within departments so that students can develop a sense of departmental identity. Many honors students can be found at all hours of the day and night throughout the various academic buildings on campus, but having a place to call their own within their departments would foster intellectual exchange among the students.

- The D-Plan does allow many students to carry out research off-campus, but at the same time there is often a lack of continuity in on-campus research efforts. Any re-consideration of the D-Plan should investigate the impact on student research.

- As opportunities for independent research by students increase, the institution must take steps to ensure that such work is in compliance with all appropriate institutional policies and protocols such as those of the Institutional Review Board, charged with overseeing research that involves the use of human subjects.