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## How-to: Undergraduate Research

Melissa Lee  
mlee48@utk.edu

Franco S. D'Aprile  
*University of Tennessee - Knoxville*, fradapr@utk.edu

Sahba Seddighi  
sseddigh@utk.edu

Alexander Lee Houck  
ahouck@utk.edu

Evan Ford  
eford6@utk.edu

*See next page for additional authors*

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## How-to: Undergraduate Research

### Authors

Melissa Lee, Franco S. D'Aprile, Sahba Seddighi, Alexander Lee Houck, Evan Ford, and Kristen Lynn Beard

# How-to: Undergraduate Research

The *Pursuit* Editorial Board

Here at *Pursuit*, we know the value of undergraduate research and believe it to be a vital component of a complete undergraduate education. But, we know that research can seem like a scary thing—something that overachievers in the sciences do as they are approaching their senior years and thesis deadlines. We want to change that. In the next few pages, you will find a guide, composed by the editors here at *Pursuit*, to finding and pursuing many of the different types of undergraduate research.

Research is an act of creation; we take what already exists in each of our respective fields, and we use it to make something new—whether that be a paper or a data set or an art installation. We think everyone should get to be a part of it. We have just two general rules for every undergraduate researcher:

- 1. Never underestimate your inability.** You're going to make stupid, careless mistakes. You're probably going to make a lot of them. Try to predict them, and introduce safeguards to minimize their negative effects. Find the organizational style that works for you and stick with it. Color-code. Label everything. Write it all down. Make back-up copies. Don't try to just rely on your own memory.  
And, even with all these safeguards, you're bound to slip up—everyone does. Don't let it get you down. Remember that if you can learn from it, you've done what you, as a student, are supposed to be doing.
- 2. Never underestimate your ability.** All that said, don't ever let anyone—not even yourself—think of you as “just an undergraduate.” Sure you may start out washing lab dishes or looking up references for a graduate student or a professor, but show that you are dedicated and eager to learn more, and you will be able to do just that. We all start at the bottom. Don't give yourself an excuse to stay there. Each and every article published in *Pursuit* is a testament to all that you can accomplish as “just an undergraduate.”  
If that sounds like something you might want to do, we encourage you to keep reading for more specific guides on how to find and participate in certain kinds of research.

## Creative Activity as Undergraduate Research

Evan Ford, Research Editor

One of the primary goals of *Pursuit* as an undergraduate research journal is to expand students' understanding of what research is. The common stereotype of a scholarly project conjures up images of lab coats and pipettes—a scientist slaving away to discover the latest medical or technological breakthrough. While we are correct to admire this type of project, the scope of *Pursuit* reaches far beyond the traditional methods of research into the creative fields. We strongly believe that the work of creators and the work of scientists should be equally commended and supported.

Artistic creation, like research, is an arduous and intensive process. Unfortunately, the resources that universities expend are often more directed towards scientific and analytical research. This imbalance is pronounced at public research universities like the University of Tennessee, and creative students can often feel like their artistic pursuits are hobbies, disconnected from their lives as university students. The university is trying to remedy this problem, and in this short editorial, I will add my small contribution to this cause in the form of unsolicited advice. So here are a few lessons I've learned in my time as a creative student.

1. **Be confident in your creativity.** For my first two years at UT, I was a closeted creative. When professors and peers would ask me what I did, I would reply, often sheepishly, "I play music." I hesitated to identify myself as a musician, or a composer, or anything other than a student who "just happened" to be creative.

At first, this hesitancy can seem humble, even polite—labeling yourself a musician or a poet puts you on the same level as Bach and Whitman. Gradually, though, I realized that my hesitancy was rooted in cowardice, not humility. If a "student who plays music" fails to practice for a few days, that's no big deal. If a "musician" skips a few days, you question whether she's a musician at all. If you leave yourself an excuse not to take your craft seriously, you will use that excuse. Your professors will only take you as seriously as you take yourself.

2. **Give yourself space.** Education is, in a way, non-creative. Most classes are trying to get you to learn something—to *internalize* the beliefs and methods of someone else. Creation, on the other hand, is a process of *externalization* and expression. Sometimes these modes can coexist—when things are coming easy. At other times, you need plenty of space and time to fully process and transition to creation after being a student all day.

Perhaps the only advice I have for making this process easier is starting early. I don't mean waking up at sunrise and cooking eggs, I mean starting the creative process early in your day, whenever that begins. Instead of dozing off in composition class or at work, allow your mind to wander to that story you started over coffee. This turns the mundane day into an input in your creative process, rather than an obstacle.

3. **Make your own rules.** I was tempted to write 'break the rules,' but that's better in theory than practice. The greatest creators often broke "the" rules but followed their own. Stephen King writes for hours every day, Robert Frost viewed writing as capturing and honing fits of inspiration. Some slave meticulously over each creation, others hardly edit at all.

The point of this advice is not just to "do your own thing"—it's also to *learn what your thing is*. Improving your methods and routines can be just as valuable for improving your creative output as honing the craft itself.

As an associate editor for an undergraduate research journal, I recognize the difficulty of taking creative advice from this sort of source. As much as we may want to, *Pursuit* cannot publish a cello recital, or a stage performance (though there are plenty of places to do that on and off campus). We can, however, acknowledge the strong ties between the endeavors of researchers and artists. We can soften the barriers between art, science, and the humanities. We can acknowledge each of these fields as avenues for the same uniquely human desire: the love—and pursuit—of knowledge.

## Undergraduate Research in the Humanities

Kristen Beard, Guest Editor

Humanities research is like a conversation that takes place through academic articles and books. The typical humanities research project consists of one person “listening in on” a conversation by reading and then eventually offering an idea they think will advance it in some important way. Many different types of contributions can advance a dialog in humanities. Examples include argumentative essays, such as a criticism or defense of an established view; creative works, such as short stories or poems; and reference materials, such as a translation of a historical text or glossary of technical terms.

The primary goal of undergraduate research is to tailor your learning to your specific interests, while acquiring useful skills and background knowledge. Especially in humanities, undergraduates need not be overly concerned with making novel contributions to their field. The value of undergraduate research resides more in the process of designing and conducting a project rather than the final contribution that one makes to the field.

To get started, find the conversations that relate to your interests and read a lot of them. Think about what you enjoy reading, looking at, listening to, and thinking and writing about. Don't feel like you need to limit yourself to the topics you've encountered in school; most things that have a significant role in human life can find relevance somewhere in humanities research.

How to match your interests to a research topic:

1. **Use the Internet.** I probably don't need to say this, but Google and Wikipedia are great for learning about a lot of general topics quickly. They are a good first step to narrowing down the academic topics that might relate to your interests. A preliminary exploration of general topics can save you a lot of time when searching databases and discussing your interests with professors.
2. **Go to your librarians.** For each academic field there is at least one librarian who specializes in it and whose job is to help students find research materials. At the University of Tennessee, Hodges Library has a room in the Commons dedicated solely to assisting undergraduates in their research. The library website provides more information on these resources.
3. **Go to your professors.** To find professors, you can either talk to your professors from class or browse the faculty pages on departmental websites; the latter lists the research interests of all faculty. Professors are typically very happy to help students who want to learn more about research, especially when their interests coincide with the professor's own; just politely request a meeting, advice, or suggestions through email.
4. **Read the references.** Most documents reference others on similar topics, so it should be simple to locate further material once you find one or two interesting pieces of reading.

After exploring your interests and reading some of the surrounding dialog, you can then design a research project. The best way to do this is by talking to a professor. In general, the more you can seek the advice and mentorship of your professors, the better your research will be as an undergraduate. One particularly convenient way to begin a research project is to start from a paper or project done in class. If a topic sparks your interest, ask your professor how you could take the assignment further and make it into a research project.

The last step in doing research is to present and publish your work. There are many benefits to the process of doing so, including the development of skills in communication, networking, and more that will prove useful in any professional environment. There are numerous opportunities to do so at UT and through other universities, many of which can be found on the website for UT Office of Undergraduate Research.

It is difficult to overstate the benefits of doing research as an undergraduate in humanities, and, as such, graduate schools strongly prefer candidates with research experience to those without. This being said, undergraduate research is first and foremost about exploring topics for which you have a passion and engaging with them deeply.

## **Undergraduate Research in the Social Sciences**

Franco D'Aprile, Managing Editor

Almost everyone in the social sciences has been in that awkward situation that plagues most of us as undergraduates—you attend an information session about making the most out of your undergraduate career or you are simply having dinner with your friends and they start talking about undergraduate research. In your head you say, “Not this again!” The speaker says that undergraduate research is vital to having a successful undergraduate career. They pull a student who works in a lab researching fish mating habits as an example. Your friends talk about research in labs or interning at hospitals, and you just sit there and think, “Is there a lab for sociology research? Maybe we can dissect books there.” There you are, wondering if you have failed in your academic endeavors and what you can do to change things.

Well, I’m happy to let you know that there is no reason to worry. There are plenty of research opportunities out there for students in the social sciences, ranging from going out on field studies, to partaking in independent studies, to working as a research assistant.

First and foremost, though, the basics must be covered—you must know your research interests. While this may be unclear to you at the onset, you can use Google to narrow down your potential research fields. Read news articles about your field and sign up for emails from prominent journals in your field to figure out what excites you. This is one of the most interesting parts of research—finding the areas within your field of study that match your specific interests.

The next hurdle is trying to find a professor in your university who focuses on a similar field of study. This may not be a possibility—there’s a chance there may not be someone with the exact same research goals as you. But, remember that research interests change, and often all it takes to care more about a topic is to learn more about it.

Once you identify a possible research mentor, the next step is to contact them, introducing yourself and your background and asking them if they are willing to help you with your undergraduate research. Inevitably, some professors you contact will refuse or, more likely, ignore you, so it is best to contact several. You may not have a specific research plan in mind, but there's a good chance that you will find someone who will be willing to work with you to develop something. Here, the possibilities really are endless.

Research in the social sciences can have many different formats. Depending on the field and the department you are working for, this can vary greatly. In some departments, you may take part in fieldwork that involves traveling. In others, you may spend time looking for specific texts to support a work you or your research supervisor is writing. Sometimes, you may be collecting data and fact-finding to add to an existing project. To get the best idea of what you may actually want to do, talk with other people in your discipline who are involved in research. This should give you an idea of what the possibilities are for specific research activities.

While undergraduate research opportunities in the social sciences may not be as obvious as those in the natural sciences, getting involved is really just as easy. There are just three necessary steps that you need to take: discover your interests within your field, find people who conduct research related to these interests, and, finally, contact as many professors as you can. If done correctly, finding undergraduate research in the social sciences does not have to be a scary thing; rather, it can be the start of one of the most rewarding experiences of your college career—expanding your academic horizons and making the most of your time as an undergraduate.

## **Undergraduate Research in the Natural Sciences**

Alex Houck, Research Editor

'Research' can be a daunting word for many college students in the natural sciences. Fresh out of high school, many young students in the natural sciences already have an idea of what they want to do in life, and it often includes pursuing a graduate or medical degree. If they've done looked into the graduate application process at all, then they know that an undergraduate research experience could be critical to their success. Many others, still, have no idea of what they want to do in life. Undergraduate research can be important in helping them figure that out, too.

I want to interject and stress right here—start your research as soon as you can. Yes, your class and work schedule might be completely booked, and you might not want to overload yourself, but the date that you begin research can make a big impression. So, even if you only have the time to work in a lab two hours a week during your first year, do it. You may not accomplish very much technically, but once you get into the swing of things, you will have the history and the feel to really begin to intellectually and technically contribute to your lab's work. When you apply to graduate school, do you want your application to show three years of research or three months? It's a no-brainer.

Research in the natural sciences is vast and varied. You may begin by washing dishes for more experienced labmates. You may be given a project right off the bat. You may assist

in someone else's project. You may be given a lot of scientific literature to read. The natural sciences are so diverse that there's no way I could begin listing all of the tasks that an undergraduate may perform in the lab, but I *can* name some of my personal experiences. I've worked in three different labs in my collegiate career, and some of my duties have included computer programming, literature review, manuscript writing and editing, cell culturing and harvesting, immunohistochemistry, DNA purification, and Western blot analysis, among other things.

But how exactly does a student in the natural sciences go about delving into research? It seems we all know those superstar freshmen who are already working in labs and have been working there since high school. "It's easy," they say. You nod your head, wishing your high school had coordinated some sort of research experience for you. But it really is easy—all you have to do is ask.

First, though, you need to know what type of research interests you. Are you a BCMB major who wants to study the molecular basis of Alzheimer's disease, or are you a Chemistry major interested in drug design? Whatever it is that grips you, you'll need to identify a faculty member whose research interests coincide with yours, and unless you are lucky enough that one of your current professors coincidentally conducts research in your target field of interest, you're probably going to be sending emails to total strangers. Keep your email short and simple—tell them your name, your background, your interests, and why those interests match up with their research. Then, ask to meet so you can discuss working together.

Many professors will jump at the opportunity to have an undergraduate work in their lab. From their perspective, I'm sure it must be nice to hear from students interested in their niche field of research, and, if nothing else, we students are free, enthusiastic, and, at the very least eventually capable labor. But if a professor says no, don't let it dash your dreams of ever doing undergraduate research. Some professors' labs are full. Some never take on undergraduates.

There are plenty of reasons why a professor would refuse to take on an undergraduate student; don't take it as a sign that you should give up. As a starting point, many universities have database lists of professors that are engaged in undergraduate research. The University of Tennessee undergraduate research web page, for example, has a list of "past research opportunities" that may help you identify professors who have willingly taken on students in the past. And, sometimes a professor that has said no may forward you on to other faculty members who may fit your interests that you haven't found from a simple website search.

Keep up the "Pursuit," and hopefully you'll find the perfect lab for you.

## **Undergraduate Research Abroad**

Melissa Lee, Editor-in-Chief

I can still distinctly remember the feeling I had sitting in the Knoxville airport, waiting for the flight that would take me to Newark, New Jersey and then Zurich, Switzerland,



where I would be spending the next five months performing neuroscience research. The restlessness I had been experiencing for the days before my departure had, by that time, mostly subsided. In its place was an odd mix of fear and excitement—a recognition of the fact that my next five months would irrevocably change me in ways that I had no way of predicting ahead of time.

Pursuing research abroad is one of the scarier things you can do as an undergraduate—not only are you being thrown into a new research environment, you are doing this in a new culture and country, away from your established friends and family. But, done correctly, it can also be one of the most rewarding experiences you have—not just in your time as an undergraduate, but in your entire life. So, as my inexperienced advice, here's how.

1. **Find your way there.** The first step to research abroad, of course, is finding a research project that you can work on abroad. Many NSF-funded Research Experiences for Undergraduates (REU) take you on projects in various countries abroad. Other programs exist and are reachable through Google. Because I knew I wanted to go to Europe, I participated in the GlobalLinks EuroScholars Research Abroad Program, which boasts nine European partner universities and which maintains an online database of available undergraduate research projects at each of these universities.

If you can't find a program that fits for you, it may also be possible to enroll in a traditional study abroad program through your university and contact professors at your exchange university directly with your name, background, research interests, and a request to work with them directly.

2. **Find your balance.** If researching abroad is anything, it is overwhelming. There is a virtually endless amount of things that you can do. If you're not intentional about it, it's easy to either fall behind on your research or focus so much on your research that you fail to take advantage of your surroundings. So, think about what you want out of your research experience abroad, and take the steps you need to take to get there.

If you went abroad for the research, it's perfectly fine to focus on the research. If you went abroad to experience a certain country's culture, you may be spending a little more time doing that. Neither of these options is, in and of itself, better than the other. Take the time to figure out what you want for yourself and follow that. Then, don't let anyone tell you you're doing it wrong.

3. **Be prepared to work hard.** In my time abroad, I attended Munich Oktoberfest, took a cruise from Helsinki to Stockholm, saw one of my favorite bands perform live in Berlin, experienced the Festival of Lights in Lyon, and welcomed the New Year in Paris. I also spent approximately a thousand hours working on a very interesting project in the lab. This meant that most of the time I was not traveling or sleeping, I was working. If you want to make the most of your time abroad, you won't have a whole lot of time for just relaxing.

4. **But, take care of yourself.** Researching and studying abroad are both stressful things alone. Combine them, and you really need to make sure you're staying okay. Don't be so engrossed in your research that you forget to find and create a support system for yourself. Take the time to make new friendships and maintain old ones. Every now and then, it's perfectly fine to take some time off and just do nothing. You're

not wasting your precious time abroad by taking time for yourself; you're reenergizing yourself so that you can take better advantage of your time and surroundings later. And though it seems obvious, experience dictates that it needs to be said—make sure you sleep and eat enough. Your bodily needs don't stop just because you're in a new country.

Pursuing undergraduate research abroad is a doubly challenging, but also doubly rewarding task. The next time I was in the Knoxville airport, I found that my feelings of anticipation had been right; I was exhausted, but I was coming back more confident in myself, both as a person and as a researcher—with what I count as the most valuable experience of my life thus far on my back.

## Summer Undergraduate Research

Sahba Seddighi, Managing Editor

As the summer approaches, you may be musing several options for a well-spent break. Regardless of the extent of your previous laboratory involvement, exploring summer research internships is a strong option.

During the summer following my freshman year, I applied for and was awarded an internship at the National Institutes of Health. With this opportunity—as with many such programs—came much more than a summer research project. Treated as an NIH employee, I had access to countless resources in testing my inclination toward both research and science in general. While not at the bench, I was able to attend lecture series by nationally and internationally recognized scientists in my field, to partake in a journal club focused on cutting-edge research techniques, and even to build connections for future collaborations—both in the United States and abroad.

As an aspiring neuroscientist, this internship has been the most influential experience in solidifying my intentions of pursuing a PhD by exposing me to the very field that I am eager pursue for the rest of my career. I highly encourage all of you to take advantage of such opportunities during the holidays.

Some tips for the application process:

1. **Start early.** Many applications for summer internships are due in the winter. Start your search as soon as your fall semester begins. If you're on the University of Tennessee campus, contact the UTK Office of National Scholarships and Fellowships for assistance in selecting appropriate programs.
2. **Keep your resume and curriculum vitae updated.** Make it a point to update your resume and CV in real-time. You may also wish to list any specific laboratory skills that you have acquired, even if they may be through coursework.
3. **Google, Google, Google.** Finding a long list of summer research opportunities to apply for is often a Google search away, but some well-established options include the National Institutes of Health Summer Internship Program, the HHMI-Janelia Farms Summer Undergraduate Research Program, the Amgen Scholars Program, and the

NYU Sackler Institute Summer Undergraduate Research Program.

4. **Take advantage of the opportunities on your campus.** The National Science Foundation Research Experience for Undergraduates and the UTK Summer Undergraduate Research Internship are two excellent examples. The latter provides a select number of \$2,000 grants for undergraduates performing summer research at the University of Tennessee.
5. **Create your own opportunities.** You can seek research opportunities at institutions without existing internship programs by emailing senior investigators with a brief explanation of your educational background, why you are interested in their work, and how you could serve as an asset to their laboratory.

Gaining experience in my specific area of interest with a summer internship was invaluable to my undergraduate education and helped focus my interests and research goals for the near future. I am now more excited and confident than ever about pursuing a career as a researcher and sincerely hope that others will take advantage of such opportunities during their undergraduate years.

### **How-to: Undergraduate Research**

The *Pursuit* Editorial Board

So—with that, get started. If you're worried about funding, know that many universities—the University of Tennessee included—have an Office of National Scholarships and Fellowships that is dedicated to helping qualified students find and secure national or international funding opportunities. Many such scholarships are research specific. Others will take you abroad for an internship opportunity or across your country for a presentation opportunity. And, look local. Many universities have undergraduate research grants available for their students.

Research is transformative. It isn't easy. But work hard and keep at it, and you'll have the incredible experience of contributing to the creation of something new.

We wish you luck in your pursuit.