

## The Culture of Research and Scholarship in Mathematics: Undergraduate Research in Mathematics

The role of undergraduate research in mathematics has features which distinguish it from similar activities in other disciplines. These differences should be understood in evaluating the participation of mathematics departments and individual mathematicians in undergraduate research.

Both demand and opportunities for undergraduate research (UR) in mathematics have increased steadily in recent years, and there is currently much excitement in the mathematics community about supporting these types of activities<sup>1</sup>, which include independent study on research projects during the academic year; organized and externally supported research activities during the summer; and informal summer research experiences run by individual faculty. These can be a powerful way to draw students into mathematics. Simultaneously, there is growing pressure from universities on faculty in all STEM disciplines to engage undergraduates in research, in order to recruit, and then retain, the best students.

One salient aspect of UR activities is that it primarily is a *teaching* effort on the part of faculty, not a research one.<sup>2</sup> Undergraduate research in mathematics is not an automatic side effect of faculty research and is usually a major undertaking for a faculty member. It usually takes 2-3 years to bring PhD students from a solid knowledge of the undergraduate curriculum to a level at which they can, even with considerable supervision, engage in mathematical research; bringing an undergraduate to the forefront of research is very unusual. Opportunities for such UR are unevenly distributed across subfields. While some UR activities have been spectacularly successful in having students participate in truly original research, and such outcomes are highly appreciated by the discipline, this is not considered the norm.

A related issue is that there is a difference between mathematics and laboratory disciplines, where students at various levels of knowledge and competency can contribute to a faculty member's own research program. In mathematics, such positive effects on faculty productivity, although not unknown, are rare.

In summary, UR requires concentrated and highly time-consuming faculty effort, which comes in addition to the duties of teaching, advising, and faculty research, and which often does not further the faculty member's research agenda. This means that, in deciding whether or not to supervise undergraduate students in research, a faculty member will need to weigh the benefits (to the students, the institution and possibly themselves) against the costs to their other professional obligations.

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<sup>1</sup>See <http://www.ams.org/notices/201208/rtx120801112p.pdf>. The documents <http://www.ams.org/programs/edu-support/undergrad-research/PURMproceedings.pdf> and <http://www.ams.org/programs/edu-support/undergrad-research/REUproceedings.pdf> provide a non-exhaustive list of research experiences for undergraduates programs and information about how they run.

<sup>2</sup>Much of this Statement is informed by the responses to a CoProf survey. Of the department chairpersons contacted, 72% stated that undergraduate research is viewed as primarily a teaching effort, 16% as primarily a research effort, and 12% did not state an opinion.