

Center for Undergraduate Research in Mathematics (CURM) at Brigham Young University

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1. Introduction

In September 2006, we established a year-round “Center for Mentoring Undergraduate Research in Mathematics” (CURM) at Brigham Young University (BYU). CURM is supported by a \$1.3 million grant from NSF, and will promote undergraduate research projects in mathematics throughout the U.S. by: (1) training faculty members as mentors for undergraduate research projects; (2) having these faculty members mentor undergraduate students in research groups working together as a team on one research project during the academic year; (3) advising faculty members at other institutions on how to establish consistent funding to support undergraduate research at their own institution; and (4) preparing undergraduate students to succeed in graduate studies in mathematics. To help achieve these objectives, CURM will administer mini-grants each year to approximately 15 professors at various institutions across the U.S to assist them both financially and organizationally in operating successful undergraduate research groups at their own institutions. There will be an emphasis on targeting women (both in faculty who receive a mini-grant and undergraduates who are mentored by faculty) and participants from undergraduate institutions (i.e., institutions that do not offer PhD’s in mathematics).

This is a new direction in undergraduate research by providing support for small research groups during the academic year, and we are very excited about the possibilities and benefits it provides for students and faculty. CURM can help professors who are interested in initiating projects to do undergraduate research with their own students but who need guidance. Also, it can assist mathematics departments that are interested in expanding undergraduate research beyond a model of loosely structured independent projects. In addition, many younger professors at undergraduate institutions want to do undergraduate research projects with students, but there is too little time to devote to the students, because they are already teaching three to four courses each semester. This program can help them by providing funds for professors to buy out some of their teaching, freeing up more time to work with an undergraduate research group. Further, it is important for many young faculty members to be able to say that they have received external support

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for their research. Because these professors will receive funding from CURM, this may make it easier for these faculty members to convince a provost or dean to provide additional funds for their research projects. Finally, with an available stipend students will have the opportunity to spend more time and energy in a research project that is meaningful to their education by receiving a stipend, instead of having to juggle school and a part-time job that is not related to mathematics.

2. CURM

CURM will be based on a model that has been successful at BYU for several years. BYU has a strong emphasis on quality undergraduate teaching, and recently there has been institution-wide emphasis on mentoring undergraduates in research projects awarding more than \$500,000 annually to over 400 undergraduates to do research projects during the academic year. These awards are up to \$1,500 per semester per student, allowing students to work on self-designed research projects that are overseen by a professor. In addition to this, BYU awards over \$1.5 million annually to faculty members specifically for projects involving undergraduates. These projects allow faculty researchers to create research groups using undergraduates who are supported by stipends of \$1,500 per semester. Additional funds are designated for student travel and group supplies.

During the past four years, the BYU Department of Mathematics has successfully operated four different academic-year undergraduate research groups in the areas of algebraic geometry, geometric analysis, mathematical physics, and applied and interdisciplinary mathematics. These groups typically consist of 3-5 undergraduate students, 1 graduate student, and 1-3 BYU faculty members. All of these groups are supported by either university mini-grants, donations from alumni, or funding from local businesses and industries. These groups are very effective in helping students to make the transition from being an undergraduate to a graduate student, because they involve undergraduate students in mathematical research, challenge them beyond what they see in the classroom, and give them personal attention from faculty mentors. During the past four years, 53 BYU undergraduate students have participated in these mathematics research groups resulting in 44 undergraduate presentations at conferences, 15 joint student-authored refereed research papers, and 37 out of a possible 39 participants going on to graduate school (the other 14 participants are still undergraduates).

2.1. Mini-grants. CURM will serve to help faculty members set up a similar undergraduate research program at their own institution. Each year, CURM will administer about 15 mini-grants to professors who apply to the program. These mini-grants will consist of financial support for undergraduate research groups consisting of 2-4 undergraduate students and 1 faculty member. CURM will provide a \$3,000 stipend for each student in the group (\$2,000 to be paid initially and \$1,000 to be paid at the completion of the research project). The faculty mentor needs to be actively involved with the group. However, many of them will be at institutions with a teaching load of 3-4 courses/semester. Hence, CURM will offer \$5,000 for the professor to buy out at least one course from his/her teaching load during the academic year in order to free up time to spend working with these mentored groups. When a faculty member applies to this program for a mini-grant, we will require a letter from his/her department chair, dean, or appropriate administrator explicitly stating what the \$5,000 faculty stipend will be used for. At a minimum,

this must be a reduction of one teaching course. However, we suggest some additional items, such as a commitment to partially support the faculty member to attend the Joint AMS/MAA Meetings in January at which we will have a “Mid-year Project” meeting or a commitment to send undergraduate students to a regional conference where they can present their research. Also, each research group will receive travel funds (up to \$1,000 for the faculty member and up to \$400 for each undergraduate) to help cover the cost of attending the faculty training workshop and a spring research conference at BYU. Finally, each research group will receive \$250 for supplies.

2.2. Application process. We anticipate that the application material will consist of: (a) an application form (available at the CURM web site www.curm.byu.edu); (b) a letter of support from the department chair, dean, or appropriate administrator explicitly stating what the \$5,000 faculty stipend will be used for; (c) a personal statement describing the faculty member’s experience and interest in undergraduate research; and (d) a description of the research project. The combined length of the personal statement and the research description should be no more than 1 page. In addition to contact and other general information on the application form, there will be a place to list the specific names of prospective undergraduates who will be involved with the faculty member in the research project. We realize that the specific students may choose to not be involved in the research after the application has been submitted, so a list of alternate students will be encouraged. Applications for the upcoming academic year will be due in March. We anticipate that initial notification of the mini-grant awards will be emailed before the end of March.

2.3. Undergraduate research groups. During the fall semester, the undergraduate research groups will start and continue through the academic year with the students committing 10 hours per week to the research project for two semesters. Each undergraduate research group will meet together at least one hour a week and the students will meet and work together at least three hours a week. The rest of the time each individual student will work on his/her research problem. Students working in groups tend to motivate each other and also they learn to become more independent of the faculty mentor. We feel that this research experience will be a strong motivating factor for participants to choose to attend and succeed in graduate school. Hence, we will require that students must not be graduating at the end of the academic year in which they participate in the program.

2.4. Faculty training. To obtain the goals of CURM, it is necessary to give intensive, preparatory, and ongoing training for the participating faculty members. We plan to accomplish this through an intensive summer pre-workshop, a mid-year meeting, a culminating spring research conference, and an ongoing electronic list-serv for the group to discuss undergraduate research throughout the year. The 15 selected professors will attend a two-day summer workshop at BYU to discuss some logistics for the program, present ideas about effectively working with undergraduate research groups, and provide resources to help undergraduates prepare for graduate school. During this workshop there will also be some social activities, such as a banquet, a hike in the local mountains, and a possible excursion to a national park. In January, there will be a mid-year meeting at the Joint AMS/MAA meetings at which the faculty members will report on how their research group is

progressing. In addition, we will have discussions concerning topics that the mentors will address in the following semester, such as “How to help undergraduate students present quality talks at a conference,” “Where undergraduate students can publish research papers,” “How to get support from your institution to continue to do undergraduate research mentoring,” etc. In March, CURM will hold a spring research conference at BYU for students and their faculty mentors from these undergraduate research groups. During this conference, there will be a session in which the faculty mentors report on their research groups, evaluate the effectiveness of the program, and discuss issues concerning future undergraduate research.

2.5. Activities to prepare undergraduates to succeed. Since a major objective of CURM is to encourage and prepare undergraduate students to attend and succeed in graduate school in mathematics, we will plan activities to help students achieve this goal. Students will participate in a conference in which they will learn about the advantages of attending graduate school, receive information about what they need to do to prepare for graduate school, and give a presentation on their research projects. Also, students will submit a final research report. In March, CURM will hold a spring research conference at BYU for students and their faculty mentors. The conference will consist of three components: (1) Friday sessions in which the student participants will be motivated and intellectual stimulated to continue to study mathematics and prepare for graduate school; (2) Friday sessions in which the faculty mentors report on their research groups, evaluate the effectiveness of the program, and discuss issues concerning future undergraduate research; and (3) Saturday sessions in which the student participants will present their research with written feedback and guidance from faculty judges. There will be awards for the best research presentations. Finally, we will require all undergraduate research groups to submit to us a final written research paper and will assist the groups in submitting the paper to a journal for publication. These activities will help the undergraduates be better prepared to apply for and succeed in graduate school in mathematics.

2.6. National Advisory Board. In addition, we will organized a 6 member National Advisory Board for our project. These individuals will be experts in the various components of our project. They will act as consultants during the project and have agreed to evaluate the project. So far, the following individuals have committed to be members of the Advisory Board:

Name	Institution
Erika Camacho	Loyola Marymount University
Joe Gallian	University of Minnesota, Duluth
Aparna Higgins	University of Dayton
Darren Narayan	Rochester Institute of Technology
Zsuzsanna Szaniszlo	Valparaiso University
Judy Walker	University of Nebraska, Lincoln

2.7. Recruitment. Participants will be recruited nationally. We will distribute flyers at mathematics meetings such as the Joint Meetings, MathFest, and regional MAA meeting, and advertise in various magazines, such as AMS Notices, the MAA Focus, and the AWM newsletter. Also, CURM has a web site

(<http://curm.byu.edu>) with program announcements, suggestions for background reading, information about the previous programs, photos, participants' comments, and information about applying for the program. Finally, the program will be advertised on the Project NExT listserv. Applications will be accepted in the spring from faculty members who would like to participate in this program.

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