UT Southwestern
Medical Center

The Lab Rat Guide to Research

PREFACE

This is the third edition of LabRat, a compendium on medical student research at UT Southwestern. Our institution has a rich history of research and continues to meaningfully contribute to medical knowledge across many fields. However, it is not uncommon for medical students to struggle to find a research project that best suits their interests and their future career goals. When should I get started? How do I find a project? How important is it to residency applications? Should I do basic science or clinical research? The prospect of answering all of these questions concurrently with the normal course of pre-clinical studies and while learning more about one's individual career interests and goals can prove daunting. Thankfully, many wonderful resources exist to enable student exploration of research at UT Southwestern. Our goal here is only to connect students to useful resources while anticipating as many common questions as we can. We hope this will allow students to feel familiar with the research process from day one on campus, expediting any desired involvement. Note that research is by no means a necessary medical student activity. That axiom loses some credibility with more competitive specialties, but we nevertheless do not wish to pressure students into research. Explore your interests. Though due to our passion for research, we unabashedly hope that you will try it out. Many thanks to the Dean's Research Office for all they do for medical student research.

We hope to continue expanding LabRat it in future years to include sections pertaining to anything else in which there exists a collective interest. Please let us know of any suggestions—we want to help provide information that students want to know. Recommendations for future editions may be routed to Reilly Sample (reilly.sample@utsouthwestern.edu), Tyler Cepica (tyler.cepica@utsouthwestern.edu), & Holden Archer (holden.archer@utsouthwestern.edu).

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INTRODUCTION

Do you love projects that have an immediate impact on how medicine is practiced? Or debating about methodological and statistical minutia and how they impact the quality of a work? Or cringe-worthy forced acronyms? Then perhaps clinical research is for you. Do you wonder how the brain works? Or how altering the chemical functional groups of drugs allow for more specific binding with targets? Then you may want to consider basic science research. The world of research is enormous, ambitious, and relentlessly pushing forward. Through it we have learned of ourselves and our world, engendering wonder and longer lives.

The field of research is growing exponentially. In 1975, roughly 500,000 articles were published in scientific journals. Today, that number is over 3,000,000 per year.[1] The number of journals has doubled (15,000 to 30,000) since 2000.[1] The number of researchers publishing at least 72 articles per year (roughly one every 5 days) has grown from 4 to 81 in the same time span.[2] Undoubtedly, this explosion has included several amazing feats. The Human Genome Project (HGP) completed less than 20 years ago, and we are only scratching the surface of its implications even today.[3,4] Invasive brain recordings hardly existed in humans at the time HGP concluded, and now researchers can use them to predict which words a person is saying internally.[5,6] Work like this has dramatic and life-altering potential impact. However, this explosion also makes it increasingly difficult to stay up-to-date, and to responsibly consume medical research. Which studies are well-formulated enough to contribute to the “evidence” in “evidence-based medicine”? How can I possibly keep up with the tidal wave of new information published every day?

More pragmatically, many students view research as a way to strengthen their residency applications. Certainly, especially for certain fields and programs, this is important. Moreover, many studies demonstrate the positive impact of research during medical school on future career outcomes like attainment of faculty rank, career publications and citations, awards, and funding opportunities.[7]

So, whether you are inclined to contribute to medicine through research or are trying to responsibly understand research to inform your clinical practice, or you view it as a means to an end, hands-on research experience in medical school can have great value. While it is not a necessity, your medical school studies come first, and this author is admittedly biased, we sincerely hope you will try it out.

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STRUCTURED RESEARCH OPPORTUNITIES AT UTSW

Summer Research

1. **UT Summer Research Program**
   https://www.utsouthwestern.edu/education/medical-school/degrees-pathways/md-research/summer/
   Awards ~70 students a full-time, paid research position in clinical, basic, or translational research over a 9-week period
   - Application opens November 1st and is due March 1st.
   - Letter of intent is due **February 9th** so meet with mentors prior to this to come up with project ideas. Ideally, you should begin to reach out to potential mentors just prior to or after winter break.
   - Project description (background, hypothesis, study methods, and relevance), Letter of Recommendation, Online application, and essays are due **March 1st**.
   - This is typically done as an MS1 the summer before starting MS2 curriculum.
2. **ENRH 129 Summer Research Enrichment Elective**
   For students who would like to experience research but might not be able to commit to 9 weeks of summer research or could not attain funding (typically 5-8 weeks)
   - Application due April 1st.
   - Runs concurrently with the Summer Research Program the summer after MS1 year.

Scholarly Activity

Each student has a 12-week scholarly activity during the clerkship years. Some schedules have the scholarly activity grouped into one 12-week block or split with 1 8-week block followed by a 4-week block later in the year.

- May choose from a variety of tracks including basic, clinical, and translational research; community health; global health; medical education; and quality improvement.
- Must begin finding a mentor at least 3 months before the block, solidify plans with an application 2 months before the block, and finish credentialing and training one month before the block.

RSRH 2101 Directed Research Elective

For students who would like to conduct research in clerkship/post-clerkship years (MS3/MS4)

- Good for students who would like to receive credit for research done outside of scholarly activity/summer research approval with registration form and proposal for research elective **due 6 weeks before the start of the block**.

Dean's Research Scholar

https://www.utsouthwestern.edu/education/medical-school/degrees-pathways/md-research/deans-scholar.html

Provides a year-long opportunity in basic, clinical, or translational research to highly qualified UT medical students with a well-designed research project proposal.

- Two funded full-time positions are offered for students who complete an application, present a yearlong research plan, and have a mentor who will support the research.

- Year-long leave of absence usually taken between MS3 and MS4 year (between MS2 and MS3 also possible).
- Applications **due April 1st**.

MD with Distinction in Research

Recognizes students who distinguish themselves by conducting meaningful research during their medical school training beyond the normal requirements of the curriculum.

- Must conduct significant, full-time research, write a thesis/article, and present their work culminating in a M.D. with a Distinction in Research and recognition at graduation.
- Application for candidacy due **January of MS3 year**.

Medical Student Research Forum

The UT Southwestern Medical Student Research Forum is an annual event celebrating research conducted by UTSW medical students.

- Students participating in any research (either summer research, scholarly activity, etc.) may submit abstracts for oral or poster presentation.
- Four students are selected for oral presentations and recognized with certificates and cash prizes.
- Applications **due November 1st**.

ADVICE FOR FINDING A MENTOR AND PROJECT

In the past, the AOA research committee has hosted a panel discussion related to the mechanics of finding a mentor. Below is a summary of the responses to frequently asked questions.

When did you find your research mentor?
Students may initiate a fruitful relationship at nearly any time during medical school. However, as discussed later, be mindful of how long it takes to complete a project. It is true that certain clinical projects may take as little time as a month or two, but this is not generally the case. Even after a manuscript is completed, the journal submission/revision cycle begins, and this can take many months. As is generally the rule, it never hurts to start earlier rather than later.

With this in mind, it is perhaps ideal to initiate a relationship mid-way through or near the end of MS1 year, in preparation for research during the summer bridging MS1 and MS2 years. If the summer experience works out from the perspective of both parties, the relationship can then smoothly continue during margin time and for scholarly activity. Given how long it can take to get a project completed (especially for basic science), the more long-term the relationship, the better.

In the past, students had the opportunity to participate in the Summer Research Program before their MS1 years. This is great, but far from necessary. In fact, most students will choose to not do research during their first summer. This too is okay. However, given the amount of time it takes to publish, to save potential stress over publications under review, try to give yourself *at the very least* around 6 months before residency applications are due (in reality most people will need ~1 year). So, in summary, while everyone's "ideal" will depend on individual interest and competitiveness, if the goal is to publish something that counts towards residency applications, it is generally prudent to begin exploring research ***as early as the end of PC1 and as late as mid-C3.***

Your medical school studies are always the priority. It is never too early to begin exploring research, but make sure this does not compromise your understanding of the normal curriculum.

How did you find your research mentor?
Below is a list of potential avenues to explore while seeking out a lab to join.

1. ***Explore past medical student summer research projects.*** The Dean's Office of Medical Student Research compiles lists of medical student summer research projects for publication each year. This is a useful way to familiarize yourself with which mentors are open to medical student involvement in the lab and yields a potential peer contact who may be willing to answer some questions about the lab before you commit. These lists can be found at the following URL:

https://www.utsouthwestern.edu/education/medical-school/degrees-pathways/md-research/summer/project-index.html

2. ***Talk to classmates who are interested in the same field as you***. Getting information from upperclassmen, or even students in the same class, who have worked in labs in your field of interest can help direct you to high-output labs with working environments conducive to medical student involvement. One structured way of talking to classmates about research is attending the Medical Student Research Forum put on each year in the winter. It can be hard to determine which labs are ideal for medical students from websites at times. Talking to fellow students can direct you to a warmer trail. Also, no need to be shy about cold calling (emailing) a medical student working in a lab in which you are interested!

3. ***Go to the Medical Student Research Forum***. It is early in PC2 and therefore allows for subsequent time to complete all necessary paperwork for the Summer Research Program application (typically due March 1st). Also, apply to this once you have done some research! It is good practice for presenting scholarly work in a familiar and convenient space.

4. ***Ask residents while you are on rotations about research opportunities.*** This will not always pan out, but some departments have industrious resident researchers. In the very least, they are often more familiar with which clinicians are heavily involved in research and can point you in the right direction.

5. ***Reach out to faculty interest group sponsors.*** They often serve as useful and enthusiastic liaisons between medical students and the rest of the department. If you are having trouble finding an in road by directly emailing labs yourself, faculty sponsors can help jump start the process.

6. ***Talk to the Dean's Office of Medical Student Research.*** The office has a great grasp of what kind of medical student research is going on across campus and may be able to help. They provide lots of helpful resources for this very search, so be sure to check out the website and its various pages:

https://www.utsouthwestern.edu/education/medical-school/degrees-pathways/md-research/

7. ***Rifle through lab websites***. This is perhaps not the most efficient manner by which to find a lab, but if you are unsure what you are interested in to begin with, this can be a useful, and even a fun, exercise. Going to the faculty pages of different departments and determining who is doing what takes some time but need not be a neglected practice.

What were the mechanisms of getting involved in a lab? How long did the process take?

The process may take ***months*** depending on the responsiveness of busy faculty, so plan ahead. If you are hoping to secure a mentor for scholarly or the Summer Research Program, you will need signatures and some basic information on your project in the lab. For this, it is considerate to give your mentor weeks, not days, to get all necessary forms signed and to allow for the formulation of your project. For the specific example of the Summer Research Program, with the March 1st due date in mind, start looking when PC2 begins.
Generally, after identifying a lab, reach out via email to the PI (principal investigator) or the research coordinator, if specified. At that point, set up an in-person meeting to discuss your interest in joining the lab. The following section, "Reaching out to a Potential Mentor" discusses this in more detail.

What should I look for in a mentor?
Following is a list of mentor qualities that engender a good working relationship with medical students. Hopefully, you will be able to get a sense of the fit either through other students who worked in the lab or through a preliminary experience, like the Summer Research Program:

1. ***History of training students.*** The absence of this trait should not be considered a red flag per se. However, if the mentor has trained medical students in the past, it may be easier to align expectations and have a productive partnership.

2. ***Lab members seem happy and cooperate.*** Trickle-down sociology. Happy researchers usually imply that the PI is reasonable and approachable. This emphasizes the utility of talking to past medical student researchers, if possible. If given the chance, try to meet some lab members when considering joining a lab.

3. ***Strong publication history.*** You can check this via Google Scholar or PubMed. You can also check the lab's funding status with the NIH's RePORT tool. This is really useful to get a sense of where the lab is in its own developmental journey. It is a good way to familiarize yourself with the grant process as well.

4. ***Interested in training medical students and has time for it***. While having more senior research advisors has its own advantages, at times, this means a bigger lab and less facetime with your mentor. Ideally, look for a research advisor who is both capable of and enthusiastic about supporting a mentee in their career pursuits more generally.

5. ***Has enough data for a good project.*** For better or for worse, the quality of success of research often comes down to the availability and quality of the data. Ask about what datasets you will be working with. Will you have to make them? Are they ready and waiting to be analyzed (ideal)?

How can I be an effective mentee?
Ask not what you mentor can do for you, but what you can do for your mentor. Some proposed answers are below:

1. ***Be enthusiastic but not overbearing***. This is a good general rule for success on the wards too. The best way to appear interested is to be interested. This underscores the importance of finding a lab well-tailored to you.

2. ***Be timely with your deliverables***. Do not be shy about asking for deadlines. Others on the project will often appreciated your frankness. This becomes particularly important when juggling multiple projects or coursework with research.

3. ***Deliver your deliverables.*** In other words, try your best to do everything you say you will do. Projects fall through sometimes and that is okay. Just try your best to not be the weak link that leads to the chain breaking.

4. ***Resist over-committing.*** You will thank you even more than your collaborators will thank you. It is not inherently bad to be ambitious but be realistic about the amount of time you are able to commit to a project.

5. ***Be a team-player***. Team building is just as important in the research environment as on the wards. It is perhaps of even greater value as research teams do not turn-over every two weeks like in the hospital. Thus, it behooves you to have good working relationships with your lab-mates.

When are good times to do research?
We refer to the "Structured Research Opportunities at UTSW" section of this document. In brief, the Summer Research Program, scholarly activity, a dedicated research year, and fourth year electives allow for intensive research without distracting from studies or rotations. However, it is certainly possible to use some pre-clinical, or even clinical, margin time on research.

Should I consider taking a dedicated research year?
There are several reasons to consider taking a research year. Talk to a trusted advisor in your specialty of choice about this. By no means is taking a research year necessary, or even universally beneficial. However, it may be worth considering if you would like to strength your residency application, improve your chances at a specific program, or simply want to explore research as a career option further.

What should be my goals for research output?
This depends on which field and which residency programs interest you. More competitive fields generally put a higher premium on research, as do more academic programs. More "academic" programs are not necessarily "better" programs. Because this is so specialty-, program-, and individual-specific, it is best to talk to a trusted mentor about this. Faculty sponsors for student interest groups and your research mentor are good people to approach with questions about competitiveness and goals. The National Residency Matching Program's (NRMP) *Charting Outcomes in the Match* provides a rough estimate of the average research output of medical students who match in each field (http://www.nrmp.org/main-residency-match-data/).

For more bespoke statistics, like residency program-specific research accomplishments of matched students, we suggest accessing the Texas STAR database: https://www.utsouthwestern.edu/education/medical-school/about-the-school/student-affairs/texas-star.html.

Does basic versus clinical research matter?

This depends on your goals and interests. Frankly, it is challenging to complete basic science projects without a dedicated research year because it often requires time-sensitive in-lab tasks. However, anecdotally, some residency programs recognize the increased rigor and are accordingly increasingly impressed. Also anecdotally, this is not always the case as the residency process is not immune to using simple, but at times misleading, metrics like “number of publications, presentation, or abstracts” to stratify applicants. But putting aside the rat race that is the protracted application cycles, the best answer is that it matters if it matters to you. Do you want to do basic science because you are interested in a career in it? Then pursue it. If you like the pragmatism of clinical science or do not think you love research enough to treat your cell cultures more gingerly than your house pet, then pursue clinical science.

REACHING OUT TO A POTENTIAL MENTOR

Once you have identified a project that interests you, reach out to them either directly or through a specified departmental research coordinator. This information is often found on lab websites. While attaching a CV is not formally necessary at this point, it can potentially expedite the process. Further, it is good practice to keep your CV updated as you will begin using it heavily during your MS3/MS4 years (for away rotations, as a reference for your residency application, and so on). The office of student affairs offers an excellent resource on CV writing on the Student Affairs d2l site: https://d2l.utsouthwestern.edu/d2l/le/content/28506/Home. CV resources, 18 example CVs (!!), and a CV template can all be found under the "Residency Application" tab of this site.

Email serves as the primary vehicle for initially approaching a prospective mentor. This should go without saying but remember to keep all discourse professional, enthusiastic, and concise. An email should generally include (1) an introduction of yourself (2) that you are reaching out regarding a research opportunity (3) something specific to their research (i.e. "I find your work in cultural barriers to contraception interesting" instead of "I find your research interesting") (4) something specific to you that makes you an interesting prospective mentee (e.g. aligns with your career interests or your past research experiences) (5) a request to meet or discuss a potential partnership further (6) a reference to any attached materials like a CV.

Below are two example emails:

Dr So-and-So,

My name is Bob and I'm a MS1 here at UTSW. I am looking into research opportunities for the ___ Program (Summer Research, HHMI, DRS, TL1, MED 1800 Elective). I have experience in a lab where I worked on ___ (some experience that would be in line with their research goals) and found the work on ___ (something specific to their research) in your lab very interesting.

After looking through your lab website, I would love the opportunity to talk to you about your research and any opportunities that you might have in your laboratory for this summer.

Thank you,
Bob, MS1

Hi Dr. Dreamlab,

My name is Analise and I am a second-year medical student here at UT Southwestern interested in a career in Obstetrics and Gynecology. I am reaching out because I am seeking a research project to work on during my three-month research elective this upcoming spring. I noticed that you have worked with medical students in the past regarding the use of contraceptives in the Hispanic population. Would you be willing to mentor another student for a similar project, and, if so, do you have availability to meet with me in the next week regarding potential projects?

I have attached my CV and look forward to hearing from you!

Warmly,
Yours Truly
UTSW Class of 202X

The process does not end with the email, of course. Hopefully the lab will receive your communication favorably and offer a time to discuss the opportunity in person. For this meeting, it is important to remember professionalism as well. Come prepared, with some familiarity of their research and of your research goals, and dress professionally (business causal). And do not worry, these conversations can be fun—mutual intellectual interest engenders bonding.

Finally, if both parties agree upon the arrangement, then that is great! Often times, the mentee will require signatures and certain commitments from the mentor (e.g. for the Medical Student Summer Research Program). Be forthcoming about all that you need and be sure to give your mentor plenty of time to fulfill these obligations (on the order of weeks, not days). Congrats and let the work begin!

THE VARIOUS FACES OF RESEARCH

While this document primarily focuses on basic and clinical research, there are other ways to meaningfully contribute to medical knowledge such as quality improvement, health education, and public health.

Clinical Science

A nice way of understanding the various facets of clinical research is by working up the "evidence pyramid," a way of organizing clinical research by both its quality and approximate difficulty of implementation (Figure 1).

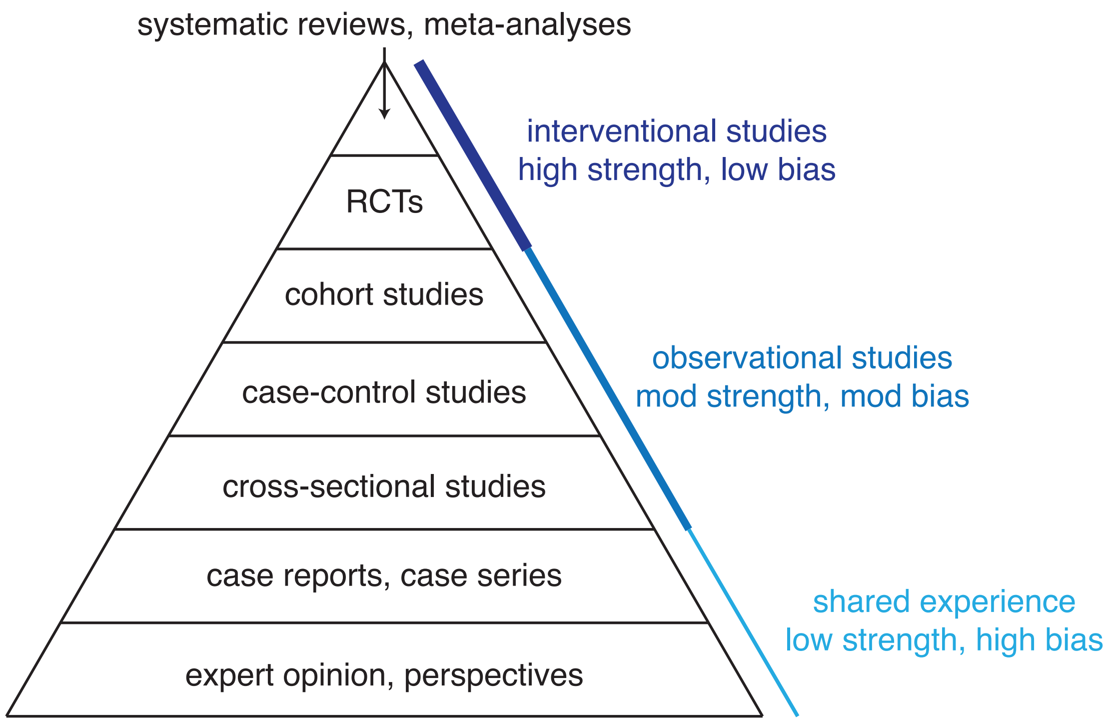

Figure 1. Evidence pyramid. Various clinical research study designs. The strength of evidence increases and bias decreases from the bottom to top of the pyramid.

It is likely that, if you have not already, you will see some variant of this graphic at some point during medical school. Using it as a guide, we will briefly talk about the various study designs.

1. ***Expert opinion and perspectives.*** You will pick up advice from sage clinicians throughout your medical career. This may be in the form of formal communications in journals or simply passing comments on the wards. Learning from others with decades of experience is invaluable and among the more enjoyable student responsibilities.

2. ***Case reports and case series.*** Many literature databases are inundated with this type of article. Completing these projects are often very accessible to medical students and can be a good experience. However, be warned that some view these reports as something less than research and therefore they are not necessarily

given equal weight (nor should they be) come residency application time. A *superb* article series that combines expert opinion with case reports is the New England Journal of Medicine's "Clinical Problem Solving." In these articles, the journal presents information on a real patient to an expert clinician in stages. At each stage, the clinician shares his/her thought process given the available information including the working differential, proposed work up, and so on. These are great fun and usually teach esoteric knowledge that others would be impressed to learn you know. Here is the URL for a recent example:

https://www.nejm.org/doi/full/10.1056/NEJMcps1902835

3. ***Cross-sectional studies.*** In this study design, measurements from the sample population are taken at the same time with no follow-up period. An example would be obtaining the BMI and exercise-level of all pediatric patients at a single office visit to look for associations between these two variables. These can provide helpful estimates of the prevalence of a disease across various demographics. However, because there is no longitudinal data, these data cannot be used to inform important variables like incidence, prognosis, or causal relationships.

4. ***Case-control studies.*** The terminology for case-control and cohort studies can confuse as the former is generally retrospective and the latter prospective but this is not necessarily the case. In this design, the researcher identifies individuals with (case) and without (control) a disease of interest, attempting to control for demographic factors between the two groups to reduce bias. The researcher then looks back in time, attempting to find differential distributions of risk factors between the groups. An example is chart review of patients with and without cellulitis and comparing the proportion of IV-drug users in each group. These studies are cost-effective and efficient for studying rare diseases but can only study one outcome and are more susceptible to bias than cohort studies.

5. ***Cohort studies.*** In this study design, researchers enroll subjects, measuring certain variables that may influence future disease-related outcomes (i.e. BMI, blood pressure, age, race, and so on), and follows the subjects, measuring the outcomes of interest. These investigations allow for calculation of incidence and provide some evidence of causality. However, they can be expensive and are poorly suited to studying rare disease outcomes.

6. ***RCTs.*** Randomized controlled trials, an interventional study design, can provide stronger evidence than the best observational studies. The design of these studies is complex and often requires hundreds of millions of dollars to execute. As a wards tip, familiarity with key RCTs in the field is viewed favorably (but far from expected). For an excellent RCT resource to buff up for the wards, check out the following link:

https://www.wikijournalclub.org/wiki/Main_Page

7. ***Systematic reviews and meta-analyses.*** The strength of these articles depends on the quality of the studies from which they draw. A systematic review of case reports or observation studies is not necessarily as strong as a RCT. As a medical student, you may have the opportunity to perform a systematic review of the literature. This is a useful skill to develop. For this, familiarity with PRIMSA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, http://www.prisma-statement.org/) is helpful. Statistical analysis for these types of studies often gets complicated, so you might want a biostatistician on your side.

If you are interested in learning more about the strength and weakness of these various study designs, Hulley et al.'s *Designing Clinical Research* provides a concise overview and is available electronically, free of care, through the library's website.

Basic Science

Even when only focusing on fields directly overlapping the field of medicine, there is incredible diversity and breadth to this side of research. Thus, it is challenging to succinctly and systematically break down the anatomy of basic science. Instead of attempting to do so, below is the AAMC's advocacy statement (https://www.aamc.org/what-we-do/mission-areas/medical-research/basic-science) which provides a serviceable summary of the scope and importance of basic science:

> All scientific research conducted at medical schools and teaching hospitals ultimately aims to improve health and ability. *Basic science research* – often called fundamental or bench research – provides the foundation of knowledge for the applied science that follows. This type of research encompasses familiar scientific disciplines such as biochemistry, microbiology, physiology, and pharmacology, and their interplay, and involves laboratory studies with cell cultures, animal studies or physiological experiments. Basic science also increasingly extends to behavioral and social sciences as well, which have no less profound relevance for medicine and health.
>
> Basic research can address clinical issues from a reductionist approach, including the discovery and analysis of single genes or genetic markers of diseases, or sequencing and manipulating genes. Typically, basic science research focuses on determining the causal mechanisms behind the functioning of the human body in health and illness, and utilizes hypothesis-driven experimental designs that can be specifically tested and revised. More recently, "systems biology" has focused on understanding how complex systems arise from elemental processes. Once these fundamental principles of the biologic processes are understood, these discoveries can be applied or translated into direct application to patient care.
>
> In the absence of information and insights generated from basic research, it is difficult to envision how future advancement in treatment of disease and disability will occur; physicians would increasingly be in the position of mechanics who do not know how engines work, or programmers who do not understand how

computers store and compile information. Basic research is also a source for new tools, models, and techniques (e.g., knockout mice, functional magnetic resonance imaging, etc.) that revolutionize research and development beyond the disciplines that give rise to them.

The AAMC advocates for basic research, as part of the continuum from laboratory-based science to clinical and translational investigation to studies in and with communities and whole populations. The Association strongly supports the work of the U.S. National Institutes of Health (NIH), the American people's leading organization in support of basic as well as general health research, reflected in the NIH mission statement:

To seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability

FUNDING OPPORTUNITIES

Securing funding is central to research. It should be noted that ***volunteers are not supported by the Office of Medical Student Research***. This means that if you wish to take a dedicated research year, you must demonstrate that you will be paid for your work. This section is an attempt to centralize information related to medical student funding. Note that there are more opportunities than what are listed here. For both summer and year-long opportunities, there are many specialty and institution specific programs. Departmental advisors may be particularly helpful here.

Year-long Programs

Sarnoff Fellowship
https://sarnofffellowship.com/Default.asp
The Sarnoff Fellowship provides paid research positions to medical students who wish to focus on cardiovascular research. Applications are due the January preceding the desired dedicated research year. The program takes around 10 students per year. UT Southwestern has had students accepted to the program in recent years.

NIH Medical Research Scholar Program (MRSP)
https://www.cc.nih.gov/training/mrsp/index.html
The NIH accepts MS2/3/4s for a year-long research opportunity at the NIH campus in Bethesda, MD. The program integrates basic science, clinical science, and career building opportunities. The application cycle runs from the October to January preceding the research year. As an example of competitiveness, in the 2018-2019 application cycle, the program accepted 37 students (34 medical, 2 dental, 1 veterinary) of "over 115" (so I guess 116-119?) applicants.

Dean's Research Scholar
https://www.utsouthwestern.edu/education/medical-school/degrees-pathways/md-research/deans-scholar.html
We are fortunate to have a homegrown year-long research opportunity at UTSW. The program accepts 2 to 3 students with an established plan to conduct basic, clinical, or translational research. Applications are due April 1st preceding the desired research year. Accepted students are notified by May 1st. The webpage on the UTSW website (above) provides a thorough and clear overview of the application process. Participants perform research and take classes covering often-used statistical analyses and an overview of the various types of clinical research.

Washington University TL1 Predoctoral Clinical Research Program
https://crtc.wustl.edu/programs/predoctoral/tl1predoc/
The one-year (intensive) TL1 program at WashU allows medical students to work with a mentor of their choice in St. Louis for one year. The program benefits include a stipend, tuition funding for a master of science in clinical investigation (MSCI), research support, travel awards, and health insurance. Applicants must write a grant with their mentor and submit to the NIH in order to qualify for the award. If you are interested in this program, it would be best to start reaching out to faculty at least 4-6 months before the deadline (February 20th).

American Heart Association Predoctoral Fellowship
https://professional.heart.org/en/research-programs/application-information/predoctoral-fellowship
One- or two-year funding for research with a mentor of your choice. This program requires a project proposal and 3 letters of support. Projects should advance scientific knowledge in cardiovascular, cerebrovascular, or brain health. Benefits include stipend and research support. All proposals undergo a rigorous peer review process, so this is another one where an early start would be highly beneficial.

NIEHS Medical Student Research Fellowship
https://www.niehs.nih.gov/careers/research/med-students/index.cfm
One-year fellowship at the National Institute of Environmental Health Sciences (North Carolina). This program is geared toward students interested in how the environment affects patient disease and health outcomes. Interested applicants should find a potential mentor at the NIEHS and submit a project proposal to be considered. This is a rolling application program, but—as always—the earlier you submit the better.

Other Funding Mechanisms
There are countless specialty-specific year-long research programs at other institutions, especially for traditionally competitive residencies (orthopedics, ENT, dermatology). Do a very detailed Google search for programs, and check your specialty-medical student webpages for opportunities (i.e. Orthogate (ortho), Headmirror (ENT), etc.).

As mentioned above, this is not an exhaustive list of available funding opportunities. Reach out to a trusted mentor in your field of interest to see if institution or field specific programs exist. Also, depending on the financial status of your research mentor's lab, the lab may have the resources to directly hire students to a research assistant position. Do not assume that this is possible! However, if you know you want to take a research year, it is worth exploring all possible avenues.

A brief note on predatory year-long research programs:
Unfortunately some programs capitalize off the competitive nature of certain residencies and recruit medical students into programs that utilize their labor without offering the benefits traditionally associated with year-long programs. Beware of programs that do not offer pay or health insurance coverage. Reach out to previous participants and ask about their experience. You will eventually need to clear your leave of absence with Dr. Mihalic, and she will want to assure that you are joining a solid program that seeks to elevate you—not take advantage of you. It can also be helpful to look at the track record of previous students who participated in the research program; were they successful in attaining a residency spot in your specialty of choice?

AOA Carolyn L. Kuckein Student Research Fellowship
https://alphaomegaalpha.org/student_research.html
This financial award can apply to a summer project 8 to 10 weeks in length, working 30+ hours per week, or a year-long program, working 4+ hours per week. However, it is not available as an award to support a dedicated year of research. A school may only nominate a single student, but

this appears to be a relatively low-exposure award. Applications are due in January before the summer/year of interest.

Other Funding Mechanisms
https://students-residents.aamc.org/attending-medical-school/research-and-training-opportunities/
The AAMC provides a useful database of clinical and research opportunities for medical students at the listed address. Many of these are site and field specific.

THE PUBLICATION PROCESS

The exact details under each subheading will in every case depend on the mentor's style, the mentor's valuation of the mentee's ability, who else the mentee is working with (other students, residents, post-docs, etc.), the field, the type of research, and so on. In other words, the following is a simplified generalization of the publication process, aimed at providing a rough idea of what to expect. Depending on the kind of research and your target journal, the work is far from over after you complete your final analysis. This is just something to keep in mind as a reminder of why it is always better, as possible, to begin research earlier rather than later.

Preparing a Manuscript

The first step in preparing a manuscript is selecting a target journal. The senior authors on the project will often inform the student of which journal target they think appropriate. This will generally depend on the potential impact and the scale of the project. Moderate-sized observational studies may be appropriate for sub-specialty clinical journals. Large-scale randomized controlled trials may aim for high impact (i.e. broad readership) clinical journals such as the New England Journal of Medicine, the Lancet, or JAMA. Discovering new oscillatory properties of a well-known neuron type may best fit in a mid-tier basic neuroscience journal such as Journal of Neuroscience. Discovering and exhaustively characterizing a previously unknown flavor of neuron (e.g. "Jennifer Aniston Neurons" – look them up!) may allow for consideration by an upper-tier basic neuroscience journal such as Neuron or Nature Neuroscience or even a broad-readership basic science journal such as Science or Nature.

In conjunction with deciding the target journal, the research team has to decide what kind of article to write. There are many types of papers out there—articles, brief reports, commentaries, perspectives, reviews, case reports, and so on. The available article types will depend on the journal, and several paper types (e.g. perspectives, reviews) are often invitation-only. Therefore, for the trainee, there are two main types to consider:

Article

Basic Science

- Description: A full-form report. The exact figure requirements and word allowance depend on the journal but often cap at around 8-10 figures and 6,000+ words. Some journals choose not to set a length limit.
- Examples: Nature "Article," Science "Research Articles"

Clinical Science

- Description: A full-form report. Exact figure requirements and word allowance depend on the journal. Generally, includes meta-analyses, interventional controlled trials, observational and modeling studies.
- Examples: NEJM "Original Research," JAMA "Original Investigation"

Brief Report

Basic Science

- Description: Generally, the same quality of research but less of it. The exact figure requirements and word allowance once again depend on the journal but are often 2-4 figures and roughly 2,000 words.

- Examples: Nature Neuroscience "Brief Communication," Science "Report"

Clinical Science

- Description: Same categories of clinical research as articles but shorter.
- Examples: JAMA "Research Letter"

Once your team has determined (1) the target journal and (2) the content type (i.e. Article or Brief Report), go to the "For Authors" page for that journal. It will contain figure and word requirements for each content type, formatting information (the bane of research), the editorial decision timeline (the other bane of research), and so on.

There are various options for document preparation. There is always the ever-present, ever-steady Microsoft Word, but LaTeX systems have grown in popularity of late. LaTeX is a typesetting system that takes a more programmatic approach to formatting. What it lacks in direct manipulability it makes up for in automation. Certain journals have LaTeX templates that take care of all formatting for you. All you have to do is add the text and upload your figure files. Other journals are more old-school and instead have Word templates. Regardless, if you have multiple projects going at once, using LaTeX in conjunction with an online LaTeX editor like Overleaf, is worth considering. This allows you to work on different projects with different people simultaneously "on the cloud" and to keep them all in one place. This can prove considerably simpler than emailing edited Word documents back and forth.

If you will be responsible for making figures, ask your lab about software resources. Many journals prefer vectorized image files (.ai, .eps, .pdf, .svg). All this means is that the images can be re-sized without losing resolution. Make sure that your lab provides access to software that can generate these file types. Preeminent, but cumbersome to learn, is Adobe Illustrator. It is worth lobbying for your involvement in figure-making. Apart from simply being useful to the lab, making figures is, in my personal experience, an excellent artistic outlet in an otherwise highly technical field.

With the journal, article type, and tools determined and formatting guidelines in hand, it is time to start writing! You may find that, after 6 months or longer on a study, the words simply fall out. The sections you will be responsible for will depend on the project and mentor. Some mentors like to take the lead on the introduction and discussion due to their greater fund of relevant knowledge, letting mentees draft the results and methods. However, you may find yourself in a situation in which you write the entire draft. This should be the goal, for practice's sake. You will learn a lot by at least attempting a discussion and then seeing how a more experienced researcher either molds what you wrote or re-writes it.

So, in summary:

1. Pick your target journal
2. Pick your content type
3. Familiarize yourself with formatting guidelines
4. Pick your manuscript and figure preparation software
5. Write the paper, which sections contingent on your situation

Journal Impact Factors/H-Indices

As an aside, there are many analytics applied to journals (and researchers) to determine their relative productivity and impact. Two that you will encounter often are the Impact Factor and the H-Index. Understanding scientometrics (quantitative characteristics of the field of scientific research) is not a prerequisite for performing high-quality research (and perhaps is the wrong thing to focus on), but it is reflective of the increasingly data driven world in which we live and is interesting from historical and methodological standpoints.

Impact Factor

In 1955, Eugene Garfield first introduced the idea of an impact factor, an analytical valuation of the influence of research articles based on the number of citations they receive, to the research community in the journal *Science*.[1] After securing NIH funding, he published a book on the topic in 1961.[2] Considered one of the fathers of the fields of scientometrics, he spent much of his career building the Institute for Scientific Information (ISI), which survives today under the purview of the Web of Science. Judging the quality of papers and journals by the number of citations they receive has sparked considerable debate over the years. Garfield himself viewed the metric with lenses of realism, calling the impact factor a mixed blessing, "like nuclear energy."[3] Regardless, the reach of scientometrics has only grown since its conception, and you will no doubt interface with these metrics during throughout your scientific career.

Below is the equation for calculating the journal impact factor (JIF):

$$JIF(c,p) = \frac{C_{y-1} + C_{y-2}}{P_{y-1} + P_{y-2}}$$

where C_{y-2} and C_{y-1} are the number of citations in the current year received by articles published in that journal over the previous two years and P_{y-2} and P_{y-1} are the number of articles that journal published over the previous two years. So, JIF can be understood as a recent estimate of the average number of citations papers published in that journal receive in a year. For reference, the 2018 impact factors of NEJM, Nature, Lancet Infectious Diseases, and Journal of Neuroscience are 70.67, 43.07, 27.52, and 6.07 respectively. From this, the general trend of high impact factors for clinical journals over basic science journals, and of broad-readership journals over sub-specialty journals, is apparent. This metric incompletely captures the influence of journals, as other metrics have basic science journals outpacing clinical science journals in overall influence. Despite its shortcomings, the impact factor lives on as a useful proxy of a journal's importance to scientific discourse across the globe.

H-Index

The h-index is a more modern metric than the impact factor but has already generated more than its fair share of healthy controversy. The physicist Jorge Hirsch introduced the index in 2005 as a mean for assigning a numerical estimate of quality to individual researchers.[4] Since then, it has been adopted across scientific fields. In true physics form, the derivation of the index is hilariously mathematical (respect). Formally, the h-index is defined as follows:

$$h - index(f) = \max_i min(f(i), i)$$

where f is a discrete function that orders the number of citations received by each paper published by an author, in descending order. So, if an author has 5 papers with 10, 15, 21, 101, and 3 citations, $f(i)$ = [101, 21, 15, 10, 3] for i = [1, 2, 3, 4, 5]. The first index, i, for which $f(i)$ is less than i, is the h-index. For our example researcher, $f(i) > i$ for all i until $i = 5$ ($f(i{=}5) = 3$). Therefore, the h-index equals 5. As another example, an h-index of 200 (crazy high) means that a researcher as 199 publications with at least 199 citations each.

References

[1]Garfield, E., 1955. Citation indexes for science. *Science*, *122*(3159), pp.108-111.

[2]Garfield, E., 2006. The history and meaning of the journal impact factor. *JAMA*, *295*(1), pp.90-93.
[3]Wouters, P., 2017. Eugene Garfield (1925–2017). *Nature*, *543*(7646), pp.492-492.
[4]Hirsch, J.E., 2005. An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, *102*(46), pp.16569-16572.

Submitting a Manuscript

Your involvement in this phase of the process will depend on your specific situation. However, it is always better to be prepared! Every journal has an editorial management system through which to electronically submit your research. Below is a brief checklist of information you will need to submit. However, before you begin preparing your manuscript, reference that journal's specific formatting guidelines. They vary significantly based on journal, and your manuscript may be sent back if formatted incorrectly.

[ ] All necessary files (main text, figures, supplemental information, journal specific requests). Sometimes the system asks for a single file with all information included, sometimes they request separated files.
[ ] The names of all authors and their academic addresses. Also make sure that all authors have signed off on the final version of the manuscript.
[ ] The field or subfield that best reflects your paper so that the paper goes to the proper editor (e.g. computational neuroscience, cell biology, etc.)
[ ] Suggested reviewers (researchers in the field relevant to your paper who have the requisite expertise to judge the scientific credibility of your work). There is some strategy to this so definitely discuss with your mentor.
[ ] Suggested reviewers to exclude (researchers for whom a conflict of interest precludes them from objective review). For example, you may put names of researchers you know are simultaneously working on similar projects.
[ ] Payment information. Journals may have a submission fee. Find out if this is the case and ask your mentor for lab funding. You should not have to pay 100+ dollars out of your own pocket to submit your paper.

Timeline on Journal Decisions

This widely varies from journal to journal. It is perhaps dangerous to make such sweeping generalizations, but the time from submission to publication for most clinical papers medical students publish is likely considerably shorter than the time it takes to publish basic science journals. As the prestige and scope of a journal decreases, the rigor of the review process also generally decreases. Conversely, it is not unheard of for the high impact journals to hold papers hostage for a year or more after receiving the initial submission. However, it appears that journals in general are attempting to expedite the review process, recognizing that it takes probably too long to publish research these days. For example, *Science* and *Cell* return an editorial decision in a matter of days, opposed to weeks, and *Cell* now states that they usually try to make a final decision on an article after only one round of revisions.

Some journals, in an effort to promote transparency, will state the date they received the initial submission in the final published paper, often as a footnote somewhere. It is worth looking at multiple articles from your target journal to see if they do this. It is very helpful to have a rough timeframe in mind when preparing to submit. The main point in stating this is to keep in mind that ***it could take 6 months or more*** to receive a final yes or no from a journal ***after the***

paper is "done." Be mindful of this as you try to boost those numbers before residency applications are due.

A general outline of the process, from time of initial submission to final journal decision is as follows:

1. ***Initial editorial decision (days – weeks).*** If the editor deems the paper worthy of eventual publication, then the paper is passed on to journal-selected reviewers. The editor tries to answer the question: "Is this paper interesting enough for my journal's audience?" They may or may not use any of your suggested reviewers. Journals often ask researchers who have published in their journal to review for them.
2. ***Initial reviewer comments (weeks – months).*** Two to three content experts will review your manuscript, assessing the quality of the science. They try to answer the question: "Is this good and important science?" Each reviewer will read through the manuscript and come up with a list of concerns and comments. Sometimes these are split into "major" and "minor" concerns. The hope is to receive as few "major" concerns as possible. These usually pertain to methodology central to your paper and can be potentially fatal to the manuscript's chances of publication. "Minor" concerns are just that. These range from polite requests for a new control or to visualize the data in a different way. In any case, they are often easier to answer convincingly than "major" concerns.
3. ***First editorial decision (in parallel with initial reviewer comments).*** The editor will compile all of the reviewer comments and will decide between one of three possibilities: accept the paper (yes), allow for revisions and resubmission (soft no), reject the manuscript (hard no). Hearing yes with no request for revisions is exceptionally rare, except at lower tier journals. The revise and resubmit catches many manuscripts. Depending on the exact nature of the reviewer comments, the eventual chances of publication range from good to impossible.
4. ***First revise and resubmit (weeks to months)*****.** If your team receive an invitation to revise and resubmit, your task is to address all the reviewer comments, one-by-one. Journals often allow a couple of months or so for the research team to resubmit. The goal for this is to answer every major concern raised by the reviewers, doing whatever it takes (new controls, changing methodology, new experimental paradigm, etc.) to do so.
5. ***Cycles of resubmit-reviewer comments-editorial decision (months).*** Once you have incorporated all suggested and demanded changes to your manuscript, you will repeat (2-4) until the reviewers and editor are satisfied or determine that your manuscript is unfit for publication. As mentioned before, some journals may commit to making a decision after only the first round.
6. ***Final decision (total time ~ months).*** Eventually you will hear a yes or no. If yes, then yes! Congratulations. If no, it is time to pick another journal target and start the process over.

RESEARCH ON THE INTERVIEW TRAIL

The interview trail is the time to show off all the hard work you've done for your research projects! Although talking about research may seem intimidating, it is a great opportunity to demonstrate critical thinking and the ability to present complex ideas concisely. The points below will hopefully help you prepare for this exciting time.

Everything is fair game!

Any and everything you put into ERAS is fair game for discussion. Interviewers will ask you about projects from other specialties, case reports, projects from years ago, even undergrad if you list it! It is safest to know the basics of anything you list. Generally, know what question was being asked/addressed by the project, the basic methods, any results, and future directions. If you are unsure, reach back out to those mentors. Provide them with a brief summary of your understanding and ask for any clarification. They will be happy to help you out!

What will you be asked?

In nearly every interview you will be asked: "Tell me about a research project of which you are especially proud." You should prepare for this question, designate a project or two you feel comfortable discussing in depth and answering questions about. These should be projects you are knowledge about and participated in a significant portion of the project. Ideally, one in which you helped come up with idea and drafted the manuscript. These do not have to be published projects nor publications in which you were first author. Your interest and excitement about the project are more important.

A potential format for this answer:

1) Quickly address as to why you are proud of this project (Was it the first time you got to write a manuscript? Was it your idea? Was it the first time you really felt like you contributed to the project/team? Is it a topic you especially love?)
2) If not addressed above demonstrate your level of involvement with the project
3) Discuss the research question and how you sought to answer it
4) Discuss results and conclusions
5) Discuss the future direction you personally see this project or similar ones needing to take

Finally, remember, even if the interviewer is an expert in the field of your project, you are the expert on your specific project!

Quality over Quantity

Generally, interviewers and programs are interested in what you will bring to their institution as a researcher, they do not necessarily expect you to be prolifically productive. Research is an opportunity to show your ability to think critically about a topic. Discussing research allows you to demonstrate your curiosity about the field, as well as your knowledge base of the literature (what has been studied/explored before). Programs will appreciate dedication to projects, even if not published, over case reports in which little literature review or time commitment was required. (That being said, grab those case reports when you can!)

Research as a career?

Another common question: "Where do you see yourself in ten years? Do you anticipate research as a part of your medical career?" This should be answered as honestly as possible. That being said, remember these are academic and research centers, as a resident you are expected to conduct research at most programs, and the faculty interviewing you likely have incorporated research into their careers. An approach for one who does not intend to incorporate research: Although I see myself strictly in clinical practice, I understand the importance of literature evaluation, and continued reading on recent results for the best care of my patients. I look forward to honing my critical analysis of research during my training at this program.

USEFUL RESEARCH SOFTWARE

The UT Southwestern Software Core is an underutilized source for students to access a lot of useful software. You may need to be on campus or connected to the VPN to download some of these programs. Visit this link to check it out: https://www.utsouthwestern.edu/research/core-facilities/research-software-core/

Data Analysis

- **R and RStudio (Free)**
  A free and open-sourced statistical analysis software for R, a programming language used for statistics and graphic generation. This is an excellent option for someone who is new to statistical analysis, but who may want to utilize the wide-ranging functionality and robustness of this software for more complex analysis later on. Be sure to check out the free text "Applied Statistics with R" which serves as the go-to introduction for the R language. Download here: https://rstudio.com/products/rstudio/download/

- **IBM SPSS (Available at certain computers in the UTSW library)**
  This statistical software is quite simple and very user-friendly. It will get you through the basics (t-test, chi-square, linear regression) as well as some more complex analysis (multivariate, loglinear regression). This is definitely an excellent go-to for the beginner who wants to carry out their statistical analysis and easily generate some basic figures and graphs. Although it requires an annual license for personal use, SPSS can be accessed on computers numbered E2.16 and E2.17 in the South Campus UTSW library.

- **SAS Studio (Free)**
  SAS Studio is the free, cloud version of SAS, a statistical software known for its simplicity and clean production of descriptive statistics. Although it lacks some versatility, this is another good option for the beginner who just needs to get the basics done. Download here: https://www.sas.com/en_us/software/studio.html

- **GraphPad Prism (Free through UTSW libraries)**
  This robust software is fantastic for making many different kinds of plots and curves as well as carrying out your run-of-the-mill (and complex) data analyses. It is often used by PI's and many will have it available for your use in their lab.

- **Microsoft Excel (Student pricing through UTSW libraries)**
  Many people write off Excel as overly simplistic and unsophisticated, however it can be a very useful program with easily accessible functionality for the beginner statistician. Despite its ubiquity, the vast majority of Excel users do not utilize the software to its fullest potential. "Real Statistics Using Excel" is a good (and free) introductory text to using excel for statistical analysis.

Bibliography Management

- **EndNote (Free through UTSW libraries)**

The leading reference management and bibliography building software. EndNote makes organizing and incorporating your citations into manuscripts very easy. Note: if you download the program through UTSW, know that when your license is up, you will lose access to your citations until you re-activate at your next institution.

- **Zotero (Free)**
  A free, web-based application similar to EndNote. In addition to all the functionality of EndNote, this program also makes it easier to download and save snapshots of webpages and store their citations. It has limited compatibility with Google Docs as well, although we recommend you draft your manuscripts in a formal word-processer like Word. Download here: https://www.zotero.org/

- **Mendeley (Free)**
  Free desktop application similar to EndNote. Its Word plug-in seems to work with less fidelity than that of EndNote, but it is a good option for the student who does not want to have their references tied up in a university license.
  https://www.mendeley.com/?interaction_required=true

Figure Design

- **Graphpad Prism (Free through UTSW libraries)**
  In addition to designing plots and curves, Prism is also used to generate figures and images for any kind of research-related deliverable. There is a bit of a learning curve associated with this software, but there is no shortage of resources online. Getting familiar with Prism will pay off, especially if you plan to pursue a career in research.

- **Adobe Illustrator (Special pricing for students on Adobe's website)**
  Many researchers swear by this program. Its ability to produce excellent figures is tried and true. Although there is no special discount through UTSW, Adobe has a 60% off sale for students that includes all Adobe Creative Cloud software (Photoshop, Illustrator, Lightroom, etc.). Find it here: https://www.adobe.com/education.html

- **Lucidchart (Free)**
  Easy to learn and useful for flowcharts and diagrams. Lucidchart is completely web-based, but you can easily export your figures into a word processor or PDF version for easy sharing. After making a free account, your PI or other lab members can easily collaborate on and edit your work. Check it out here: https://www.lucidchart.com/pages/

- **GIMP**
  A free and open-sourced alternative to Adobe Photoshop. GIMP can be used to edit and manipulate images or retouch graphics for your final manuscript. Be sure to allow yourself time to get to know the interface and learn how to use this powerful software to its fullest potential. Download here: https://www.gimp.org/

- **Inkscape**

A free alternative to Adobe Illustrator. Use this software if Adobe's discounted bundle is still more than you are willing to shell out. Like Illustrator, Inkscape is complex and requires some tutorials before you can dive in. But learning how to leverage this program and other image editing software will make you a very valuable commodity in the future. Download here: https://inkscape.org/

- **BioRender (Free basic version or paid subscription for upgrade)**
  An online resource for creating nice, professional scientific schematics and figures. You can register for the free version which has basic features but still allows you use their pre-made icons and templates: https://biorender.com/

Data and Protocol Management

- **LabArchives (Free version available online)**
  If a simple lab notebook or word processor doesn't do it for you, then LabArchives may be an alternative for developing, storing, and using experiment protocols and their resulting data. Find it here: https://www.labarchives.com/

- **RedCap Data Manager (Free through UTSW libraries)**
  Secure, web-based application for building and distributing surveys. Data from responses are stored within the program, but they can be easily exported into .csv or .xlx files. Additionally, new versions of the application have in-house data analysis capabilities that allow for quick and simple calculations without having to export the dataset.

Word Processers

- **Microsoft Word (Student pricing through UTSW libraries)**
  Obvious, but widely utilized for a reason. Word is the most common word processor used to draft and submit manuscripts. In addition to writing, many people use Word to create publication-quality data tables. Producing a well-organized and neat manuscript draft with pretty tables will surely impress your PI—even if the writing itself needs revision!

- **Overleaf (Free version available online)**
  As mentioned previously in "The Publication Process", the LaTeX typesetting system is gaining popularity in academia as a document preparation system that automatically formats your writing based on the type of document you want to produce. Although it requires some time spent learning the LaTeX system, many argue that this way of producing documents is more efficient and elegant than Word. Overleaf is a free LaTeX editor that is available online at: https://www.overleaf.com/