FOCUS on Students: Undergraduate Research

By Robert W. Vallin

This article is going to be a little different. I am going to be a bit of a Homer on this. D'oh, no, not that guy. In this case a Homer is a person who interprets everything through his/her own "hometown perspective." Now I mean my home institution, a "second-tier state school with an atypical name."

That being said, let's get to the topic at hand: undergraduate research. To begin with, we need to define undergraduate research. Here's what I've found: undergraduate research is work done by an undergraduate to understand, conjecture, analyze and/or prove results which were previously unknown. There is still a problem. What does *unknown* mean? Is that unknown to the undergraduate or unknown/unpublished/un-presented by the mathematical community? Unknown by the student, but known to others means the work is more an independent study project than research. So we will go with the unknown/unpublished/unpresented idea.

At my home university, usually the first reaction to doing research is, "I can't do that. That's only for the really supersmart people at the big name schools." This is absolutely *not* true. How can I convince you? The best way to see what student research is comes from seeing the research done by others. Undergraduate student research can be seen in poster form at the Joint Mathematics Meetings and in talk format at MathFest. On a smaller scale, your MAA Section Meeting, which should be nearby, is full of student talks or posters. Each meeting is a great place to look, listen, and realize, "Hey, I can do that." For a list of more conferences for undergraduate students to attend, see the Student Meeting Opportunities section of the MAA page for undergraduates.

Obviously, doing research looks good on your résumé. If you're already planning on going to graduate school it is also a helpful glimpse into your future. But does doing undergraduate research really help? Yes, it does. Three recent studies, undertaken with grants from the National Science Foundation and the Howard Hughes Medical Institute support that answer. They all concluded that significant learning and growth are accomplished by students undertaking research projects.

This research can be done at one's own university or through a more structured program such as a Research Experience for Undergraduates (REU) Program sponsored by the National Science Foundation or the MAA's National Research Experience for Undergraduate Program. Structured research at a home university may possibly earn credit, while REUs take place over the summer and have a stipend attached to them.

Summer research programs have limited space and slots are earned on a competitive basis, so make sure to apply to many programs. I recall a student of mine who I urged to apply to REUs. She applied to 11 of them, in her words, "So you'd be quiet," She expected nothing and was accepted into eight programs. After her REU she presented her group's findings at the 2002 SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) meeting in Anaheim and at the Joint Mathematics Meeting in Baltimore. She is now finishing up her PhD, which was not part of the plan when she arrived as a freshman. To see a list of REU locations and similar summer programs go to the MAA's Undergraduate Student website http://www.maa.org/students/undergrad/.

There is not much for me to say about the actual research one could do. It varies from person to person. However, I will say this: It is work and finding results takes time. That said, every student I have seen come back from an REU has returned a more focused and excited mathematics student. Each also had several fun stories about what went on. You are not signing up to do time in a gulag, so don't worry about being chained to a desk until you have results. Several issues of *Math Horizons* have articles on what goes on at different REUs.

Doing individualized research at your home institution has its benefits. Things can be much more relaxed and there is more time to get the work done. Also, there is a lot more freedom in choosing a topic. My own students have studied topics ranging from trigonometry in non-Euclidean metrics to scoring systems in tournament blackjack play.

Once your research is completed, there are several outlets available. Some print and e-journals are devoted to publishing research by undergraduates and very good work may be sent off to more mainstream research journals. Many outlets exist for students to give talks on their results. Each MAA Section has at least one meeting per year, plus there are Regional Undergraduate Math Conferences held all across the country. On a larger scale, student talks are a large part of the annual MathFest held each August.

An alternative to giving a talk is presenting a poster. At the Joint Meetings of the MAA and the AMS every January there is an Undergraduate Poster Session. This past session in San Diego had over 170 posters. If you want more information on the posters, the session has a facebook group. Section meetings and RUMC's are usually near by so there are no major expenses. For MathFest and the Joint Meetings, the MAA has travel grants available for presenters and, for being involved in the meeting home institutions will usually give some assistance.

To quote MAA President Joe Gallian, "Undergraduate research is hot!" Not that you should do it to jump on the bandwagon, but you should become involved in undergraduate research because it is a great opportunity for you to learn and grow mathematically. For any faculty reading this, the MAA now has an online column on undergraduate research. Check it out at http://www.maa.org/columns/resources/resources_2_08.html.