

As the end of the semester is in sight, now is a good time to start thinking about what you will do next summer, specifically if you would like to apply for a summer research program. The deadline for these is typically early next year. This issue covers some common questions regarding undergraduate research.

### Undergraduate Research

-----

What is undergraduate research?  
-----

Undergraduate research is a real research project. The results of the experiment or calculation are not known ahead of time. The results are thus original. It is not a book report or literature survey, although you may start your project with a literature survey.

A good research project will also be at the right level for the student. There are some experimental projects which with the help of a good advisor you can start as freshman or sophomores. There are some experimental projects which require our electronics lab or the machine shop course. There is a similar range of theory projects. If you wish to study grand unification theories, then there is probably little you can do as an undergraduate. On the other hand, there are plenty of theoretical projects which you can do as an undergraduate.

Why do undergraduate research?  
-----

There are several different answers to this. In my mind the best answer to this question is to learn what research is about. Research is different from course work. The answer to a research project is not known ahead of time. In some cases the question is not even known. A homework problem takes at most a week or two, while research projects take months or years. While exams have a time limit where speed is of the essence, persistence and accuracy are more important in research. 95% is a very good grade on an exam, but only 100% is acceptable for research. There is not simple correlation between performance in courses and research ability. A hard working and persistent B or B+ student may do much better than a student with a 4.0 GPA.

Another reason to do research is that many graduate schools and awards now ask for one's research experience. There are clear sections in applications devoted to prior research experience as well as research interests or even a research plan. Furthermore, based on feedback from some of our graduating students last year, it may be becoming almost necessary to have a publication at least in the form of a preprint to get into the elite graduate schools in Physics. Thus, given the choice between another major and a significant research project it is probably best to do the research project.

Finally, yet another reason to do research is that you can in cases be paid for it. Both REU programs and the University Scholars Program pay a stipend (see below). Students may also be paid off of grants depending on the faculty member and the usefulness of the student. I prefer to have students work for me for a semester before I consider paying them.

How do I get started in research?  
-----

Summer research: One of the best ways to get started is to do a summer research project. In the summer you can devote yourself completely to research without interfering with your required course work. In addition there are a number of different funding options which will allow you to get paid a stipend.

NSF-REU programs: REU stands for research experiences for undergraduates This is a National Science Foundation program, which allows students to go to different universities and do research with a faculty member over the summer.

You get a stipend, which is typically around \$4000 for the summer. REU programs also teach you important skills like writing scientific papers and making scientific presentations. The U.F. Physics department runs an REU program (<http://www.phys.ufl.edu/reu/>), which can accept up to 5 of our own students. There are also many other REU programs around the country. In fact in recent years students have gone to REU programs at other universities to see if they might like going to graduate school at that university. More information about the REU programs may be found at: [http://www.nsf.gov/crssprgm/reu/reu\\_search.cfm](http://www.nsf.gov/crssprgm/reu/reu_search.cfm) . Applications are typically due early in the new year.

University Scholars Program: This is a summer research program sponsored by the University of Florida. It also pays a stipend. Our physics department typically gets two each year. For this program you need to find a research mentor and then write a short proposal of what you intend to do for research. To find a research mentor you will need to ask an individual faculty member. Since the majority of our faculty have had undergraduates work with them in the past, there is nothing unusual in going around and talking to faculty about research opportunities. If one faculty member is not willing to take on an undergraduate at this time, they may know of another who is. More information on the University Scholars Program may be found at <http://www.scholars.ufl.edu> . Applications are due in the Spring. The program seems to have increased in size somewhat. Last year Physics had 4 recipients instead of the usual 2 per year.

Research during the school year: A number of our undergraduates do research with a faculty member throughout the school year. This has the advantage that you can get more done working on research throughout the year - not just a few months in the summer. Although a few of our REU students publish papers as a result of their REU work, many more of the students working with a faculty member throughout the school year publish papers, perhaps even as the lead author. The disadvantage of doing research throughout the school year is that you need to balance research and course work. Some students can do this effectively and some can not. You should treat your research at the very least as taking as much time as another course. If you do not spend this amount of time, then it is unlikely that you will make substantial progress and you are probably wasting your time and your faculty mentor's time. As for the University Scholars Program, there is no clearinghouse for faculty looking for undergraduates in research. You need to take the initiative to talk to individual faculty; however, most faculty will be happy to talk to you, and if they are not looking for a student, they may know someone who is. The Society of Physics Students has popular series of research presentations by faculty, which is also a good place to begin.

When should I start research?

-----  
There is no hard and fast rule for this; however, here are some guidelines. I would say that if you have finished several of our 3000 level physics classes, then you can benefit from an REU program. Assuming that you have done well in your courses, you will probably get into an REU program if you apply to several of them.

For research during the semester, some students start working in the laboratories as early as their freshman year. It is more common for students to start in their sophomore or junior year. Starting in your senior year has been done in the past, but it is not a good idea because you will have less time to do research because you will graduate soon. No matter when you start, make sure that you are willing to make the time commitment to do research. The benefit from doing research in applying to graduate school is from the letters of recommendation you get from your research advisor. If you do not work hard, it is unlikely that you will get a good letter of recommendation.

-----  
Please send comments or additions to Selman Hershfield ([selman@phys.ufl.edu](mailto:selman@phys.ufl.edu)).