

BME Undergraduate Research Guide

Department Diversity Initiative, Pipeline Committee
UNC/NCSU Joint Dept. of Biomedical Engineering

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How to Find Research

What does it mean to research as an undergrad?

Contrary to popular belief, scientific progress and medical breakthroughs are not just the turf of esteemed professors or Nobel Prize winners. In reality, the research process is an ongoing endeavor involving people of all ages and backgrounds -including undergraduate students!

By participating in undergraduate research, you can not only contribute to our greater scientific knowledge but also learn hands-on technical skills and demonstrate your strong work ethic to future employers.

Learn technical skills

Taking classes can introduce you to different technologies, but nothing gives you more confidence and credibility than hands-on experience. Instead of just reading or learning about cutting-edge fields, you can gain firsthand experience in these fields.

What careers ask for this? Research experience is valued in a wide variety of career paths. Graduate schools and research organizations (e.g. national labs, or the FDA) will most obviously value your academic experience, but private industry will also recognize your endeavors. Many Biomedical Engineering-related companies also perform in-house research for product development (“R&D”), as well as other research-related functions like quality engineering; your skills and experience will be just as useful in the private sector. Even if you don’t continue a career in research, employers could prioritize your resume because of your experience in specific fields or technologies. Research labs looking for graduate researchers may also ask for people with experience in certain technical fields or experimental methods.

Why should I care about this? Practical experience makes you competitive in any career area in two ways: it adds credibility when you show interest in a specific company, school, or technological field, and it demonstrates that you have the words, skills, and knowledge to dive into the weeds of nuanced, technical topics. Even if you don’t become a professional in the field of your undergrad research, your technical knowledge and skills in problem-solving and critical thinking could help you in unexpected moments.

Demonstrate work ethic

The world after college doesn’t have answer keys, and it frowns upon flaky people who can’t handle their fair share of work. Your experience as a researcher can show that you can ask thoughtful questions and solve problems in a team environment.

What careers ask for this? All job positions (academic, industry, and elsewhere) want to make sure their new hires are reliable and don’t back down from a difficult task. The

expectations of a medical student and a consultant may be different, but most employers appreciate a track record of initiative, adaptability, and consistency.

Why should I care about this? Research projects have unknown timelines, ever-changing goals, and are difficult to continue without drive and motivation. These are important skills in work and elsewhere in life, but it's difficult to demonstrate. Experience in undergraduate research, however, can be a compelling way to do just that.

How do I get into research?

How do I find labs?

University research laboratories (labs), led by faculty members, run individual research projects. Labs can announce existing projects and search for researchers, or create a research position just for you. There's several ways to find labs, such as:

- Types of Research in BME bme.unc.edu/research-overview/
- BME Faculty bme.unc.edu/home/people/primary-faculty/
- BME-Affiliated Faculty bme.unc.edu/home/people/primary-faculty/
- NCSU Department of Undergraduate Research undergradresearch.dasa.ncsu.edu
- UNC Office of Undergraduate Research our.unc.edu

Most labs have simple websites linked to the leading faculty member's profile on their department's website. However, these websites widely vary in quality and accuracy. These websites can give you an idea of the types of work they do, but information may be vague, outdated, or even missing.

How do I learn more about labs?

Once you find labs that spark your interest, you can get a better feel for their works by reading **publications** written by the leading faculty member (or their graduate students).

You can go to your university's library website or Google Scholar, and put the professor or student's surname. If they have a common last name, you could add their first name or a keyword that describes their area of research.

A paper's header usually lists the affiliations of each author. Once you verify that the paper is written by the author(s) you're looking for, you can read the paper to have a better idea of what the lab recently accomplished and showed to the world.

Google Scholar search results for "keita yokoyama".

Articles About 2,580 results (0.03 sec)


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Keita A. Yokoyama - Verified email at unc.edu - Cited by 3

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 L Patey, **K Yokoyama** - Advances in Mathematics, 2018 - Elsevier
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An example of a poor Google Scholar search result for Keita Yokoyama, a UNC-based student and one of the authors of this guide. Rather than any of his works, the query shows papers by a mathematician with the same name. However, you can still find the “correct” Keita in the 2nd result under “User Profiles”.

Usually, the faculty member is listed on all publications done within their lab by their graduate students or post-docs. Many papers list authors in order of their contributions; faculty members are often listed as the final author, or “**senior author**”.

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A Platform for Rehabilitation of Finger Individuation in Children with Hemiplegic Cerebral Palsy

Publisher: IEEE [Cite This] [PDF]

James V. McCall ; Miranda C. Ludovice ; Jared A. Blaylock ; Derek G. Kamper **All Authors**

241 Full Text Views

Abstract:
 The brain injury that results in cerebral palsy (CP) may adversely affect fine motor control of the hand. The degradation of manual dexterity in the fingers profoundly impacts overall functionality of the upper limb, yet research efforts to facilitate rehabilitation of finger individuation in children with CP have been limited. This study describes the development of an integrated hardware and software platform for training and evaluating finger individuation. A pneumatically actuated glove provides extension assistance or flexion resistance independently to each digit in concert with playing a virtual reality keyboard. This setup enables intensive and efficient practice of fine motor control of either or both hands. Bimanual training options range from mirror movements to fully independent motions and rhythms in each hand, thereby enabling maintenance of the proper level of challenge. Additionally, an instrument was created to provide assessment of individuated fingertip force generation in order to evaluate effectiveness of the training.

Document Sections

- I. Introduction
- II. Methods – Finger Force
- III. Preliminary Data
- IV. Discussion
- V. Conclusions

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 2017 International Conference on Virtual Rehabilitation (ICVR)
 Published: 2017

Virtual reality treatment for complicated mild traumatic brain injury: A case study
 2017 International Conference on Virtual Rehabilitation (ICVR)
 Published: 2017

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An example of a journal article. The middle of this webpage lists the authors, including Miranda Ludovice, one of the authors of this guide. The senior author for this paper, then, would be Dr. Derek Kamper.

How do I find research positions?

The best way is to reach out to faculty doing research that catches your eyes. Since the job of academic researchers is to train students how to research and work as a scientist, research faculty are often happy to welcome undergrads into their labs as long as they have the time and means to do so.

Contacting faculty is better than using university resources because:

1. The research positions on university databases may not be up-to-date
2. Many labs don't post their latest, most relevant research positions on university databases -if they post it anywhere at all
3. A position may not exist in a lab at all; the lab may simply welcome undergrads on-demand, and not have a formal process of doing so

For more details, jump to the section on [getting a research position](#) or writing emails to faculty.

Who works in a lab?

University research labs are run by a research faculty member. This person is called the **principal investigator (PI)** of the lab. PIs may or may not have the title of “professor”, which is more of an academic job title.

The PI drives the overall direction of the lab and provides guidance for graduate students or other researchers working there. PIs may also apply for grants or other funding opportunities to pay for the research happening in their lab. Funding is especially important, since academic research units are usually expected to be self-financed; a lab usually funds itself, and doesn't rely on money directly from a university.

Postdocs, Lab Managers, and Lab Technicians

Depending on the lab, PIs may also hire two types of workers:

Postdoctoral researchers (postdocs) already hold a doctoral degree, but are working under another faculty member. PhDs who want to work in academia have **fellowships** that fund their research as they work towards running their own labs.

Lab managers are professional researchers or technicians. They assist the PI in managing a lab's research and researchers. Not all labs have lab managers, and labs that have them may confer different responsibilities to them. If someone is working in a lab with a similar arrangement but does not act as a supervisor, they may be called a **lab technician**.

Graduate Students

PIs in research universities advise a small number of **graduate students**. Grad students are often responsible for doing the actual experiments that form the backbone of a lab.

Grad students have already received their Bachelor's degrees. They're working toward at least one of two types of degrees: a master's degree or a doctoral degree.

Master's degrees are awarded to students who have achieved *mastery* on a specific subject. Depending on the program, master's programs may or may not require a student to write a **thesis** in the end to demonstrate their knowledge.

Typically, a masters student in a "thesis track" program will perform research in addition to taking graduate-level courses. They may publish papers and present in conferences, and will write a final thesis to earn their degrees. Most non-thesis-track students only take classes and do not work in labs, though it may depend on the school and student.

Doctorates in philosophy (PhDs) are awarded to students who contribute entirely new knowledge to a specific field. Doctoral students may be working on a PhD, or another doctoral degree such as an MD (Medical Doctorate). Although grad schools in many countries require PhD students to have a master's beforehand, many programs in the United States (including our department) now admit students after they receive their bachelor's degrees.

After completing their course requirements, they must finish by writing a **dissertation**, a long publication about a series of experiments that come together to explain a certain topic or research question. Since doctoral degrees are inherently about research, these are the most common graduate students in laboratories.

Master's degrees tend to take one to three years to complete, while doctoral degrees take from four to six years to complete. For this reason, doctoral students will be around one lab for much longer than masters students.

Undergrads and Volunteers

Students interested in grad school or a research career may want to take part in undergraduate research. These students are ultimately managed by a lab's PI, but may often be supervised by a grad student.

Some labs may be highly structured with a clear recruitment path and expectations for undergrads, while others may be much more informal. Undergrads, depending on the university and how they arrived at their positions, may be a:

- **Volunteer:** a student is freely working in the lab
- **Student Employee:** a student is employed by the lab
- **Researcher-for-Credit:** a student is taking a "course" that allows their research to count as a part of their degree requirements

For more information about student-employee researchers, check out the section on [getting paid as a researcher](#).

Keep in mind that, while the faculty member is in charge of recruiting undergraduates, graduate students are usually doing the bulk of the research. Some faculty members may assign a smaller individual research project to each undergraduate, while others may simply assign them to help a graduate student.

Occasionally, high school students may also participate in research as a part of an enrichment curriculum or summer program. Their responsibilities would be similar to an undergrad working in the lab for credit, though they may be much more supervised by a faculty member, lab manager, or grad student.

How do I get a research position?

This section assumes you've already read the section on [getting into the research world](#).

The easiest way to get into a lab is to speak to a faculty member, and the best way to do this is to send them an email, and schedule a meeting to talk about their research.

Tips on “Let’s Talk” emails

Lab PIs and other faculty members know that your request to “talk about research” will eventually lead to *some* sort of request. Still, it’s helpful to start your conversation this way so they know you are genuinely interested in their work and you seriously want to be a part of it.

Research faculty can get lots of these emails (and emails in general), so it’s easy to get lost in the noise. Here are some tips to help you make your point, stand out from the crowd, and make it more likely for them to respond):

- **Use your school email, and not a personal address.** Emails from outside domains like @gmail.com may be blocked or ignored for various reasons. Plus, your university address may make it easier for the faculty member to quickly learn more about you.
- **Keep your writing short and sweet.** A multi-paragraph essay may not be the best way to convince a stranger to give you their time of day. How can you quickly summarize your story, or why you’re interested in working with a specific researcher? Consider making your email easy to skim, and;
- **Use your subject line as a one-phrase summary of why you’re writing.** This will give the faculty member an idea of what you want and, as you’re writing your email, remind you to stay on topic.
- **Mention relevant experiences.** Include any relevant classes you’ve taken, similar volunteer or work experiences, or independent projects you’ve tackled in your free time. Even if those past accomplishments are not exactly the same as the research, it will show that you know what you are getting yourself into. Of course, you should not be expected to have tons of experience under your belt, but the faculty member will appreciate that you’ve started *somewhere*.

- **Personalize your email to your recipient.** Mention why you're interested in the faculty member's lab or research area. Beyond sounding genuine and passionate, this can help your recipient stay organized if they hold multiple positions in different labs/institutions.
- **Be flexible;** allow for plenty of time to get a response, but understand that you may need to send multiple emails to get through. If you already have a working relationship with this faculty member, you could directly schedule a time with them. For instance, if you are taking a class taught by a professor, you could use their already established office hours to talk to them about research (assuming you're not getting in the way of students wanting to ask them class-related questions). However, a dedicated meeting to specifically discuss research may still be ideal.
- **Be patient;** don't expect research conversations to happen overnight. Faculty and graduate students are often busy and may not have a lot of free time to meet with you. Don't take it personally if you don't get a prompt response or do not hear back after a meeting. After a week, you may want to send another email or stop by their office hours.

If you'd like additional support for writing emails, the writing centers at [UNC](#) and [NCSU](#) exist just for this purpose! Also, check out the section on email templates.

What if I don't get a position?

A lab that you want to get into may simply not be able to accept you -and this may not be your fault. This can happen if a lab does not have enough people to advise undergrads, if a lab does not have any research projects that can be performed by undergrads etc. This may be a good opportunity to explore (or ask the PI) to see if other labs are also conducting similar research.

If you're still interested in the lab, you could also ask if you can visit lab meetings to learn more about its research. Not all labs may be comfortable with this, but if they are and an appropriate opportunity opens up, someone in the lab may remember your interest in the lab and ask for your help. This approach could help you, too, since you'd already be familiar with the lab's research so you can hit the ground running!

What happens after I get a position?

Many students start as volunteer researchers or work for research credit hours. This is a great way to get to know a lab with minimal commitment. The lab also does not need to find money to fund you, so a lab may have an easier time making space for you.

It's possible to start off with a paid position, depending on the lab! However, you may need to work your way up to such an arrangement. The arrangement of a part-time research job like your hourly rate will also depend on the lab.

What sort of work will I do?

The work you will do will vary depending on the research interests of a lab. Some labs prefer that students write code, run computational simulations, and analyze data, while others encourage students to conduct more hands-on experiments.

Unlike in school or established businesses, you may not have a clear assignment. Research changes from day to day, and researchers learn what to do as they go. It is unlikely that someone will hold your hand or tell you exactly how to do something. If you want to go into research, teaching yourself how to do things is essential. Don't be afraid to ask for help if you need it, but make sure to put in some effort into solving it yourself. If you want to learn a specific technique or skills, ask a lab member to schedule a time when they can demonstrate the skill to you. This may be required in order to use certain equipment. You may want to ask for sample data or ask someone to watch you demonstrate a skill before you try by yourself. Certain skills or techniques may require someone else in the lab or be present for you to use them. Make sure to clarify all rules or traditions. You may also want to make your own instructions list or ask someone to write one for you. You may also want to ask the person showing you how to do something if you can film or audio record them for you to follow later.

What will be expected of me?

While you may report to several people in “big” roles, as an undergrad researcher, you will still be a critical part of academic research with unique expectations. Although different PIs and different labs may have different ideas, many research labs may foresee or hope that you can do the following through your research experience:

Be curious, even if you aren't yet an expert in your topic. Unlike grad students, undergrad researchers are not yet expected to be familiar with the topic of their research. This means you'll be expected to learn more about your research over the course of your work, and motivate yourself to keep putting one foot in front of the other. This could take on many forms like asking questions and presenting in lab meetings, or reading papers from the lab so you can learn more about their techniques.

Be available and responsive. Make sure you clarify with your professor and grad student about when you'll work in the lab, and that you are easily accessible during those times. Be responsive to text, email, Slack, or whatever else the lab uses to communicate. Research plans shift frequently based on availability of equipment, specimens, and deadlines so you want to make sure that you don't hinder someone else's research by not being responsive.

Clearly communicate your needs and capabilities. Grad students and PIs can find it especially helpful if you can provide clear expectations about your work. This can include estimates of what you can get done and when they may be complete, whether you need more time or data, or concerns and opinions about the data you may work with.

Be in charge of your own work or trajectory. If you want to learn something new or get a publication, it's your job to make sure you get there. It is very common for motivated undergrads to lead their own small projects once they've been in the lab a couple of semesters. Many labs

will not monitor how often you work or what you get done; it's expected that you get your work done well and in a timely manner. If you're not sure what you need to know, ask. Find places where you can help with any project. Be willing to try new things even if you don't know what you're doing.

Participate as a teammate, and keep in mind the bigger picture. For example, your research may be central to another student's degree, so the success of others' work may depend on yours. On top of clear expectations for your work, clear communication can be important. This can take the form of organized lab notebooks, proper code commenting, and reliable interpretation of your experimental data by others.

How do I get out of research?

Whether it's planned or not, you will have a day when you leave your position as an undergraduate researcher. However, for a variety of reasons, your departure may not be as simple as continuing to work until the last day and simply disappearing from the lab's doors. Here, we will consider what is the best time and way for you to close the curtains on your undergraduate research assistantship.

When should I consider leaving my lab?

You realize you're more passionate about a different research field. Perhaps you've finished a year of work in a lab, but you learned that you are much more passionate about a different technology beyond the scope of your lab. This is okay; PIs and grad students should expect undergrads to wander and explore to find their passions. If this describes you and you're becoming interested in a different lab, it may be worthwhile to take that thought seriously.

Your schoolwork needs to take center stage. Whether it's because of a personal health issue (physical or mental), a family emergency, or something else entirely, life may hit you and demand your full, undivided attention. In these situations, it's important to remember that you are, first and foremost, a college student; the last thing you want is for your extracurriculars to be a distraction to your studies. Depending on what challenges you are facing, pausing your research endeavors could be the most responsible decision.

You're having professional problems in the lab. There may be times you feel disrespected by a mentoring grad student or PI. If this continues to the point that you feel actively unsafe and unable to do your best work, we urge you to talk to your department advisor, another mentor you trust, or the *impartial and confidential* Ombuds Office ([UNC](#) / [NCSU](#)). Depending on your situation, the best way for you to work safely with dignity may be to leave your lab.

You're leaving the university. Maybe you're graduating, transferring, or dropping out. Either way, if you are leaving your home university, you may need to follow specific rules and procedures so that you don't cause any awkwardness in the lab or potential issues with lab safety and data privacy.

Does it “look bad” if I switch between labs?

Not necessarily! Undergrads are expected to learn about their fields of interest. If you join one lab but realize that your skills are better used in a different lab (or you find a new passion, otherwise need to switch labs etc.), those are important decisions that should be respected.

Whether you’re going into academia or industry, we believe you’ll gain much more from your research by feeling safe in your environment and being as engaged as you can in your work.

How to switch labs

If you want to switch to a different lab, it’s best to treat it like you are switching to a different line of work (rather than hopping over to a rival company). The general tips laid out in [the section on getting a research position](#) will all still apply to you. However, you could choose to bring up your past research experience -and bring up how it awakened your newfound interest outside of your current lab’s expertise.

How can I get paid to do research?

If you receive [Work-Study](#) as a part of your federal financial aid, you may be able to conduct research as a work-study job. Requirements are listed in Office of Undergraduate Research websites for [UNC](#) as well as [NCSU](#).

Here are some other starting points for what organization could help fund your research:

The Joint Department

The Joint Department offers two competitive processes where undergrads can be paid to conduct research for one year. These are:

- [Lucas Scholar Fellowship](#)
- [Abrams Scholarship Program](#)

Your Home University

UNC and NCSU both offer financial support for undergraduate research as a university. Some programs, though, may place restrictions on how the funds can be used.

- [Several UNC-specific funding opportunities](#)
- [NCSU OUR project-specific funding](#)
- [NCSU Comparative Medicine Institute](#)

Federal Government of the United States

Several federal agencies also offer funding opportunities specifically for undergrads. The most well-known of these within the Joint Department are:

- [NSF Research Experiences for Undergraduates \(REU\) Grants](#)
- [NIH opportunities for funding undergrad research](#)

Private Organizations

Third-party organizations outside of the umbrella of the university or federal government may also offer funds for undergrad research. Note that some faculty members may be wary of private funding due to conflict-of-interest issues. Assuming you are eligible, you should talk to your research advisor if you'd like to pursue these funds.

- [External funding sources recognized by UNC](#)
- [External funding sources recognized by NCSU](#)

Co-Ops

In cooperative education (**co-op**) programs, students alternate each semester between taking classes and working for a full-time job position.

While universities like Georgia Tech or Northeastern offer robust co-op programs where students can gain experience in industry or research positions for pay *and* course credit, NCSU is still developing its implementation (and UNC does not formally offer it at all). You should consult your department advisor or [NC State's Career Development Center](#) for more information.

Should you decide that a co-op is a good option for you, several research facilities offer co-op opportunities including the NIEHS, Sandia National Laboratory and other Department of Energy national labs, and the FDA headquarters in Bethesda, MD. Some corporate employers, both local and multinational, may offer co-ops and internships with research components.