# Graduate Studies in the Sciences and Engineering: Opportunities in the United States

Cameron F. Abrams
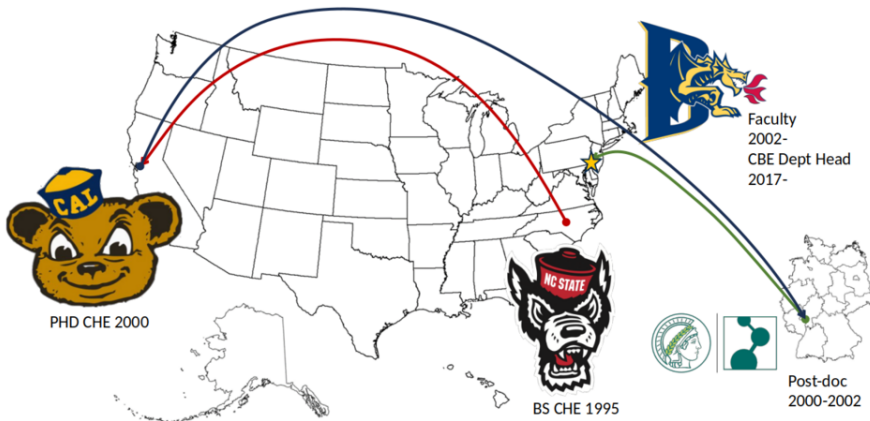
Bartlett '81 – Barry '81 Professor and Head

cfa22@drexel.edu

March 25, 2024

Drexel University, Department of Chemical and Biological Engineering

PHD CHE 2000

BS CHE 1995

Faculty
2002-
CBE Dept Head
2017-

Post-doc
2000-2002

## Some terminology

- **STEM**: Science, technology, engineering, mathematics
- **BS**: Bachelor of Science degree
- **MS**: Master of Science degree
- **PhD**: Doctor of Philosophy degree
- **ScD**: Doctor of Science degree (uncommon)

# Introduction

## Why am I talking to you?

- The world needs more STEM PhDs (except from computer science)
- Hundreds of STEM PhD programs in the US depend on a steady supply of well-prepared and talented students
- STEM undergraduates from Latin America are usually exceptionally well-trained and well-qualified for graduate school
- Latin Americans are underrepresented among non-US PhD students in the US (and they are mostly Brazilians)
- We would <u>love</u> to see more applicants to US PhD programs from Argentina

# Typical STEM Degree Pathways in the US
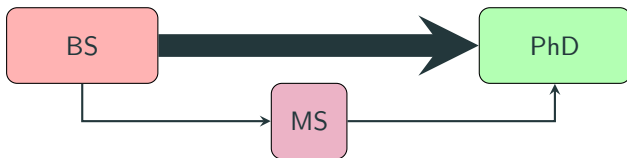


- Most applicants to PhD programs come straight from the BS
- Most PhD students never earn an MS
- Some programs offer the MS as a "consolation prize" for PhD students who fail to progress in research
- Applying with an MS can be advantageous if you received it directly and not as a consolation prize from another program

# MS vs PhD: An Incomplete Comparative Analysis

|  | MS (w/o thesis) | MS (w/thesis) | PhD |
|---|---|---|---|
| Duration | 1-2 y | 1-3 y | 4-6 y |
| Who pays who? | You pay institution | You pay institution | Institution pays you |
| What are you trained for? | Not much | Help w/ existing research project | Conduct your own independent research |
| Why do it? | A bit more pay | Try research (& more pay) | Advance humanity's knowledge |
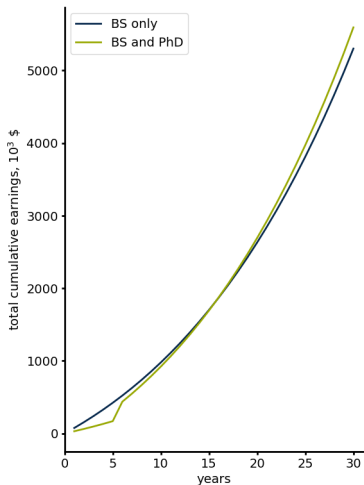
Assumptions

- BS starting salary $75,000
- PhD starting salary $100,000
- PhD stipend $30,000
- Average interest rate 3%
- 30 y career

# Things to know about the process

## PhD Programs

- One typically applies directly to a "program"
- A "department" can have one or more programs
- A "college" or "school" typically comprises multiple departments
- A university has multiple colleges or schools
- A university will also typically have two special divisions:
  - a "graduate school" that
    - oversees all graduate education at a university;
    - handles all incoming applications;
    - determines what is required on applications; and
  - an "international students/scholars office" that handles all university immigration responsibilities

## PhD Program Advisors and Committees

- Programs typically have one person in charge of PhD admissions; titles for such a person include
  - "graduate program advisor";
  - "graduate chair";
  - "associate department head for graduate studies";
  - "grad advisor"; or
  - "graduate recruiting advisor"
- Program advisors are responsible for setting the program's PhD enrollment target each year, based on open or pending positions in each professor's research group
- PhD applications are reviewed by a committee of 3-5 faculty chaired by the graduate program advisor
- It is a good idea to know who the graduate program advisor is for any program you apply to

## Choosing a Program

- Choose programs based on the disciplinary home(s) of the research topics that interest you
- Most research topics "belong" to more than one program
- Faculty with primary appointment in a department that does not house a particular program can often advise students in that program (I can advise students in Biochemistry, for example)

## PhD Program Requirements

Most STEM PhD programs have a common set of requirements:

- "Core" courses
- Teaching assist (TA) duties; 1-4 courses in total
- Examinations
  - "Qualifying" exam: candidates demonstrate capability to ask an original research question and design a research program to answer it; usually in year 1 or 2
  - "Defense": candidate defends their dissertation

STEM PhD research advisors determine:

- Overall research directions
- Elective or concentration courses

## PhD Application Fees

- Most universities require applicants to pay a fee to apply (US$10-100)
- Fee payment is usually the last checkpoint after which the university lets graduate program advisors "see" applications
- Many programs waive application fees; if it is not clear, then ask the grad program advisor!

## PhD Program Application Management

- Most programs begin evaluating applications late in Fall terms (before December), even if their deadlines are much later
- Most offers are made between December 1 and April 30 for PhD positions beginning the following September
- Getting applications in early in this process is a good idea – try for October or November of your final undergraduate year.
- Programs often reach out to international applicants for pre-decision interviews – this means they are very interested in you
- If you accept another offer, it is considered polite to inform other places you have applied so they stop bothering you

# Preparing your application

## PhD Application Major Components

- Transcript (your grades)
- Proof of Test of English as a Foreign Language (TOEFL)
- Personal Statement
- Letters of Recommendation

## Some thoughts about transcripts

- Most applicants have very good transcripts, mostly A's
- B's or C's are not necessarily going to lead to a rejection; depends on
  - what courses they are in; if math, chemistry, physics, or major courses, this is somewhat concerning;
  - when they occur; early is OK, late is not so good
- Elective courses that show your interests can be a plus

## TOEFL: Does it matter?

- Most applicants from non-English-speaking countries have high TOEFL scores
- There is significant concern among most program advisors that there is inflation in these scores
- TOEFL is not typically used to rank applicants
- However: the TOEFL score is an absolute requirement for applicants from non-English-speaking countries.

### Your Personal Statement: Some Guidance

- It is important! Put real time into writing it
- Describe
  - what motivates you to pursue a PhD (e.g., career goals and/or research)
  - what research topics you are particularly interested in and why;
  - what professors in the program look most interesting to you
- Try to keep it under one page, 11 pt font
- Don't worry if your English is not perfect; we are looking past English mistakes for clarity of expression
- Do not use ChatGPT or any other generative AI tool. We see this a lot and it is easy to spot (so far).
- Professors and mentors at your undergraduate institution should be happy to review drafts of your statement (I do this for every Drexel senior who asks)

## Recommenders

- Three to five professors who can say nice things about you
- You provide contact information and the application system makes the letter requests directly
- Be sure to ask each one if they are willing to be a recommender, and inform them of what programs you are applying to
- If possible, meet with each one specifically to discuss your application plans; they may have good advice.
- Avoid asking job supervisors, post-docs, grad students to be recommenders
- A letter from an undergraduate research advisor is highly recommended

## Undergraduate Research Experience

- Most STEM PhD programs in the US highly value undergraduate research experience in applicants
- Meaningful undergraduate research experiences provide a lot of inspiration for personal statements
- Getting your name among the list of authors on a publication can be very valuable, but only if you can clearly describe how you contributed
- Undergraduate research can compensate for less than stellar grades on your transcript

# Recommendations on where to apply

# Carnegie "R1" Doctoral Universities
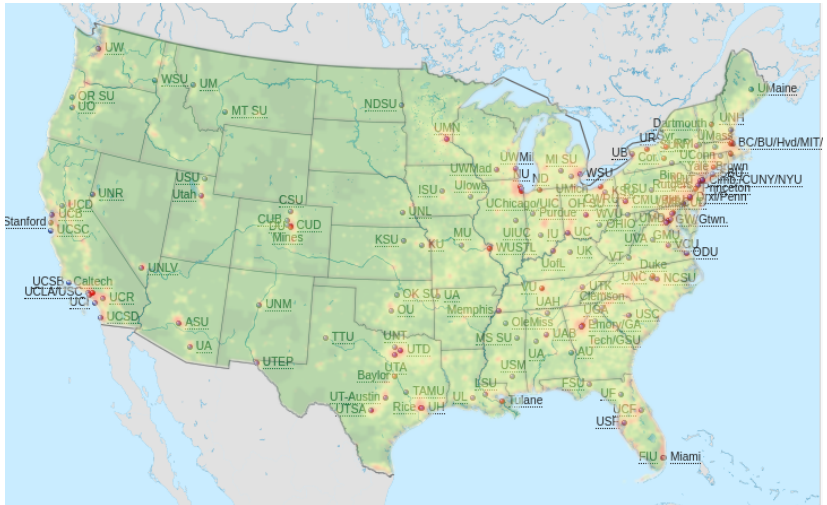


wikipedia

Google "list of US research universities"

## Some Words about "Elite" PhD Programs

- US News and World Report ranks graduate programs based **solely** on reputation score (voting by department heads)
- For example, in 2024 the top 10 for Chemical Engineering are:
    1. MIT
    2. UC Berkeley, Caltech, Stanford (tied)
    5. Georgia Institute of Technology
    6. University of Minnesota
    7. University of Delaware, Princeton, University of Texas (tied)
    10. University of Michigan
- Non-US applicants are often overlooked by elite programs unless
    - A faculty member
        - has direct knowledge of an applicant's institution; and/ or
        - is from an applicant's country; or
    - There is history of strong students from an applicant's institution
- Elites essentially never waive application fees
- Elites often do not recognize credit in graduate courses from other institutions (no MS advantage)

# After you apply

# Some particulars about Drexel University

# Concluding messages