Undergraduate Research: A Guide To Getting Started

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Why is Undergraduate Research (Independent Study) Important?

Working in a research group or internship is an important part of learning and understanding the agricultural and life sciences. Undergraduates are encouraged to gain independent research experience and/or obtain positions as hourly workers in groups that are doing research in their area of interest. Students typically work in a research group for credit (see your mentor for course number and appropriate number of credits) or an hourly wage.

There are many advantages to these positions: students experience firsthand the excitement and frustrations of doing research, they learn techniques that can be useful in subsequent research projects, they begin to integrate their course work knowledge with practical research situations, they can develop responsible work habits, and they make contacts with researchers who may be able to help them make career decisions and who will be able to recommend them for jobs or graduate/professional school admissions.

The impression that an undergraduate makes in a research laboratory can have powerful effects on future decisions. Graduate admissions committees and prospective employers may put much more weight on a letter of recommendation than on grades or GRE scores. An important part of working in a research group is demonstrating a sense of responsibility. Research is a collaborative effort and it is critical that an undergraduate student or employee maintain his/her part of the effort. The student should show up at appointed times, work carefully and neatly, return equipment, books and other borrowed items to their rightful owners promptly, and meet all deadlines for written reports. These may sound like trivial concerns, but by following these guidelines a student can demonstrate that he/she is a reliable, conscientious worker who would be a desirable addition to a research group. It is easy to alienate a supervisor by being sloppy, late, lazy or inconsiderate, even if it happens only once! It is equally important to remember that future employers will be most impressed by a strong, supportive letter that describes a conscientious worker who takes his/her work seriously. If you do not think you can make a real commitment to a research project or if you can give only minimal effort, it may be best to defer the experience.

Finding out about potential mentors

In order to find a mentor you will need to decide what research area interests you. You may want to discuss this with your academic advisor or a professor or TA in one of your courses. Often they can give you ideas about faculty who are working within your area of interest. However, there are several ways you can learn of potential mentors on your own. All involve identifying a faculty member on the basis of his/her area of research and reading about his/her research before approaching them.

Consult the Timetable for listings of all departments on campus. Find departments that

sound interesting using the index. Under each departmental listing, an address for the departmental office is given. Go to the departmental office and ask for a list of the faculty and their research interests.

Visit the web pages of biological sciences departments on campus. Many departmental web pages have links to web pages of individual faculty members where descriptions of their research can be found. Visit a new web site, Undergraduate Research Clearing House. At this site some mentors on campus post announcements about specific research projects they are seeking undergraduates to work on. Use a searchable database to search for a topic that interests you. One such database is the Community of Science.

Reading about a potential mentor′s area of research

Read about the research of potential mentors. The faculty web page that you visited probably has a brief overview of the research projects going on in that mentor's laboratory/ research program. In addition, many faculty web pages list some of the publications that the faculty member has authored. You may want to locate some of these publications at a campus library and read them for a more in-depth background before approaching the potential mentor. You may find that these publications are written at a level that is hard to understand, given your exposure to specific scientific areas thus far, but you will probably be able to get a basic idea of what the research involves by reading the Abstract and Introduction portions of the research article.

Approaching a potential mentor

Once you have an idea of the mentor's research, you are ready to contact the mentor. You may choose to do this initially by email or to send him/her a packet containing a letter of interest and some information about yourself. In some cases, you may be able to contact the mentor by going in person to his/her office or lab or by calling them on the telephone.

In an initial contact with a potential mentor, you will want to convey some of the following information about yourself and your research interests:

1) Background information about yourself including your name, address, phone number, email address, your area of research interest, your educational background (for example, course work in biology, chemistry, physics, computer sciences), and any previous research experience. You may find that a simple one-page resume is the best way to organize this information and to make a good impression on the potential mentor. Many mentors also like to see a copy of your academic transcripts.

2) The amount of time you are able to commit to a research project. You should also indicate when this time is and give an idea of what your other weekly commitments are. Often it is helpful to show a potential mentor a copy of your weekly class/work

schedule.

3) What you read about the mentor's research that particularly intrigued you. Also, you will want to identify a general area of the mentor's research you read about that you might like to work on.

4) What your motivation for pursuing a research project is. For example, are you considering a career in research and looking for an opportunity to try it out? Have you learned about a topic in your course work that fascinated you and you want to investigate it in more depth?

Following up on your initial contact with the potential mentor

If the potential mentor you contacted does not respond to your email, phone call, or letter, you will want to contact them again after about one week or so. If you initially e-mailed the mentor, you might want to try sending a letter this time or calling them on the phone. Getting in touch with a mentor often takes several tries. Don't be discouraged if you don't hear back from them immediately or if you cannot reach them right away. Keep trying! Although mentors are extremely busy people, they are almost always happy to talk to undergraduates about their research.

Once you are able to contact the potential mentor, you should ask if they received the information that you sent them about yourself and your research interests, restate your interest in getting involved in a research project and ask if they might be interested in meeting with you to discuss the possibility of your working on a research project with them.

Meeting with a potential mentor

Usually when a potential mentor agrees to meet with you, they are interested in finding out more about you before they make a commitment about acting as your mentor. The potential mentor is probably interested in hearing about your interests in research and in judging your level of motivation and enthusiasm. Be prepared to explain what you hope to get out of a research experience, why you are interested in this mentor's research and what general type of project you are interested in. Be sure to ask the mentor to describe the research projects going on in his/her labs and which projects you might be able to get involved in. Remember that the mentor is an expert in his/her field but that you are only starting in this area. Now is the time to ask the basic questions that you need to understand the project and the science involved. There are also some other important questions you may want to ask a potential mentor. These include:

1) Have you had undergraduates working in your group before? How did it work out? What are some of those undergraduates doing now?

2) Who would directly supervise my work? Possible answers range from the professor to post-doctoral researchers, graduate students, and more experienced undergraduate students. In nearly all cases, you would be assigned a supervisor and not be "on your own".

3) Is there potential to eventually work on my own project? Most mentors will reward hard work, reliability, and acquisition of skills by giving an undergraduate increasing amounts of responsibility and independence.

At some point in this conversation, if you feel this mentor/research project is right for you, you will want to ask him/her if he/she will be your mentor and allow you to work on a project you have discussed. Good luck!

Understanding undergraduate research from a potential mentor's point of view

Faculty have research opportunities for undergraduates BECAUSE they have been successful in obtaining funds for doing research. It is of some importance that you understand the nature of this process, as it greatly affects the way faculty members do business.

To get research funding a researcher writes a proposal to a funding agency, e.g. National Science Foundation, U.S. Department of Agriculture, to build a case for why they have an important and interesting scientific problem and why they, in particular, have the background and insights to make progress on this problem. The latter part demands two things: firstly, they need to show a history of getting science done and the expertise to do the proposed science and, secondly, they need to lay out a research plan that convinces the critical reader that it is highly likely that they will learn something important, even if some of the testable hypotheses happen to be wrong.

It is a truism in science that no one ever "solves" any problem, but instead they change the nature of the problem. That is, any important problem worth funding will not be completely understood in the 2-5 year time frame of a grant (the time frame and the amount of cash depends on the agency and a bit on the nature of the proposal). One might argue, for example, that it is important to understand how a bacterium can grow on cyanide and therefore propose to identify the central proteins(s) for cyanide utilization and find the genes. After several years, when the initial funding is about over, a researcher may have done all that but probably will still not really understand things. For instance, the researcher may have found that there are more proteins and genes involved and it is still not quite understood how the bacterium gets energy, so THESE questions are proposed for the next grant cycle. If, again, things have gone well, then the researcher may next propose a more molecular analysis of specific parts of proteins for the next cycle. Note that we are talking about perhaps 10 years of funding here.

Now all of this process will involve not only the faculty member and undergraduates, but graduate students, post-doctoral fellows (people who have received their PhD degrees and are getting more experience and broadening their backgrounds for application to jobs in academics and industry), and staff scientists, all of whom need to receive support so they can continue the research and whose time-frames almost certainly do not match any specific grant period. As you can see, when one runs a research lab, it is not merely a "nice idea" to renew your grant at the end of every grant period, but it is critical for the people who are supported by that grant (and their families). It is therefore important to everyone in the research group that the group, as well as the individuals, get science done because otherwise there will be no research group in the future. The faculty member is, in essence, responsible for supporting a research "family". When you ask to do undergraduate research, you are seeking to join that family.

Put yourself in the shoes of a faculty member. You have a research group with one or a few funded projects and everyone is working hard to get science done (which is measured by the production of quality publications in peer-reviewed journals). You do not have "extra" piles of money lying about and you and the people in your lab do not have extra time either. Essentially all of their careers depend on how much good science they get done.

Now a bright young undergraduate approaches you and asks to join the lab. What that undergraduate is really saying, certainly without knowing it, is "Will you and the students and staff in your lab, who are trained to do science and whose careers and even livelihood depend on the continued production of good science, take the time to teach me to do some science, too? " Why on earth, when you think about it this way, would anyone say "yes"? Well, there are several important reasons: (i) The only way any of us got into science is because, at some point in our lives, someone said "yes" to us. Most faculty members still remember that. (ii) This IS a university and we therefore owe it to the students, both undergraduate and graduate students, to teach research skills. (iii) Good undergraduate researchers are fun to have around. It is neat to see their interest and excitement at things that the rest of us have long since taken for granted. (iv) Very good undergraduates, with the right mentoring become very valuable members of the research group.

What will cause a faculty member to say "yes" when you ask to join a research group? First, there must be a group member with time to mentor and there must be physical space available. Assuming that these requirements are met, the faculty member will look to see how likely it is that the undergraduate will "pay back" the research group, as well as the individual who spends time training them - by getting things done. The undergrad must be able to learn to do some things and then do them carefully and reliably so that others in the group can trust the results. The faculty member will look for students who are motivated and interested and will have the time to spend so that there is a good chance that they will "pay the group back". A student shows motivation by knowing something about the research when they knock on the door and by displaying enthusiasm. If someone is not enthusiastic about getting in the door, they will probably not be enthusiastic about doing the work. As for "time to spend", there are a couple factors: the amount of time the student can commit per week and the number of semesters

they are likely to be around. In both cases, the longer the better, as it becomes ever more likely that they will become a valuable, trained member of the group. Most faculty will have almost no interest in a student, however bright and motivated, who knocks on the door at the start of the spring semester of their senior year and can commit 10 hours per week. That is enough for the student to learn something, it is true, but not enough time for the student to get anything done. A research group simply cannot afford to make this sort of commitment very often. Therefore the earlier in your undergraduate career that you join a group, the better, especially if you can spend a summer or two, which is absolutely terrific for providing the extended time periods necessary to learn the process of doing science.

Despite the best intentions, a research experience may occasionally just "not work" for you. Be open with your mentor about this and be prepared to fulfill any time commitments you've made. Try to avoid leaving a group on a bad note. Your current mentor may help you identify settings more suited to your interests and skills.

So why do all of this?

If you think that you have any interest in being a scientist at any level, you really must get involved in a research group for the following reasons (in no particular order): (i) A letter of recommendation for you that says "X worked in my lab for Y years. They were conscientious and motivated. They thought about their science and were very careful. They were honest and interacted well with others in the lab. They will be an excellent addition to another research group. " is the sort of thing (perhaps with a few more details!) that will get you a job and/or get you into graduate school. Science is NOT the body of facts that exists in books, but rather is an approach to critically and honestly analyzing the world. If you show you have these traits of a good scientist, then you will be a valuable member of other research groups. (ii) Doing science ought to be an amazing and liberating opportunity. You will rapidly see the extent of human knowledge and have a small but significant part in the long process by which we as scientists gradually understand the world. You will begin to understand the nature of "fact" and how very difficult it is to know things with certainty and how much we need to view the world in terms of "degrees of confidence" about all of our conclusions. This will affect not merely your view of science, but your view of all claims about the world. (iii) You will learn if you like research in the agricultural and life sciences. Indeed, the science you do as an undergraduate in an agricultural and life science research group anywhere on campus is the same as what people do in industrial labs around the country. The specific problem and the specific tools might vary, but the process of science and the interactions among scientists in a research group, are essentially the same. Worldwide , that means, in contrast to so many fields touched on by the University, you really can do "real science" here; in contrast, for example, to the difficulty in doing "real business" here at the UW (you can, of course, play "real music" as a music major, but you are not actually spending much of your time doing the real-world things that a professional musician does to pay the bills). (iv) You'll probably be a better student. In your courses, especially in breadth courses like chemistry and math, it can be tough to see why this information might be valuable, partly because many of these classes are taught as if all the students will major in that field. However, when you spend much time in a research lab, on almost any project, the use and importance of understanding math and physics, and especially chemistry, will become pretty obvious. Moreover, when you are sitting in your organic chemistry lecture, you will see molecules that

will remind you of some that "your organism" makes or uses. This connection is, for many of us, a major reason why we became more interested in the subjects and, of course, therefore became much better students.

Bottom Line:

The time you spend in a research lab will be the most important period of your undergraduate career. If you take charge of your career in this way, it truly will change your life and open doors that you did not know existed. It will change your view of the world, your ability to understand that world and show that you are a unique human being who can contribute in unique ways to the unraveling of the world's puzzles. UW is the absolutely perfect place to do that, as it has one of the largest and best agricultural and life sciences research structures on earth, so the opportunities for undergraduates to become involved in research are without comparison.

Do it!