

The purpose of this document is to be a resource for our majors when deciding whether and when to do undergraduate research and to provide guidelines on how to proceed in order to obtain a fitting undergraduate research position. These research tips have been accumulated in our lectures over the course of the semester.

#### General advice:

- sometimes it's easier to find out if you like research by just trying it out – don't spend all of your time speculating about your options
- what you begin with may be very different from what you end up studying—that is way more common than you might imagine (e.g. Prof. Ginsberg's trajectory, Prof. Ting Xu's 'tree')
- summer research allows you to spend more continuous time on a project than during the semester, so consider trying both out!
- you may not start out PASSIONATE about your research—that comes with time—but you ought to be curious from the outset
- research isn't all about running reactions: you may find you end up building part of an apparatus, doing some plumbing, writing a computer program to analyze data—lots of variety to choose from!
- in undergrad research you do not have to devise your own project, you will not have to work alone, and you are not expected to know everything before you begin (from Abby and Effie's mythbusting)
- why do research: good experience not only to see if you'd enjoy a research career but also in whatever you are applying for next (industrial position, medical school, etc) since you will have to solve problems that do not already have solutions; it can make it easier to understand the importance and application of the basic concepts you learn in classes (Abby and Effie's suggestions)
- timing: a good time to begin is in the summer when you can spend more time getting up to speed on a project (e.g. summer after sophomore year); having contiguous time during the semester is helpful, e.g. two afternoons and one morning each week
- what to look for in a group in addition to the research: find a good mentor—the grad student or postdoc you are paired with can strongly shape your experience
- opportunities off-campus (LBL, REUs—see below) in addition to on campus
- how much research experience is enough to, e.g., apply for graduate programs?
  - Short answer: enough so that you can decide if spending 5+ years doing research is for you!
  - Longer answer: It is helpful to have enough time to complete a project so that you get a good idea of what it entails to go through the entire cycle of beginning from a hypothesis, testing it, revising your approach, analyzing data, and communicating your results. The duration for such a procedure varies widely, and you may not need or get the chance to experience all parts of this process from start to finish. As a rule of thumb, spending at least a year in one lab is helpful to this end, but spending a summer can be as productive as an entire academic year.
- how many different research experiences are enough to apply to graduate programs?
  - Short answer: There's no right or wrong number, but enough so that you can learn what areas of chemistry you would like to (or hate to) further pursue!
  - Longer answer: When you apply to graduate programs, you will need to ask three people to write you letters of recommendation. While you might expect these letters to come from professors who taught you in a particular course, for graduate school, the selection committee will also be interested to learn about your research ability from some of the letters. It is important that one of your three letter writers is a research advisor who can describe your research experience, and it can be a bonus if there is more than one. That said, it is important to balance between breadth and depth of experience! If you really enjoy working in a single lab during your time at Cal, your research advisor will be able to write a valuable letter. If you would also like to learn about a different research topic, you might consider working on another lab, or you might consider spending a summer elsewhere doing research (see below).

To find out what types of chemistry research you might like best:

- go to seminars by researchers invited to Cal from around the world ! (check out Seminars & Events at <http://chemistry.berkeley.edu/> for the schedule, and keep your eyes out for free coffee and snacks before the seminar...)
- go to shorter (~20 min) research seminars given by Cal grad students: check out the "Graduate Research Conference" and the "Graduate Research Seminar" on Thursdays at 4 pm and 11 am, respectively
- ask your lab GSIs what groups to research similar to a lab you particularly enjoyed
- try taking a lab class as soon as you've finished the prerequisites—e.g. Chem 105 (Analytical), Chem 108 (Inorganic), Chem 115 (Organic), Chem 125 (Physical)
- attend our College's Annual Undergraduate Research Fair (Poster Session) in April to learn what fellow students are researching

How to get involved:

- investigate different research groups based on which sorts of labs you've enjoyed in your lab classes
- you can find listings of the labs in Chemistry by subfield on the department website (sometimes the faculty bios are out of date, but each bio has a link to the corresponding research group webpage)
- take a look at a few individual research group webpages—in particular look at the research descriptions and the publications for keywords; you may also find that one of your GSIs or upperclassmen/women are in that lab
- if the webpage seems like it might be out of date, you can find the latest publications for the professor by searching Google Scholar: for example at <http://scholar.google.com>, use search term *author:"ns ginsberg"* to find Prof. Ginsberg's complete up-to-date publication list, with options to restrict the search to most recent years
- once you have identified a few groups that interest you, make contact with either or all of the professor, the grad students, or the undergrads already in the group
  - professors can be hard to reach because they are juggling many different responsibilities at once, so exercise polite persistence by continuing to either email or show up at the start/end of their lectures or at their office unless they tell you they do not have a position for you
  - asking a current or former GSI if they are looking for an undergraduate researcher can be easier if you know of one who works in a lab you are interested in; you can also knock on the door of a lab you are interested in and politely ask for a tour and about research opportunities
  - when emailing or directly addressing a professor, be brief and direct about your intentions, your experience, your interest, and your qualifications—remember that professors are looking for signs that you are able to resourcefully solve problems, whether or not you have previous research experience (e.g. experimental cooking, fixing broken gadgets around your house could each count!)
  - if you are sending an email to a professor, summarize your information in the body of the email, and consider listing relevant courses that you've taken (you can attach a résumé/CV and unofficial transcript if you wish, but they most important information should be in the body of the message)
  - in your communication, do not apologize for what you have not yet done—focus (creatively) on what you have to offer!!
- you may want to contact multiple groups at once since not all groups will have a position available at any given time; above all, be persistent!
- for summer research, consider beginning to make contact by the middle of the spring semester
- look out for student groups on campus that focus on topical areas of interest to you e.g., if you are interested in renewable energy, you could attend BEREC (Berkeley Energy and Resources Collaborative) meetings: <http://berc.berkeley.edu/> to make contact with people involved in energy-related research instead of going through a professor or GSI

What to expect:

- research is cyclic, meaning you will often repeat the process of discussing/defining goals, reading protocols or literature to design an experiment, executing the experiment, evaluating the results, and repeating these steps until it is properly executed
- you will be trying things that have not necessarily been tried before and also learning things that are not yet in textbooks—it can take some getting used to compared to homework and lab reports, but it is often exciting to be on the cutting edge!
- if your research doesn't initially seem like a good match, stick with it for at least a semester so that you have a chance to see it deeply enough to decide what is not a good match; it's possible that you will enjoy it once you get to know it better, but if you decide it is not for you, there is nothing wrong with learning what you don't like and trying something else next

## The academic track:

Undergrad (4 years) → graduate school (5-6 years) → postdoctoral studies (2-3 years) → professorship

## Seminar:

"Intro to experimental design in chemistry" Mon 7-8 pm, Library Room F

Programs with research opportunities beyond the College of Chemistry (school year and summer!):

A webpage dedicated to undergraduate research at UC Berkeley run by the Office of Undergraduate Research and Scholarships (OURS):

<http://research.berkeley.edu/>

- Many resources and tips on the campus, plus a listing of events related to finding research opportunities
- Click on "Opportunities" in the menu to search listings for positions and programs
- OURS administers:
  - [Undergraduate Research Apprentice Program \(URAP\)](#) (earn money for doing research)
  - [Summer Undergraduate Research Fellowships \(SURF L&S and SURF/Rose Hills\)](#) (earn more money for doing research)
  - [Haas Scholars Program](#) (earn even more money for doing research)
  - [Berkeley Undergraduate Journal](#) (research articles by undergrads for undergrads)

Opportunities to do undergrad research at Lawrence Berkeley Lab, just up the hill from campus:

<http://education.lbl.gov/Programs/undergraduate.html>

(be sure to check out the diverse research areas of this national lab: <http://www.lbl.gov/>, especially the "Molecular Foundry" <http://foundry.lbl.gov/> )

## Summer research programs

- At National labs around the country, including Lawrence Berkeley Lab and [Sandia National Lab](#) (Livermore) :  
Science Undergraduate Laboratory Internships (SULI) <http://science.energy.gov/wdts/suli/>
- At universities and colleges around the country, alongside a group of undergrads from around the country:  
Research Experience for Undergraduates program from the National Science Foundation  
[http://www.nsf.gov/crssprgm/reu/list\\_result.jsp?unitid=5048](http://www.nsf.gov/crssprgm/reu/list_result.jsp?unitid=5048)