instances where issues of identity may play a role. How we are each perceived and treated by our students and colleagues can be affected by our (actual or assumed) gender, race, nationality, accent, etc. The reality of my mentees' experiences as teachers and academics may be different from my own, and as their mentor I trust what they tell me, and I respect that there are things which they will choose not to reveal. It's vital that I don't minimize someone's narrative or redefine it in terms of my own. Sometimes all that is required of me is to listen. I may ask if there is anything I can do that would be helpful, accepting that the answer might be "no," and that I need to be ready to step up if the answer is "yes."

Over the years, I've had support from many mentors of my own. While some were assigned to me in an official capacity, others were people I met along the way who offered guidance voluntarily, or ones that I "secretly" decided to turn into my mentors. I feel extraordinarily privileged that I can now play that role for so many people at the start of their own journeys, and I'm incredibly proud of who they each become as teachers and colleagues.

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Reva Kasman

Credits

Author photo is courtesy of the author.

Undergraduate Research: Publish or Flourish

Joel S. Foisy

I have had the privilege of mentoring undergraduates in a summer REU program, held jointly by SUNY Potsdam and Clarkson University, for many summers. Working as an REU advisor has been a lot of fun, and a good change of pace from the very busy, teaching-heavy, 12-hour teaching semesters that we have at SUNY Potsdam. Below are some observations I have gleaned through my involvement with REUs over the years.

My experiences as a student in the Williams SMALL program influenced how I organize my student groups. In particular, my mentor, Frank Morgan, encouraged us to start thinking about the topic (just a bit) before the program started, and then we dug right into research as soon as possible. As we figured out proofs, we wrote up drafts of results individually, but with all group members editing. We also gave talks to the other participants regularly during the program. After the program ended, one student took the lead in getting the group's work published. This included more revising, giving talks, and responding to feedback, as well as dealing with referee reports. I have tried to incorporate all of the above structures in my summer research groups.

The most helpful way to get students on the path to publishing is to find a good problem for them. I seek inspiration for problems from a variety of sources. I find it helpful to attend conferences, both traditional research conferences—which remind me of research trends in the larger community—and undergraduate conferences—as they allow me to see what students are doing in research. I also read papers—MathSciNet and interlibrary loan (my school has a limited journal budget) and the arXiv are my main tools there. Often, making just a small variation on a previous problem can make for an interesting new problem that requires a novel solution. For me, the topic of embedded graphs in projective space had a nice 3-year run—the second and third years were variations on the first year's topic: intrinsically linked graphs in projective space, followed by intrinsically 3-linked graphs in projective space, and then intrinsically linked signed graphs in projective space. Finally, I need solid chunks of quiet time to dream about good problems. My life during the academic year at SUNY Potsdam does not include much of this—did I mention frequently having to supervise graduate seminars and committee work on top of the teaching load? Fortunately, an academic calendar always includes breaks—typically I finalize what problem(s) I will present to my REU group over spring break. When the REU is going, and my students are working on their own, I am typically in my office thinking about what problem to propose in the subsequent summer. At such times, I am often rereading through old favorites like Adams's *Knot Book* or Harary's *Graph Theory*, hoping for inspiration. Typically, I do not know the solution to the problem that I present to my student groups. I do, however, try to pose a couple of warm-up problems that are relatively easy to solve and that build toward better understanding of the main problem. Solving these problems helps to build my students' confidence, and also gets them writing early in the program.

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Do students need a lot of background to do research? That depends on the area. If you want to work with undergraduates on a sophisticated topic, there are a small but nonzero number of elite undergraduates who would have the needed background. My work with students has generally been in an area—spatial graphs—that straddles both graph theory and knot theory. In my experience, both of these areas have open problems that can be approached with little background. Typically, when advising a summer research group, I try to get through most needed background in a day or two. We'll pick up more background later ("just in time") if needed, but my hope is that students are pondering new questions as soon as possible. As soon as they come up with an idea or proof that is new, I encourage them to typeset it, and then I have others in the group proofread their proof. I will also proofread it. Every group and every topic is different, however, and some combinations require more time on background than others.

Whatever the background of the students, working with a group of them (for me, it's been three to five of them) has its advantages and challenges. Ideally, the students discuss ideas together, brainstorm, and feed off each other. Sometimes, one student may dominate the conversation. At times like these, I may assign facets of the problem to different students. Sometimes one student will go off on a tangent, digressing a bit from the original problem. This has either been wonderful (they prove an interesting result on a problem I hadn't thought of) or frustrating (the student gets drawn to a very difficult problem and cannot come up with a proof, in spite of a great expenditure of time and effort). I don't have a magic recipe for managing group dynamics, but I do know that if a group is monitored and managed carefully, then it is likely to work well for all of its members.

The work of an REU group evolves over the course of the summer, much like the work of any math researcher must evolve over the life of a project. Early in the 8-week program, there is more brainstorming than writing. As the program goes on, there is more writing and editing. The last week is usually filled with writing and preparing a final talk. To facilitate group writing, we have used various document-sharing options in the past. What option is used is mostly up to the students. We also have students present intra-REU talks so that they are practiced at orally communicating their results and exposed to some questions that other mathematicians may have. By the end of the summer, even if the group has proved a nice result, rarely is the written paper ready for publication. Often a student will emerge to shepherd the paper through the next phases of editing. Often, but not always, this is tied in with their honors thesis. Sometimes I have been the one to finish the paper. I can remember one particular paper that had a difficult (for a student) technical hurdle to overcome, and on top of that all of the students were busy with their last year of undergraduate studies. Consequently, I finished off the final edits (with input from the students) and dealt with the referee process.

Sometimes the students do not have a result that is even close to being ready for submitting for publication. In some of these cases, if I feel there are still results possible, I have had a project followed up on by next year's group. Other times, I have let it lay fallow. In looking back, even for an "unsuccessful" summer program (i.e., no publication), the students were still engaged in doing mathematics, and in communicating it in writing and speaking. I still feel that the students and I gained a lot during these summers.

I am always looking for suitable journals to submit papers written by/with undergraduates. Fortunately, there seem to be more and more student-friendly journals out there. The following site from the University of Nebraska has a nice list of student-appropriate mathematics journals: `https://unl.libguides.com/c.php?g=51642&p=333916`. Most of those discussed below are listed on that site:

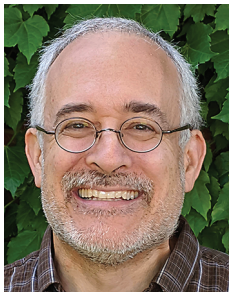
The first journal I would recommend is *Involve*. Full disclosure: I am on the editorial board. *Involve* requires at least one-third student authorship. They prefer coauthored papers (as opposed to student-only authorship). *Involve* papers are reviewed by Math Reviews. This is one of just a few student-focused journals that are math reviewed. The *Rose Hulman Undergraduate Mathematics Journal* requires student-only authorship, with a faculty "sponsor." Authors have to be undergraduates when the research took place, but can submit after graduating. *Rose-Hulman* is also math reviewed. The *Siam Undergraduate Research Online* has similar guidelines as the *Rose-Hulman Journal*. It is not math reviewed. Of course, this journal focuses on applied math. The *Pi Mu Epsilon Journal* publishes papers, preferably by undergraduates, and not necessarily by members of Pi Mu Epsilon (mathematics honor society). The *Pi Mu Epsilon Journal* is also math reviewed.

There are also several other good non-math reviewed options: The *Minnesota Journal of Undergraduate Mathematics* allows for faculty collaboration, but the majority of research and writing must have been completed by an undergraduate coauthor(s). The *Journal of Young Investigators* has articles in a broad range of sciences and mathematics. The *PUMP Journal of Undergraduate Research* publishes articles primarily by undergraduates who want to pursue doctoral studies in mathematics. Expository papers are also welcome. *The Pentagon* is the official journal of Kappa Mu Epsilon (KME) mathematics honor society. Most papers are written by student KME members.

There is always the option of submitting to a standard journal. The *Missouri Journal of Mathematical Sciences* is listed on the Nebraska page, and it is math reviewed. Other options may depend on your area. The *Journal of Knot Theory and Its Ramifications* is, of course, tailored to knot theory. If my group is doing a more knot theory-oriented project, publishing in JKTR can be a nice goal. If you know of other

undergraduate researchers in your area, I recommend investigating where they have published as possible venues.

In summary, working with undergraduates in the summer is a very rewarding process. The students bring great energy and a variety of experiences to the table. The creative process of discovery, paired with the process of communicating discovery, lead to enjoyable learning for all who are involved. Aiming for a publication is a great way to focus a group's efforts, but the process of working on mathematics, and communicating it, are foundational skills that students will take away regardless of reaching the goal of publication or not.



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