What I Wish I Knew and What I Wish my Students Knew for STEM Grad School

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Department of Materials Science and Engineering
Texas A&M University
College Station, TX, USA
A bit about me

• Grew up in Indiana
• Bedford, IN (~13,000 people)
• >96% white, 88% Christian
• Average annual family income of ~$40,000
• People good at math and science become medical doctors!
• “Generation 1.5” (father has B. A., mother does not)
• Did well in high school—scholastically and athletically
• No high school guidance (councilors were concerned with getting kids graduated)
• Applied to 3 colleges (Purdue Univ., Butler Univ., Texas Christian University)
A bit about me

• Attended Butler University (PUI)
  • Started in Pharmacy
  • Switched to pre-med (chemistry and biology)
  • Spent a summer trapping squirrels by day and serving tables at Joe’s Crab Shack by night

• I was stressed about paying for medical school (and not all that into it) when a prof told me I should go to graduate school- “What’s grad school?”

• Participated in an REU program after junior year at UMass Amherst
A bit about me

• Started at Northwestern Fall 2005, organic chemistry track
• Joined Sonbinh Nguyen’s lab, NSF GRF - part of different centers
• Worked on developing new polymers for drug delivery (no biology)
• Active in outreach in Chicago Public Schools
• No clue what I wanted to do...

• Through a poster session at ACS Chicago, I met Ezat Khosravi (Durham) who invited me to a NATO conference in Turkey, where I met someone who used to work with my REU advisor, so emailed my REU advisor and he offered me a postdoc
A bit about me

• Started postdoc at UMass Amherst July 2010 with Todd Emrick in Department of Polymer Science and Engineering
• Part of the DOE EFRC “Polymers for Harvesting Solar Energy”
• Worked on the synthesis of conjugated polymers and small molecules, quantum dots, self assembly, transient absorption spectroscopy, and solar cell fabrication

• In fall 2011, Todd told me I’d apply for jobs the next year
• In fall 2012 submitted 67 applications, 8 interviews, 4 offers
My path

• Started independent career at Case Western Reserve University (Cleveland, OH) in July 2013
• To date mentored:
  • 10 PhD (4 Dr’s)
  • 6 MS (5 in PhD programs)
  • 27 UGs (20 in PhD program)
  • 7 HSs (all in UG)
• Research focuses on soft materials and applied chemistry—particle surfactants, new monomers for chain growth polymerizations and reactive small molecules
• Moved to Texas A&M, started July 2019
Don't panic, it's our PASSION for science!!

the Pentzer Lab

Pentzer Group January 2019

PhD Students
Qinmo Luo
Sarah Mitchell
Maria Escamilla
Katelynn Edgehouse
Kevin Pachuta
Sarah Lak
Ciera Cipriani
Yifei Wang

Collaborators
Prof. Rigoberto Advincula (CWRU Macro)
Prof. Agata Exner (CWRU BME)
Prof. Burcu Gurkan (CWRU Chem Eng)
Prof. Daniel Lambrecht (UPitt Chem)
Dr. Ina Martin (CWRU MORE Center)
Prof. Alp Sehirioglu (CWRU Mat Sci)
Prof. Chris Wirth (Cleveland State)

Funding

Chemistry (MSN)
Polymerization of Silyl Ketenes
DMR (Polymers, CAREER)
Janus Nanosheets
AFOSR
Exfoliation of transition metal oxides
IoTC
Evolution of Composite Morphology

EFRC
BEES
Breakthrough Electrolytes for Energy Storage
ACS PRF
ND
Molecular Dielectric Monolayers
# Preparing for Graduate School

## Undergrad Career

<table>
<thead>
<tr>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th + year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get settled in, figure out how to manage</td>
<td>Explore research opportunities (shadow? Summer plans?)</td>
<td>Narrow down desired field of expertise</td>
<td>Do a full time summer research program (on campus, or REU)</td>
</tr>
</tbody>
</table>

## Final Year

<table>
<thead>
<tr>
<th>Now</th>
<th>November 15</th>
<th>November 30</th>
<th>December 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of research and school appeal to you?</td>
<td>Have working draft of personal statement</td>
<td>Have excel sheet of information to letter writers, be polishing</td>
<td>Deadlines- Be aware of overlap with finals and holidays</td>
</tr>
<tr>
<td>Get your resume up to snuff!!!</td>
<td>Identify grad programs to apply for</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Don’t let senioritis take hold... Or do.</strong></td>
</tr>
</tbody>
</table>

**SUBJECT GRE**

Deadlines start 12/1
Choosing Where to Apply

- **Location**: Metro or rural? Close to home or far (what are your obligations?)
- **Lifestyle**: Big or small school? Large or small department? How social do you want to be with your colleagues?
- **Your Principle Investigator (PI’s)**: have multiple options (highly discipline dependent); you can ask about funding, former student career’s, PI retiring or taking a sabbatical?
- **Other considerations**: rank of university, department, and sub-discipline can vary; no such thing as a safety school

**THERE ARE MANY RIGHT DECISIONS**
Interacting with Letter Writers and PI’s

- **Your letter writers**
  - Chose people who really know you and will write you a strong letter
  - Be direct in asking for a strong letter
  - Provide your CV and draft of personal statement (you can ask if they want it via the cloud)
  - If you want a meeting provide times you are available
  - Provide a spreadsheet of information for them—don’t change it!!!
  - Ask if they want to be reminded...

- **Prospective PI’s:**
  - Be polite, use proper salutation and email address
  - Be specific about why them (do not copy and paste!)
  - You will get varied response
  - Most won’t know about funding for a year from now

<table>
<thead>
<tr>
<th>School</th>
<th>Dept.</th>
<th>Profs</th>
<th>Due date</th>
<th>How?</th>
</tr>
</thead>
<tbody>
<tr>
<td>North-western</td>
<td>Chemistry</td>
<td>Mirkin, Scheidt, Nguyen</td>
<td>12/15</td>
<td>You will be emailed a link</td>
</tr>
<tr>
<td>UMass Amherst</td>
<td>Polymer Science</td>
<td>Emrick, Hayward, Crosby</td>
<td>1/01</td>
<td>Mail to: E30 Goodell Building University of Massachusetts 140 Hicks Way Amherst, MA 01003-9272</td>
</tr>
<tr>
<td>Case Western</td>
<td>Chem</td>
<td>Sauve, Burda, Pentzer</td>
<td>1/31 (Rolling)</td>
<td>You will be emailed a link</td>
</tr>
</tbody>
</table>

**USEFUL ABBREVIATIONS FOR THE TIME-PRESSED ONLINE READER**

- **TL;DR** Too long; didn’t read
- **VS:SDR** Very short; still didn’t read
- **SR:MP** Should read; probably won’t
- **RH:PA** Read headline; posted angry comments
Starting Graduate School

• Attend multiple group meetings and meet with multiple students and PI’s- not just to work with them but for potential collaboration
• Attend department-wide seminars
• Every experience is unique, and impacted by your PI, your classmate, your labmates
• Research “hot topics” ebb and flow- what was funded five years ago may not be funded now
• When choosing a group, talk with current students away from the PI...
• Don’t be afraid to ask questions, but also don’t ask just to ask

THERE ARE MANY RIGHT DECISIONS
Read Literature

• How do you "keep up" on the literature?
  • Read titles and look at TOC (table of contents) images
  • RSS feeds and social media- sooooo easy, so overwhelming
• How do you read papers?
  • You don’t have to understand EVERYTHING
  • Read abstract, look at figures, read conclusions
  • Keep track of what you read
  • Be critical- some are just badly written or trying to make a big point...

Set aside 2 hours a week to read papers outside your immediate topic

Have an idea notebook you take notes in regularly
Be Prepared for Meetings

1. Know the purpose and agenda of the meeting
   • Who will be there, what information do you need to bring?
   • Bring data and idea notebook to take notes

2. Identify what you want out of the meeting?
   • How can you use the facetime to improve your research, environment, or productivity?

3. Reflect on the deliverables from the meeting
   • Understand what is expected of you- you can ask if unclear
   • Write them down and do any easy tasks immediately! (like email or keep an active document)
Keeping Track of Results: Prepare to Publish

• Be organized….Easier said than done
• Keep a scientific notebook, and label data based on page number (e.g., EP101_1HNMR)
• Reflect on results from this week and plan what you’ll do next week
• Develop a monthly report (maybe your PI requires this?)
• Check in with a postdoc, senior grad student, or your PI- there may not be a system in place...
• When you start to have a story to tell, use ppt slides to organize what the figures will look like
• Bullet point (and sub-bullet point) paragraphs before you start writing

"We are drowning in data, but starving of information" - someone

Scientific Data Lifecycle
From this (publish and forget)...

Mario Valle, CSCS
Demystifying How a Manuscript Becomes a Paper

1) **You collect data and write a manuscript**
2) You identify a journal you want to submit to (do you contact the editor)
3) You put the manuscript in the template
4) You submit through the website
5) The Editor in Chief (EIC) sees your paper and can reject or send to an Associate Editor (AE)
6) AE looks at paper and can reject, or identifies 2+ reviews and asks them to review the manuscript (you can suggest some)
7) Reviewers review, can suggest reject, major revisions, minor revisions
8) You do revisions (or find another journal to submit to)
9) AE can evaluate your response to reviewers or can send back to reviewers
10) You get published and don’t even realize it
If paper is not suitable for one journal, it is easier to transfer it to another (no changes)

Impact factor (IF) is determined by how many times a paper is cited in the two calendar years after the calendar year it is published in.
What goes into submission

- Manuscript
  - Section headings, number of figures, length determined by journal
  - Abstract submitted separately
- Supporting Information (and movies)
- Cover letter - why the work is important and relevant
- At least 3 (sometimes >5) preferred reviewers (experts in the area)
- Opposed reviewers (if too close, in competition)
- Preferred editor?
REJECTION

• What are papers rejected?
  • Lack of novelty
  • Lack of suitability with regards to scope
  • Poor context of other work

• Are the reviewer criticisms clear? Do they offer suggestions for improving your work? (what citations make it not novel, what ”other characterization” is required?

• Be objective about your work and recognize when reviewers are not 🎉
Figures for Publication

A)

B)
Oral Presentations

• Know your audience
• Tell them what you’re going to tell them, tell them, tell them what you told them
• Use a template and animations appropriately
• Have a conclusion on each slide- no one pays attention to a full presentation
• Not too much whitespace
• Include citations! No need to number
• Don’t just pull from papers (no a), b), etc.)- white boxes can be your friend
• Don’t: flip back and forth between slides, use yellow, use font that can’t be read, mix fonts
• Make sure to have acknowledgements! Including funding and group, people like to see pictures
• When you finish “Thank you for your attention and I’d be happy to answer any questions”
Poster presentations

• Posters can be harder than oral presentations.
• Does your group have a template?
• Avoid too many words (no one reads a poster, they look at pictures).
• Use your hands when presenting.
• Have a 3 minute speech - Practice!
• Do the math - if there are 200 posters in 2 h, how much time will someone spend at your poster?

Ask:
• Can I give you a 3 minute overview of my poster? - puts viewer at ease that you won’t suck the life out of them.
• Are you familiar with XXX? (are you familiar with graphene oxide) - save time on the background.
• Leave time for questions.

We Don’t Have to Pick a Side: The Middle Is A Fine Place to Be

Andrew R. Smith
Appalachian State University

INTRODUCTION
Mike Morrison created a template for a “Better Scientific Poster” (BSP) (https://osf.io/ef53g/)
The BSP format has been praised by many, yet disparaged by others.
The current project had 2 goals:
1. Create a template that I think could be useful.
2. Point out that we don’t need to either love or hate the new format—the middle is just fine.

METHOD
To create a new template, I identified strengths of the BSP template and the traditional format:
BSP strengths: clear take-away message, minimal text, QR code
Traditional format strengths: room for figures, reasonable text size on sides, large title to make finding posters in poster session easy, web link and email for people who don’t like QR codes

RESULTS
• Preregistered analysis: 78% increase in liking compared to traditional format and 24% increase compared to the BSP format.

Why must we pick sides? The new poster format is a revolution, or the new poster format is garbage!
Take the good parts of the new format, keep the useful aspects of the traditional format, add in your own ideas, and create something better.

DISCUSSION
• Sometimes it makes sense to pick a side; this is not one of those times.
• Praise what you like, make suggestions for improvement, and then make something better.
• Take Mike’s ideas, incorporate some of mine, be creative, and let’s make posters more useful.

Poster template: https://osf.io/ayjzg/
smithar3@appstate.edu
Networking

• Recognize if you’re an introvert or an extrovert, and use that to your success
• Have a “buddy” to go to events with
• Don’t be afraid to mingle (i.e., exit a conversation)
• Follow up with emails, linkedin, Twitter
• Know that time is valuable

Show up & be engaged
Work-Life “Balance”

• You will feel overwhelmed
• Identify what is important you to
• An advanced degree is about delayed gratification
• You must find things outside of grad school to occupy your time
• A therapist is a wonderful help

White circle is all of human knowledge
Mentors and Role Models: You need both

• Coach:
  • Goal oriented person which gives critical feedback, focuses on immediate challenges and opportunities for growth

• Mentors:
  • Help with operational aspects, someone you know and interact with, can reach out to when needed
  • Can have multiple mentors based on complexity of field
  • Can be assigned or develop organically

• Role Model:
  • Help with the aspirational aspects, you don’t need to know them or have every met them
  • Individuals can be role model for only specific portion of your career
  • You typically choose them
My Journey- Obstacles

- I recognize my privilege
- Not knowing if I was “smart enough” to be professor- if I could have good ideas
- Not having role models who were “like me”- at the time 2 female faculty NU chemistry, 1 female faculty UMass polymer science
- Unsure of what the process was (for ANYTHING)
- Unknown culture- nothing in my childhood prepared me
- Feeling disconnect from family and friends from childhood
Culture Shock and Cultural Conflict

• Added difficulty for first generation college students if culture is substantially different than what they are accustomed to—cultural disconnect in higher education

• Being “upwardly socially mobile” can lead to feelings of being lost, isolated, and imposter syndrome
  • Survivors guilt for getting through
  • Rejection from family members and friends “so you think you’re too good for us”

• Sociocultural differences between families with and without college degrees

Differences commonly around food—can you drink beer out of a bottle?
Cabernet Sauvignon...
Petite Syrah...
Chillabble Red....

A “family recipe” to me-
From the back of the box

No one understood I was serious...
Cultural Conflict

• Sociocultural differences between where you came from and where you are
• Can carry different values, vocabulary, knowledge
• Prejudice of academics towards working class culture can be frustrating for FGCSs
• Cultural conflict can add stress to graduate school

Is the change in absorption dramatic or drastic?
Dramatic: sudden and striking (related to performance)
Drastic: having a strong or far-reaching effect (radical and extreme)

Each Labor Day my uncles host “Critterfest” where they cook everything they have caught over the summer (including squirrel, three ways)

I used to shy away from this because people were confused, but now use it as a topic of conversation—point of novelty/interest with academics
Stress During Graduate School

• 43% of graduate students in the US report more stress than they can handle
• 60% say they felt overwhelmed, exhausted, hopeless, sad, or depressed; 10% contemplated suicide
• 47% of graduate students at UC Berkeley said they are depressed
• 2/3 of academics suffer mental health problems which they believe are attributed to their work situation
Doldrums of Graduate School

• You’ve figured out how to survive, but the connection to thriving is unclear
• Deadlines- self imposed and imposed by others
• Loneliness- people you were closest to don’t understand grad school
• Financial Strain
• Interpersonal interactions (fight with friends, partner, parents, family)
• Lack of perfection or understanding goals
Knowledge Gained During Graduate School

How to search literature

Technical laboratory skills

How to work up and evaluate data

Problem solving skills

How to be creative

How to communicate

How to handle stress

Perseverance

How to lead and follow

How to use software

You learn many Transferrable Skills
Personal Growth During Graduate School

“It is hard for first generation students to complete applications and student aid forms where parents don’t know how to fill them out...my mother has another primary language and I have to complete the forms myself.” – former REU student

“My biggest hurdles were not knowing what opportunities were available...‘graduate school’ sounded like spending thousands of dollars to take classes and delay job entry.” – former undergraduate

• Graduate School will require you to push yourself beyond what you have done before
• Graduate school coincides with a time of self discovery
• Graduate school offers opportunities to have new experiences

“The biggest challenge I face is finding a way to feel confident within a scientific environment and believing that my ideas are ones that bring a huge contribution to the research at hand.” – former ACS SEED researcher
Thank you!