



GENIUS LAB GEAR

TOOLKIT AND
RESOURCES
FOR
GRADUATE
STUDENTS
AND STEM
RESEARCHERS

Why This Exists

Connecting you with the STEM community will help you celebrate the successes and stay positive about your failures. The technical tools included will make you the most effective version of yourself. Enjoy!

Written by Derek Miller, PhD, who founded Genius Lab Gear to improve the research environment by focusing on the researcher, not the research.

This document will be continually updated with the best new resources from around the world. To receive new versions straight to your inbox, [subscribe to alerts at geniuslabgear.com/toolkit](https://geniuslabgear.com/toolkit). Last update: June 6th, 2019

I know there's something new in here for everyone. Our world is overflowing with an abundance of tools for every task. The hard part is finding the right tool. Don't go after every single thing you see here. Read my comments and decide what's best for you. If you see a tool not listed that you find particularly valuable, please send me a quick email at derek@geniuslabgear.com

Happy science-ing!

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Tools for excellent research habits, data analysis and science communication:

Reference managers for writing journal articles and literature reviews:

Why you need it: Many students avoid diving in and learning a reference manager until they finally are a 1st author on a paper and are forced to do so. Do yourself a favor and learn one right away. Start tagging and organizing every paper you read in your chosen program and your future self will be thankful. Go [here](#) for a detailed analysis of strengths and weaknesses.

[Mendeley](#): A free reference manager that I used to do all 337 references in my thesis and to organize and annotate my sources for a published literature review. Download the Word plugin and take advantage of the Web Importer tool to grab citations from books or articles in your browser. Paid options will let your research group manage communal references and give you extra cloud backup space. There's really no reason to pay for a reference manager given the functionality included in the Mendeley Free Version. Mendeley primarily operates using PDFs and has the strongest online community.

[Zotero](#): A free and open source reference manager. Since it's open source, you can take heart it will never abruptly go behind a paywall. Zotero's strength is its superior integrations with non-PDF citation sources such as web documents, magazines, new stories, etc. Also compatible with Google Docs!

[Endnote](#): The gold standard reference manager in the US if you can convince your group or school to pay for it. \$250 USD standard but you may qualify for student pricing of \$115. Not necessarily more useful than the other two but it's more powerful if you deal with complex or unusual citation styles.

Analytical and Graphing software:

Why you need it: Excel is a powerful program but is best-suited to business and finance applications. If you are working with multi-dimensional data sets from complex scientific equipment you will be doing your audience a disservice presenting only X-Y charts in Excel.

[OriginLab Pro](#): The best software for beautiful publication-quality graphs and figures. It also includes powerful curve deconvolution and peak fitting capabilities which are helpful in spectroscopy. A group license is expensive but student pricing is available for \$69/yr. I used Origin to create the plot below (*see digital PDF*). It was a cathodoluminescence scan of a nanowire where every pixel contained a spectrum. How else would you show the changing energy states across the boundary of the two materials?

[MatLAB](#): (student pricing available) MatLAB has a steep learning curve if you're not familiar with coding but is incredibly powerful, especially for automating repetitive data analysis, curve fitting and computational equation solving. I had to use MatLAB instead of OriginLab for a specific curve fitting optimization problem that required iterative solving for local min/max of spectra.

[Python](#): FREE and open-source programming language that is nearly unlimited in what can be done if you're good at writing code. It does have a steep learning curve but the internet is chock full of resources, forums and free code samples on GitHub to get you started. Can also be used to interact with your PC user interface to automate button-clicking sequences between different installed programs. I did not use Python in grad school but have toyed with it to set up my Raspberry Pi for a smart-home enabled "Magic Mirror"!

Tools for making high quality graphics for posters, papers and science imaging contests

Why you need it: Spending a little extra time making high-quality visualizations will more effectively communicate your science to both experts and novices. You'll also find that the best figures get cited the most often. Go beyond the basic X-Y plot and overlay images, descriptive text and process flow diagrams to create figures that readers will understand and remember.

GIMP: (free!) Essentially a free and open-source version of Adobe Photoshop. It's not as user-friendly and takes some dedicated learning but hey, it's free. Use it to artificially color black-and-white electron microscopy images for art contests by using path selection and layering. It's also easy to cut out shapes from an image to isolate them against a white background or overlay the shape onto a new background (like putting your professor's face on a picture of Arnold Schwarzenegger and posting it in the hallway). Most importantly, it's perfect for resizing images, converting image formats for paper submissions colorizing images for easier understanding and stitching several images together for a larger tiled figure.

Microsoft Visio: Check with your institution to see if this is included in your package. Very useful for creating flowcharts and diagrams to visualize processes. I used it to represent band gap diagrams and overlay microscopy images of nanomaterials with descriptive text and graphics. Below is a figure in my thesis I made in Visio (*see digital PDF*). You could probably do this in PowerPoint but it's just easier and more precise in Visio.

Training on the visual display of quantitative information:

Why you need it: Science is all about becoming an expert in a field and communicating complex information and ideas to others which they can further build upon. All of your hard work in the lab will be wasted if no one can read or understand your work. The majority of researchers do the bare minimum when creating plots and figures of data. With a little extra effort, your data visualizations can catapult into the top tier of everything published. When writing my literature review, I found that I included other scientists' figures that could best convey the information without an entire paper of supporting text. Do you want to get more citations on your papers? Then create figures that others want to reproduce.

[Edward Tufte's training classes and book series:](#) In my third year of my PhD I stumbled upon a 1-day workshop near my university by a world expert in making amazing displays of quantitative information: Edward Tufte. I convinced my advisor to use some of my fellowship conference money to pay for the course (\$100-\$200) which included four of his books. The course completely changed my attitude toward presenting data and ideas. I highly recommend the course and his books. They include unique examples of beautiful hand-drawn figures before we were "limited" to our software programs, ways to more effectively run meetings, tips for presentations and overall just make you think outside the box when you start constructing your figures.

Getting Funding

Fellowships for graduate students:

Why you need it: Fellowships are often prestigious and noteworthy line items on your resume. But the value is really in the improved quality of your research experience. Fellowships typically come with a higher stipend which alleviates much stress about living on a shoe-string budget. Often they have additional money for conference travel and may even help create collaborations with professional researchers. Since you are essentially bringing in your own funding you have more flexibility in your research topic and may even find professors competing for you to join their lab at the beginning. My first two years of my PhD were on an NSF GRFP fellowship and my last three years were on a NASA NSTRF. Having these fellowships completely transformed my grad school experience. You should apply to at least two fellowships every year until you are no longer eligible!

This list is a great start but is by no means exhaustive:

https://www.gradschools.com/financial-aid/graduate-fellowships-scholarships/fellowships-for-graduate-students#Federally_Funded_Portable_Fellowships

Fellowships for women:

<https://www.profellow.com/fellowships/30-fellowships-for-women-leaders-scholars-scientists-and-students/>

Ongoing updated list of upcoming fellowship due dates:

<https://www.profellow.com/announcements/open-calls-for-applications-fellowships-grants-and-fully-funded-graduate-programs/>

The best list: Ask your professors about fellowships that are applicable to you. They will know most of them. Have an honest

conversation about the time and effort it will take to apply and whether or not they think you'll have a competitive application.

Fellowship and grant writing tips and resources:

NSF GRFP tips: <https://www.profellow.com/fellowships/three-year-fellowship-funding-for-graduate-students-in-stem-the-nsf-graduate-research-fellowship-experience/>

Guide to writing a personal statement:

<https://www.profellow.com/tips/prepare-a-compelling-personal-statement/>

[NIH Grant Writing Tips Collection](#): A small collection of helpful tip sheets for various stages of the grant writing process. Applies to organizations other than the NIH.

Mental Health and Well-Being in Grad School and STEM Research

Why you need it: Let's face it – grad school, academia and research work in general can be rough. Don't try to do it alone. No matter how strong you think you are, it will always be better with a strong supportive community of friends, colleagues and even complete strangers from the internet. A recent study summarized the 7-year completion rates of many different PhD programs in the U.S. ([See this article](#) about the PhD Completion Project.)

Here are the seven-year completion rates for the following disciplines:

- Engineering 57%

- Life Sciences 54%
- Math & Physical Sciences 48%
- Social Sciences 41%
- Humanities 29%

If you just said “wow” you’re correct. These numbers demonstrate the difficulty level of advanced degrees. Be proactive about finding helpful resources early on before you hit the rough patches and you’ll bounce back much faster. Below I’ve listed my favorites to save you time, but there are many others out there if you take the time to search!

Depression, anxiety, self-doubt, fitting in

[The PhDepression](#): A website with several social media accounts bringing mental health issues in academia to the forefront of discussion. They have resources for anyone struggling with depression, anxiety or imposter syndrome including personal stories shared by other students who went through these issues.

[UniqueScientists.com](#): A movement started in June 2019 to help break stereotypes of what a scientist should look like. Visit their site for stories from young and unique scientists around the world who have dealt with external pressure to “fit the mold” of a classic scientist.

<http://gradresources.org>: A non-profit faith-based organization that hosts a Grad Crisis hotline and has a library of online content for managing relationships, health, wellness and even dissertation writing tips.

[The Femmes of STEM](#): A podcast and website dedicated to finding, cataloging and telling the stories of historical and current women in STEM. Watch for their new database!

[Her STEM Story](#): A podcast and website of exceptional quality telling extraordinary stories of current women in STEM, their contributions and the obstacles they've overcome.

Above all: If you're experiencing feelings of depression or urges of self-harm, please immediately talk to a school counselor and a health professional.

Daily well-being practices:

Why you need it: I resisted these things for years. I thought "I don't need that. I can handle it." Turns out I was right. I didn't *need* these things. But since I've started using them my overall quality of life has improved and I'm a more enjoyable person to be around. Follow the advice of high-achieving individuals around the world and start some daily practices. These small habits can have a massive cumulative effect on your life and your work.

[The Five Minute Journal](#): (\$23) The most popular journal that came highly recommended from dozens of high-performing professionals. I'm currently using it and the best thing about it is how simple and fast you can keep up with it. One page per day. The morning section asks you to write down three things (big or small) you're grateful for, three things that could happen today that would make today great, and one positive affirmation about yourself. The evening section is simply three good things that happened today and one thing that could have made the day even better. This daily habit can have profound psychological effects on your positivity which will permeate to many aspects of your life. It's also a great way to recap your day and assess ways to make the next day even better, which we often fail to do otherwise.

[Headspace Meditation App](#): (free 10 sessions or \$70/yr with promotion/student pricing). Meditation has recently become widely-accepted as a cultural norm that provides measurable mental health benefits. It works by training your brain to overcome distracting thoughts and stimuli by repetitive mental exercises. This can be accomplished in many ways but Headspace is the most popular and affordable app out there. You get 10 sessions free with the app and can repeat those indefinitely if you'd rather not pay. I've personally used Headspace on and off for two years since finishing my PhD. I find my work day generally more focused and productive when I do a 15-minute meditation in the morning. It's also my go-to de-stressing activity when the demands of research seem overwhelming. Alternative apps are "Calm" and "Waking Up".

Comic relief:

[Piled Higher and Deeper \(PHD Comics\)](#): The most popular PhD-related comic that is always good for a quick laugh to make light of otherwise frustrating situations common in academia.

[Instagram accounts you should follow to get perspective on grad school and STEM research](#)

Why you need it: You don't, in short. Social media can be a huge distraction. But if you're on Instagram already, you might as well follow accounts that can be supportive and help you realize that others are undergoing similar struggles. These communities can give great advice and perspective on how to handle with these common issues in grad school and academia. Many of these have email lists to which you can subscribe by email to avoid the social media distraction.

@Academeology: Hugely supportive and welcoming account pointing out the good, the bad and the ugly of academia while starting dialogue around these issues

@Ph_d_ession: Small team of grad students bringing to light the mental health issues that are pervasive in academia

@SusannaLHarris: Founder of @Ph_d_ession and all-around #realtalk expert. Microbiologist and dog lover.

@Grad_selfcare: Sharing important messages to take care of yourself in even the toughest situations

@HerSTEMStory: Extraordinary stories of women in STEM from around the globe. 60+ podcasts and counting.

@Also_AScientist: Leader of the #UniqueScientists movement collecting amazing stories from unique STEM leaders everywhere.

@seekingscienceblog: A science blog run by four young women in STEM exploring bioscience and #scicomm

@growingthroughgradschool: A new podcast about self-care and personal growth in grad school.

@thisisgradschoolpod: Another new podcast “for grad students, by grad students”. They are just getting started so give them your support and feedback!

@thescicommunity: A strong community of science communicators (“#scicomm”)

@lab_shenanigans: Hilarious lab-related science posts for a good laugh between experiments

@stories.of.a.scientist: Professional #scicomm’er from Belgium with excellent resources

@sci_phile: Major science communicator of @becausescience

Organizational and productivity tools for research, classes and life:

Software for note-taking and to-do lists:

[OneNote](#): (free with MS Office) The place where ALL of my notes from grad school ended up. Well-tailored toward large complex projects. I loved the hierarchy of large notebooks -> tabs by topics -> pages for each tab. If you have a stylus it's also great for hand-written brainstorming. It integrates well with lecture slides from your professor while also being a great place for research notes, snippets from papers, group meeting discussions and even travel planning. Since graduate school I use it less because it's not as mobile-friendly for quick-hitter notes and tasks.

[Evernote](#): (free for syncing up to 2 devices) My new favorite and widely considered the best all-around note-taking app in existence. It combines a very mobile-friendly interface (widgets, shortcuts on Android) with a powerful and complex desktop version. It is slightly better with organizational tags than OneNote but the free version will eventually limit you in data usage if you clip many pictures, where OneNote will not. I would suggest keeping your research in OneNote and your life/travel/tasks in Evernote.

[Google Keep](#): A perfect lightweight to-do list and note tracker. Its biggest advantage is its mobile-friendly checkbox lists which sync between your phone and PC. You can also take voice notes directly using the Google assistant on your phone and have them end up here for later organizing. I use this for quick to-do lists but not for aggregating information about a complex topic.

Physical notebooks for note-taking and to-do lists:

[The Productivity Planner](#): (\$25) From the same creators as The Five Minute Journal. Instead of daily gratitude and outlook, this focuses on getting things done on a day-to-day basis. I haven't personally used this but again it has come highly recommended.

[Rocketbook](#): A truly Genius concept for bridging the gap between handwritten notes and the digital age. The concept is that you write or draw anything you want on the page and then use the companion app to take a picture of each page. The QR code in the corner of the page triggers the app to ask you what you want to do with the page. Pre-set customized "destinations" help you quickly send the note to your email, your cloud storage service or your favorite note-taking app. They have a \$32 re-useable notebook (requires special pen) or a \$12 140-page paper notebook. The app also integrates with [ThinkBoard X](#) (thin adhesive whiteboards) that gives the same functionality to your notes on the wall! I personally use the 11" Thinkboard X at my desk as a dry-erase brainstorm board that I save to Evernote before erasing. Get the 3-pack to put one at home, one at your desk and one in your lab.

[The Bullet Journal](#): (\$25) I haven't personally used this but it's been highly recommended by many friends. The concept of bullet journaling is open-sourced and doesn't require you to buy anything, so I'd recommend printing out your own sheets first before buying this journal. The premise is that you learn this shorthand system for "Rapid Logging" to efficiently keep track of all goals and tasks via handwriting. [Here](#) is a great list of bullet journal printables for specific aspects of your life!

STEM Outreach:

Why you need it: I included it under the “well-being” section because it’s truly gratifying and uplifting to spread science and technology to the next generation. Many kids grow up in schools with limited resources for science class and don’t know any real scientists. They think science is this obscure far-away thing that they can never do. Get involved with or start your own outreach program and do some good in your community. **Here’s a secret:** Many professors *are obligated* to do outreach because they wrote it into their federal grants to the NSF, NIH, NASA, etc. Talk to them and they will be delighted if you offer to do it on their behalf using their resources.

Our continually updated list of resources for finding outreach lessons and materials:

<https://geniuslabgear.com/pages/outreach>

Our extensive list of places around the U.S. where you could organize a field trip with a class or group of your younger siblings/cousins’ and friends:

<https://geniuslabgear.com/pages/list-of-science-learning-centers-in-the-us>

Resources for the transition from student to professional:

Blog posts from @LifeAfterThePhD

My blog is dedicated towards helping graduate students transition to their life and careers after finishing their advanced degrees. Check back often or [subscribe for alerts](#) whenever new blog posts are published.

<https://geniuslabgear.com/lifeafterthephd>

- [“Why I left Academia in Search of Self-Development”](#)
- [“How to KILL IT at your next conference”](#)

Resume/CV writing for graduate students:

Cornell’s staff have put together a [great little page](#) about resume/CV writing for graduate students. They include when to use a resume vs. a CV and link to academic and non-academic samples you can work from. Avoid random blogs about this online that may not be relevant to research-focused scientists and get this information directly from the people who are trained to help.

Joining a professional society:

See our extensive hyperlinked [list of STEM professional societies](#) below. Make sure to read the blog post [“How to KILL IT at your next conference”](#) for some practical tips on getting involved with the societies and leveraging them for greatest effect on your career.

<https://geniuslabgear.com/pages/list-of-science-and-engineering-professional-societies>

I will continue to update this document as new resources are discovered and become available! Make sure you're subscribed to the email list (geniuslabgear.com/toolkit) using the QR code below to receive updated versions to your inbox as they are released!



Happy researching,

- Derek
