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Lafayette College's REU

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Lafayette has been an NSF REU site in math since the early 1990s, and is currently running a program that will be funded through the summer of 2010. Each year, we fund 10 - 12 students who are partitioned into three research teams for an eight-week research experience. Eight of the students are funded by the NSF from a national search, and the remaining students are undergraduates at Lafayette who are funded through the college's EXCEL program. Typically, students work in groups of 2, 3 or 4 with a single Lafayette faculty member (although we occasionally select married faculty mentors). Here are some of the specifics for our program:

- How do the mentors decide whom to choose for their programs?

We get between 150 and 200 applications for eight positions. Student applications contains three important pieces of information: a transcript, an essay from the student and 2 letters of recommendation. These three pieces all contribute, but different mentors weigh them differently. Some mentors look for students who might not have a research opportunity at their home institution, and we are all interested in students with lots of enthusiasm for the project who have written a positive essay. Grades are important, but so is the breadth and depth of the courses taken. The essay should not include statements like:

> I have trouble working with other students.
> You will be very happy to have me in your program.
> I have been fascinated with research mathematics since 7th grade, and have developed my own approach to the Riemann Hypothesis.
> For the reasons I have outlined in this essay, I would love to spend the summer at _____ studying _____ with _____
> (with the blanks appearing in the letter).

Finally, good letters that speak to the student's personality are invaluable. Letters that read

> He got an A- in Real Analysis and asked several probing questions. I believe he would really benefit from a research experience at your institution.

are of limited value. Students from traditionally underrepresented groups are especially encouraged to apply. Gender balance is important to us, and we have had some success attracting minorities to the program.

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In sum, the criteria for selection includes the student's academic credentials (transcripts and letters of recommendation), the level of interest the student displays in the project, and the likely benefit the REU experience will have on the student. We consider this last condition one of our key criteria for admission.

- How do mentors decide on project topics?

This is hard. Different mentors use different strategies, including combing the literature for interesting problems. In general, we shy away from choosing open problems that are well known, for obvious reasons. Most undergraduates will have a research experience that is long on frustration and short on success in such a situation. Instead, we try to find areas of our own research that can be smallerized to fit an eight-week time frame and an undergraduate background. For example, a general question on matroids might be simplified to graphs, or a question about geometric groups could be analyzed for a specific class of groups. In the best of situations, this can be very fruitful, but it requires the mentor to be flexible during the summer, willing to shift the problem significantly.

- How do students get selected for individual projects?

On our web site, we advertise three projects, complete with abstracts and pretty pictures. Students read the project descriptions and apply to whichever one they like. This happens in the spring, well before they arrive on campus (usually during the first full week in June). Although individual mentors occasionally share applications with each other, the typical application is only read thoroughly by the mentor.

- What should students gain from an REU experience?

We want to give the students a sense of what it means to undertake mathematical research in a meaningful way. This will be accomplished over the summer by fostering interaction among the students within a team, between the students and the faculty advisors and between the different teams. This environment helps to build a mathematical community in which the students are integral members. In each of our previous programs, we have seen students experience the excitement of discovery, the frustration of trying to solve a difficult problem, the hope engendered from the infusion of new ideas and the satisfaction that is only obtained from a deep understanding of a problem that was mysterious or intractable a few weeks earlier. While we strongly believe that the creation of this mathematical community is the central goal of the REU, the publication of papers resulting from these projects can be an extremely valuable component of the program. Final publication gives the students a finished product of which they can be proud. We have had a strong record of publications resulting from previous REUs; in fact, nearly all of our projects have resulted in one or more publications, as is noted in Publications from REU Programs at Lafayette College. A complete list can be found at http://ww2.lafayette.edu/~math/reu/Pubs.html.

- Do students give talks?

Well, this wouldn't be a bullet point if they didn't. In addition to sharing their ideas with other members of their team, the students will present their work to the entire group at regularly scheduled seminars. Each group gives three presentations during the summer; one presentation introducing the problem to the audience (during week 1 or 2), a second presentation midway through the summer to update

the other groups on their progress (during week 4 or 5), and a final wrap-up presentation (during the last week). At each meeting, one research team will present material. These meetings will have several benefits. The presentations help prepare the students for speaking at conferences. These meetings also help foster a sense of camaraderie among the different teams. Students who are not presenting can add their insight to the problems of the team that is presenting, and listening to presentations by other teams may inspire a non-presenting team with its own research. And finally, as a simple matter of fact, students often make significant progress under the pressure of preparing their talks.

- What other mathematical activities do we have for our lucky REUers?

There are activities planned throughout the summer. The main activity is a trip to a research conference. This is a tricky enterprise; the conference should meet all of the following criteria:

- Conference must take place during the eight-week REU program (preferably within weeks 2-6);
- Conference should be accessible to undergraduates;
- Conference should last no longer than three or four days; and
- Conference must be within a one-day drive from Easton.

The advantages of attending a research conference are manifold; students experience research at the highest level, not watered down for undergraduates. In addition, they get a chance to interact with a large group of professional mathematicians this interaction has a valuable mentoring component. Finally, the students can bond as a group in the conference setting. Last summer we went to the CBMS conference at North Carolina State University for a series of lectures on Cluster Algebras.

In addition, we frequently attend a topology conference in at Lehigh University and we also visit another REU site (usually Rutgers University). Each of these activities takes one or two days.

Finally, we support travel to a conference after the summer, usually the annual joint math meetings in January, where we encourage the students to speak and/or give poster presentations on their work from the previous summer.

- What about outside speakers?

We bring 2 or 3 speakers to campus each summer to give an undergraduate research talk. Last summer we were fortunate to have Frank Morgan, Maria Chudnovsky and Eric Gottlieb speak to the group. We also have Lafayette math faculty speak to the group on occasion. In the past, we have taken advantage of our location to attract speakers from Penn (Herb Wilf), Princeton (John Conway and Maria Chudnovsky), Binghamton (Matthias Beck, Thomas Zaslavsky), Cornell (Bob Connelly) and Williams college (Colin Adams and Frank Morgan).

- What about fun and games?

Students are spending their summers here we want to make sure they have fun and plan lots of activities that have no mathematical goal. Last summer we took a trip to Philadelphia (to see the Franklin Institute and do some sightseeing), we took a day-long hike to Sunfish Pond, a glacial lake in the Pocono mountains, we took a day trip to Ringing Rocks Park, and we went rock climbing at Lafayette's indoor rock wall. We've seen baseball games in Philadelphia, gone rafting down the Delaware River, seen a play in Manhattan.

On a more regular basis, we have several get-togethers at faculty houses (opening night cookout, cookouts for various guest speakers, weekly dvd nights, etc.) and the students organize activities themselves, too. In the past, they have taken trips to New York, organized a weekly bowling night, and many more similar activities. Student reaction (see below) indicates this is a strength of the program.

- What about the logistics?

Students get a stipend of $3200 for their work during the summer and free housing in a new dorm at Lafayette. They get free access to Lafayette's newly renovated library and fantastic gym (with a challenging rock wall), and they have many food contacts provided for by the REU (when at conferences, at cookouts, when entertaining guest speakers). They also get some travel money for one post-summer math conference.

- How can we tell if we're doing a good job?

We run a survey immediately after the program and another one about 9 months after the program. Here are some student responses to past surveys.

(1) Did the program meet your expectations mathematically? How cohesive was your group?

- The math was exactly what I'd hoped it would be, with the right amount of guidance from our leader (not so little that I had no clue what was going on, not so much that I knew what was going on and didn't like it) and the right range of difficulty (since the problem was a bit open-ended, I could pick and choose an area that was interesting to me and also just hard enough to be fun). My group was very cohesive, in that we all liked each other and were interested in each other's work.
- The program met my expectations. I enjoyed working with my group. We worked together and individually and it was good meeting as a group every once in awhile to find out how everyone else was doing. I learned a lot about doing math research. The Rutgers trip was a good idea and I really liked the speakers. It was also good to present to other groups and hear updates about what they were doing.
- My group met all of my expectations mathematically. The math was challenging, but it was fulfilling when we came up with results that worked. Our group was extremely cohesive. I felt comfortable with every person in my group, and we all worked together well, allowing us to challenge one another and help each other in our research.
- Yes. The program definitely met my expectations mathematically. I had talked to some other people who had done REUs that failed to meet these expectations, so I paid special attention when applying to attempt to insure that I would have a good experience in that regard, and I did.

(1) How did the Lafayette REU influence your future plans?

- The Lafayette REU made it clear to me that I would enjoy life as a theoretical mathematician. While I look forward to getting a different experience this summer in another field, my experience at the Lafayette REU will be invaluable in figuring out if theoretical math is what I want to do with my life.
- The REU program definitely made me realize that I should work towards a PhD and stay in the field of academia. I had other 9-5 type jobs in

previous summers and could not stand them. I enjoyed the fact that we were able to set our own hours while working on research and not forced to be working prescribed hours. I also found my job experience in previous summers mind-numbing, while research kept me stimulated and excited about meeting with my group. It definitely made me begin to consider grad school and ultimately led me to my decision to pursue a PhD.

- I became more confident that I can actually do research, and that I actually like doing research. I also got a whole lot out of the conferences I could attend because of the REU (meeting cool people, hearing about new math, whitewater rafting). So I guess it influenced my future plans by making them the same as they always were (I've been planning to be a mathematician for a while now), but even more appealing.
- The Lafayette REU was a huge influence on my plans. I learned of the Penn State MASS program and of the Budapest Semester program. I applied and was accepted to both and made the decision to attend the Budapest Program. The program also helped me gain exposure to thinking like a mathematician. I was able to attend conferences about topics of advanced mathematics. I could meet many wonderful people in the field of mathematics. I am still in contact with many people who I worked with during the summer. I could practice presenting my work. The whole experience of the REU including the Boston trip and the Joint conference helped me realize I want to do mathematics as my career. The faculty members at Lafayette helped steer me further into mathematics. I cannot thank everyone at Lafayette for helping me so much.
- The Lafayette REU introduced me to the vast world of research in mathematics and the impact that pursuing such research could have on others, which is why I am convinced that pursuing my doctorate in Mathematics education will allow me to make a difference in the lives of future students with a background similar to my own.
- Lafayette was basically my first experience with mathematical research, and the fact that I enjoyed it so much has led me to go to grad school and get my Ph.D. The Lafayette REU was an amazing introduction to research. My best memories are sitting around doing math and really making a breakthrough, finally getting a result that we had been trying to get for most of the summer.

A somewhat facetious summary of our experiences with the REU program can be found at http://ww2.lafayette.edu/~math/reu/REUpaper.htm in an article published in the November, 2004 issue of Math Horizons.

- Do students publish their work?

Another silly question. Of course they do. A complete list can be found on our web site.

- So is there some sort of conclusion, or what?

Running an REU program is an enormous amount of work, from lining up good projects and project leaders to planning all of the mathematical and non-mathematical activities for the summer. We do all of the logistical work ourselves; Lafayette does not have a graduate program, so there are no graduate students to help out. Being flexible is important (last summer we had two trips to the

emergency room, one after the hike to Sunfish Pond and another after an intense capture-the-flag game; both students made complete and quick recoveries).

Our hope is that the students look back on their time at Lafayette with some satisfaction and a real sense of what it means to do research in mathematics. If we have influenced the students in a positive way, then we can take some pride in our efforts.

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