ACS Chemistry for Life™

GRADUATE SCHOOL REALITY CHECK

20 August 2012

American Chemical Society

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ACS Chemistry for Life™

Graduate School Reality Check

Step 1: Getting In and Deciding

slides will be available online:
http://www.acs.org/undergrad

Attending an ACS Meeting ⟶
Fall 2012 Meeting Highlights

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Getting In and Deciding

- How do I prepare myself for graduate school?
- How do I choose schools and programs to apply to?
- What goes into a competitive application?
- How do I know which school is the right one for me?

What program is right for me?

- What do I want from my graduate experience?
  - to diversify your knowledge and skills?
    - a Professional Science Masters?
  - to increase your specific chemistry knowledge and research proficiency?
    - a Masters of Science?
  - to become an independent scholar in a specific area of chemistry research?
    - a Doctor of Philosophy?

What is a P.S.M degree?

- "the M.B.A. of the Science world"
  - typically, this is a non-thesis "hybrid" degree
  - coursework combines chemistry and training in writing, leadership, policy, law, business, communications, etc.
  - often culminates in an internship
- a fair bit of sleuthing is required
  - not all schools have chemistry P.S.M. degrees
  - requirements for admission and completion of P.S.M. programs can vary substantially

P.S.M. program examples

- Chemistry and Polymer Science
- Pharmaceutical Chemistry/Biochemistry
- Material and Chemical Synthesis
- Industrial Chemistry
- Computational Chemistry
- Materials Science and Engineering
- Chemistry for Entrepreneurship
- Analytical Chemistry
- Nanoscience
- Forensic Chemistry
- Chemical Informatics
- Master of Chemical Education

An example of P.S.M. program

- Chemistry and Polymer Science
  - 18 credits of chemistry/polymer science, 9 credits of management courses, 3 credits of electives, 1 credit ethics seminar, 1 credit internship
  - required chemistry courses: adv. analytical chem., modern organic synthesis, adv. physical chem., modern inorganic chemistry, adv. polymer science I
  - required management courses: project management, professional communication
  - professional internship: 40 hrs/week, 3-6 months in duration; “the student will work within a business, government agency or research institute directly related to their area of chemistry”

Life after a P.S.M. degree

- P.S.M. programs prepare graduates for careers in business, government, and non-profit organizations
- 99.8% employment after 6 months of earning degree
  - Dagmar Beck, president of the National Professional Science Master's Association (2011)

http://www.sciencemasters.com

Questions about P.S.M.s?

Ms. Arin Miller

Recruiter,

Keck Graduate Institute of Applied Life Sciences

What is an M.S. degree?

- M.S. programs provide students with the opportunity to develop a high degree of proficiency in a specialized research area and modest exposure to independent research
- coursework and research is required; a thesis may be optional…
  - (write the thesis! … you'll be better for it.)
- a fair bit of sleuthing is required…
  - some M.S. programs are robust; others are a default if the Ph.D. is not obtained

Example of an M.S. program

- specialize in a sub-discipline of chemistry: analytical, inorganic, organic, or physical.
  - ~12 credits of specialization area coursework
- complete breadth requirement
  - ~8 credits distributed among courses in other areas
- perform research in area of specialization
  - complete a progress report mid-way through the program
  - write and defend a thesis
- present a seminar or similar research presentation
- attend departmental seminars

Life after an M.S. degree

- 43% go on to full time employment
  - many companies recognize M.S. degree holders as trained individuals who can fill mid-level positions
  - coveted preparation for secondary teaching positions
- 8% go on to part-time employment
- 30% enter further graduate/professional school
  - easier transition to Ph.D. programs, especially if undergraduate research experience is lacking
  - good preparation for other professional programs
- 18% are unemployed

ACS data, 2009.

Questions about M.S. degrees?

Ms. Sarah Lewis

M.S., organic chemistry

Ph.D. student,

University of Missouri

Two types of Master's Degrees

- Professional Science Masters (P.S.M.) degree
  - depends chemistry knowledge
  - provides training in business, communication, policy, etc.
  - culminates in an internship
- Master of Science (M.S.) degree
  - graduate courses in all areas of chemistry and biochemistry
  - provides modest chemistry research training
  - perform research that culminates in a master's thesis

What is a Ph.D. degree?

- doctoral degree programs develop students into professional scientists capable of independent activity.
  - research and dissertation are mandatory
  - other requirements vary by program: coursework, comprehensive exams, seminars, research proposals, etc.
- yes, a fair bit of sleuthing is required…
  - you'll be devoting a fair chunk of your life to pursuing a Ph.D. degree; you'll want to make the most well-informed choice you can!

Example of a Ph.D. program

- specialize in a sub-discipline of chemistry: analytical, chemistry education research, inorganic, organic, or physical.
  - ~15 credits of specialization area coursework
  - complete comprehensive examinations
- complete breadth requirement
  - ~4 credits distributed among courses in other areas
- present a departmental seminar
- write and defend an original research proposal
- perform research in area of specialization
  - complete a progress report mid-way through the program
  - write and defend a dissertation

Life after a Ph.D. program

- 45% go on to full time employment
  - management/ R&D positions in industry
  - teaching at a college/university
  - government
- 3% go on to part-time employment
- 44% go on to a post-doctoral appointment
  - especially if one desires a faculty position
  - possible avenue to employment in a government facility
- 9% are unemployed

ACS data, 2009.

Questions about Ph.D. programs?

Dr. Taina Matos

Ph.D., materials science

Norfolk State University

Ms. Sarah Lewis

M.S., organic chemistry

Ph.D. student,

University of Missouri

Experiences to have before graduate school

- coursework
  - 2 semesters general chemistry with laboratory
  - 2 semesters organic chemistry with laboratory
  - 2 semesters physical chemistry with laboratory
  - 1-2 semesters analytical chemistry with laboratory
  - 1-2 semesters inorganic chemistry with laboratory
  - 1 semester biochemistry
- research
  - depends on to what graduate program you aspire
  - if you do research, have something to show for it!

Experiences to have before graduate school

- practice both written and oral communication skills
- become proficient at computer software like Microsoft Excel, Powerpoint, and Word
- gain skill with ChemDraw (or similar structure drawing software) and other computation/modeling packages (Spartan, RasMol, etc.)
- gain comfort with search engines like SciFinder and PubMed
- use citation tools like Endnote, RefWorks, etc.

Applying to Schools

- does this look like a school at which you'll be happy?
  - look at websites/brochures of the department/school
  - research the location
  - small program versus large program?
- what do you want to do?
  - *if interested in research*: does the work of **current** faculty (look at research descriptions, publications, etc.) look interesting to you?
  - *if interested in teaching*: are there appropriate opportunities to learn about and get experience in teaching and learning?
  - *if interested in business/entrepreneurship/policy:* are there appropriate professional development opportunities?

Applications: The Digits

- transcript
  - chemistry/science courses and grades
  - > “B” average is a good benchmark
- GREs
  - take in September/October to have scores to institutions by December
  - averages: verbal: 153 (62% rank); quantitative: 153 (65% rank); analytical writing: 4.5 (72% rank)
  - GRE: Chemistry/Biochemistry may or may not be required
- TOEFL (international students)
  - minimum score is 80 (20 on each section)
  - TOEFL speaking: 25 (to be sure applicant can TA)

Applications: The Statement

- less is ***not*** more!
  - give us a sample of your best writing!
- a general structure:
  - what have you done up until now? how have your life and school experiences converged on your decision to attend graduate school?
  - what do you want to do with your life and career?
  - how will coming to ***our*** school help you achieve these goals?
- proof-read!!

Applications: The Statement

- some specifics:
  - address past research experiences and relevant course experiences
    - research at current and past institutions, REU experiences, industry/internship experiences
  - address leadership experience
    - *especially* teaching experience, if applicable
  - mention the faculty members with whom you are interested in working
    - and *why*!

Applications: The Letters

- typically, three letters are required
  - letters should come from scientists/faculty that have had you in class, been your research mentor, or have mentored you in some other way
  - they should be able to provide information an admissions committee couldn't get from other application materials
- decide early; ask often
  - give your letter writers *at least* one month notice
- provide specific instructions to your letter-writers
  - tables of deadlines, formats (online vs. mail), mailing information, to whom to address the letters, etc.

Applications: Odds and Ends

- deadlines!
  - most programs have rolling admissions; apply WELL ahead of deadlines
  - earlier applications have a better chance of getting you nominated for fellowships
  - late applications will likely not be reviewed
- fees
  - fees range from free to ~ $100
  - if you can't pay it, let the school know

The Offer

Congratulations! I am pleased to inform you…

- review the offer letter carefully! things to consider:
  - the stipend
    - is support guaranteed? … and for how long?
    - is it enough to live comfortably in the geographic location of the school?
  - tuition and fees
    - do you pay these out of your stipend? … or are they "waived"?
  - benefits (medical, dental, emergency, etc.)
- if any details are unclear, pester!

Selecting a School

- visit!!
  - attend a “visitation weekend” or talk to the school/department to set up an individual visit
  - get the “inside scoop” from students; *trust that the faculty are putting their best foot forward*
  - consider facilities and infrastructure
  - consider the location
    - can you live there and be happy for an extended period of time?
    - explore! are the extracurricular things you like to do available?

Selecting a School

- don't "put all your eggs into one basket"
  - are there are least 2-3 faculty with whom you're interested in working?
- program requirements and structure
  - rigid versus flexible requirements
  - available courses
- is there community amongst the graduate student population?
  - will you have a suitable peer support network?

Time for Questions!

Compose a thoughtful question about the types of graduate programs, the graduate application process, or how to decide on which schools to apply and attend on the notecard provided.

We'll see what happens when you get to grad school in just a bit...

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Graduate School Reality Check

Step 2: Staying In and Succeeding

slides will be available online:
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Staying in and Succeeding

- What happens when I get there?
- How is graduate school different than undergrad?
- How do I choose a research advisor?
- What does it take to succeed in graduate school?

The Grad School Journey

its going to be like a reality TV show

- lots of young people from all over the world converging on a single chemistry department
- many will live together
- competing in a game of whit, skill, and tenacity
- there will be tears, laugher, sadness, and swearing
- typically, the most stubborn “contestants” win

The Biggest Differences

- undergraduate
  - you play the “credit game”
  - you have courses and grades as motivators
- graduate school (M.S. and Ph.D.)
  - its a very individual process - no student takes the exact same journey as another student
  - at times, *you* are your only motivator
  - your intellectual progress is monitored by a committee; the “course game” is over

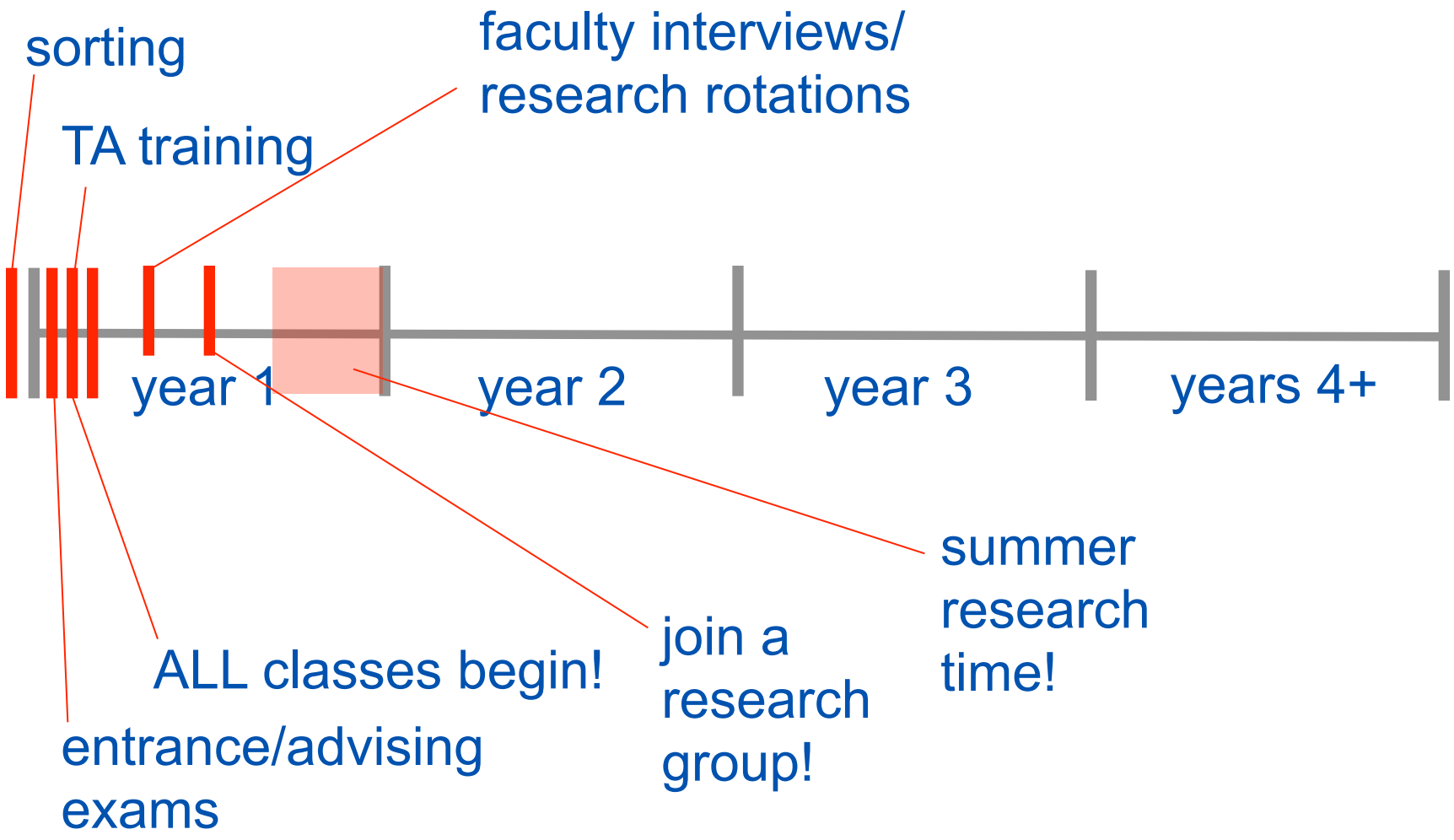
The Grad School Journey

indoctrination. a whole lot of new will be coming at you from every direction. don't worry, everyone else feels exactly like you do.

a time for intense study and reflection. rely on your strengths; recognize and confront your weaknesses.

learn to manage your time. work hard *most* of the time; work smart *all* of the time.

The Grad School Journey



A word about being a TA

Graduate Students' Teaching Experiences Improve Their Methodological Research Skills

David F. Feldon,[1]* James Peugh,[2] Briana E. Timmerman,[3] Michelle A. Maher,[4,5] Melissa Hurst,[4] Denise Strickland,[4] Joanna A. Gilmore,[6] Cindy Stiegelmeyer[7]

Science, technology, engineering, and mathematics (STEM) graduate students are often encouraged to maximize their engagement with supervised research and minimize teaching obligations. However, the process of teaching students engaged in inquiry provides practice in the application of important research skills. Using a performance rubric, we compared the quality of methodological skills demonstrated in written research proposals for two groups of early career graduate students (those with both teaching and research responsibilities and those with only research responsibilities) at the beginning and end of an academic year. After statistically controlling for preexisting differences between groups, students who both taught and conducted research demonstrate significantly greater improvement in their abilities to generate testable hypotheses and design valid experiments. These results indicate that teaching experience can contribute substantially to the improvement of essential research skills.

Academic culture in doctoral research universities' STEM (science, technology, engineering, mathematics) programs typically values research activity over teaching (*1*, *2*). Faculty commonly believe that research activities enhance teaching quality but disbelieve that teaching similarly enhances research skills (*3*, *4*). These beliefs influence not only the professional priorities of STEM faculty, but also the guidance teaching in a context that requires students to effectively conceptualize research and solve problems through inquiry (for example, frame testable hypotheses, design valid experiments, or draw appropriate conclusions based on data), instructors must practice these skills themselves as they reason through these problems in order to provide appropriate guidance to their students. When students are trying to solve different problems, (*7*). In contrast, a research assistantship in a laboratory probably provides fewer, relatively similar projects that are based on the research agenda of the lab or principal investigator. Further, many high-level research design issues are likely to be resolved without requiring the research assistant to make substantive contributions to, for example, specifying research questions or determining methodology. For graduate students new to a lab, it is likely that the funded grant proposal supporting their work was written and submitted before their arrival.

Additionally, when learners are required to articulate their reasoning processes substantial evidence indicates that they develop more elaborate and effective schemas for problem-solving that facilitate performance on both typical and new problems (*8*, *9*). Therefore, when instructors explain their own research processes to guide their students (*10*) they are further reinforcing their own learning. Research assistantships do not necessarily require extensive self-explanation (*11*).

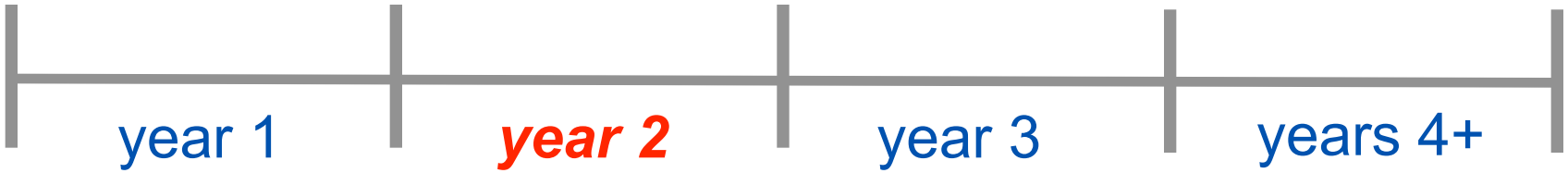
Several small, qualitative studies report benefits of teaching for graduate student participants' research development. One found that 21 of 27 teaching assistants leading undergraduate labs reported positive benefits to their research skills as a result of their teaching experiences (*12*). Another found that 33% of research advisors supervising participants in a National Science Foundation (NSF) GK-12 program (*13*) directly attributed improvements in participants' research

The Research Mentor

- a critical decision!
- don't decide on prestige alone (or at all)…
  - does your personality mesh with your mentor?
  - does your mentor's management style mesh with your work habits?
  - does your mentor appreciate your goals and aspirations?
  - can you ***learn*** from your mentor?
  - how does your mentor define "success"?

The Grad School Journey

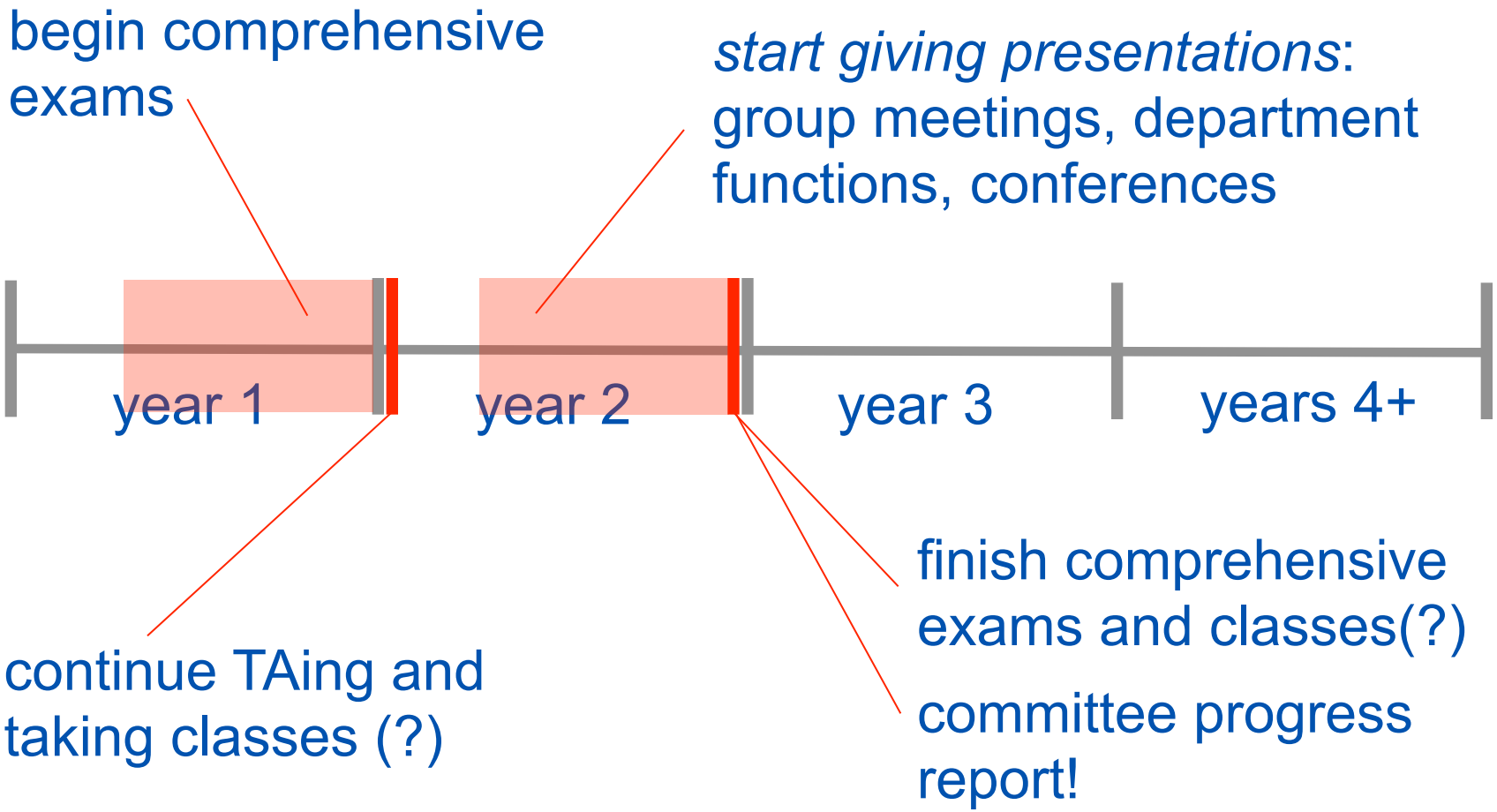
you're not new anymore. time to start becoming self-motivated and a little more independent!



transition your learning. classes are almost done; time to learn for the sake of learning and discovery

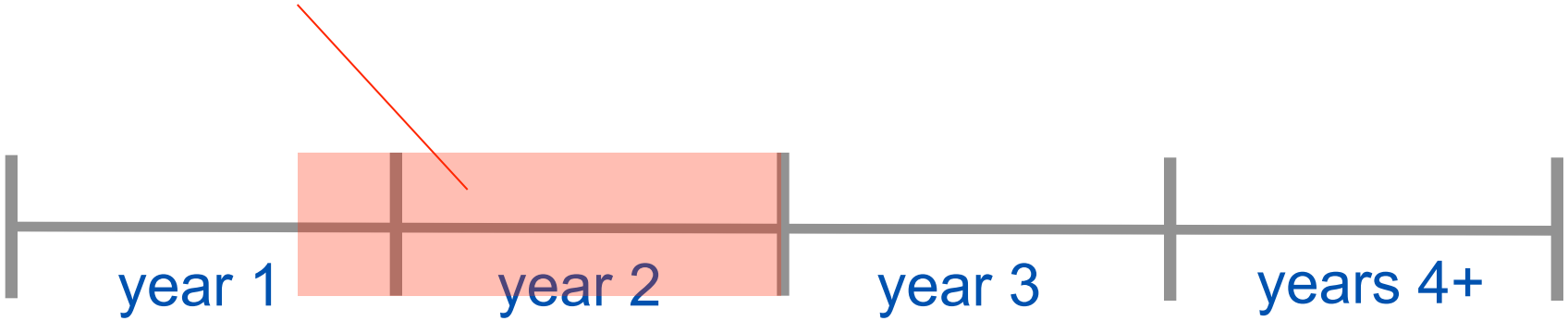
assess and reflect. you should be progressing and growing. are you? are you overcoming weaknesses?

The Grad School Journey



The Grad School Journey

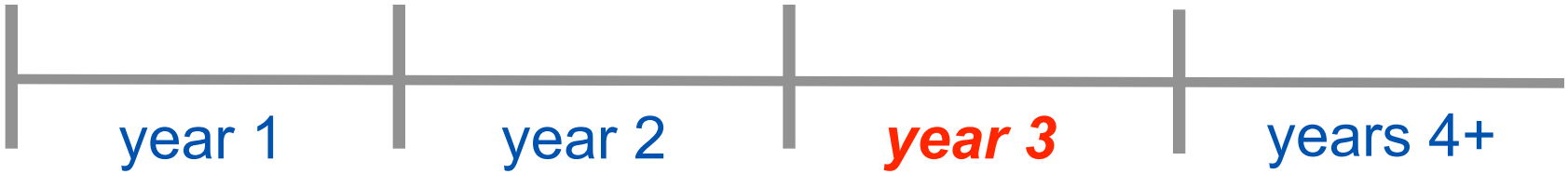
RESEARCH!
develop good habits...



- keep your lab notebook detailed, up-to-date, and indexed
- write up each of your experiments as a full report (methods, results, and conclusions!)
- keep a literature notebook - one page summaries of any publication you read
- build a bibliography (using Endnote, RefWords, etc.)

The Grad School Journey

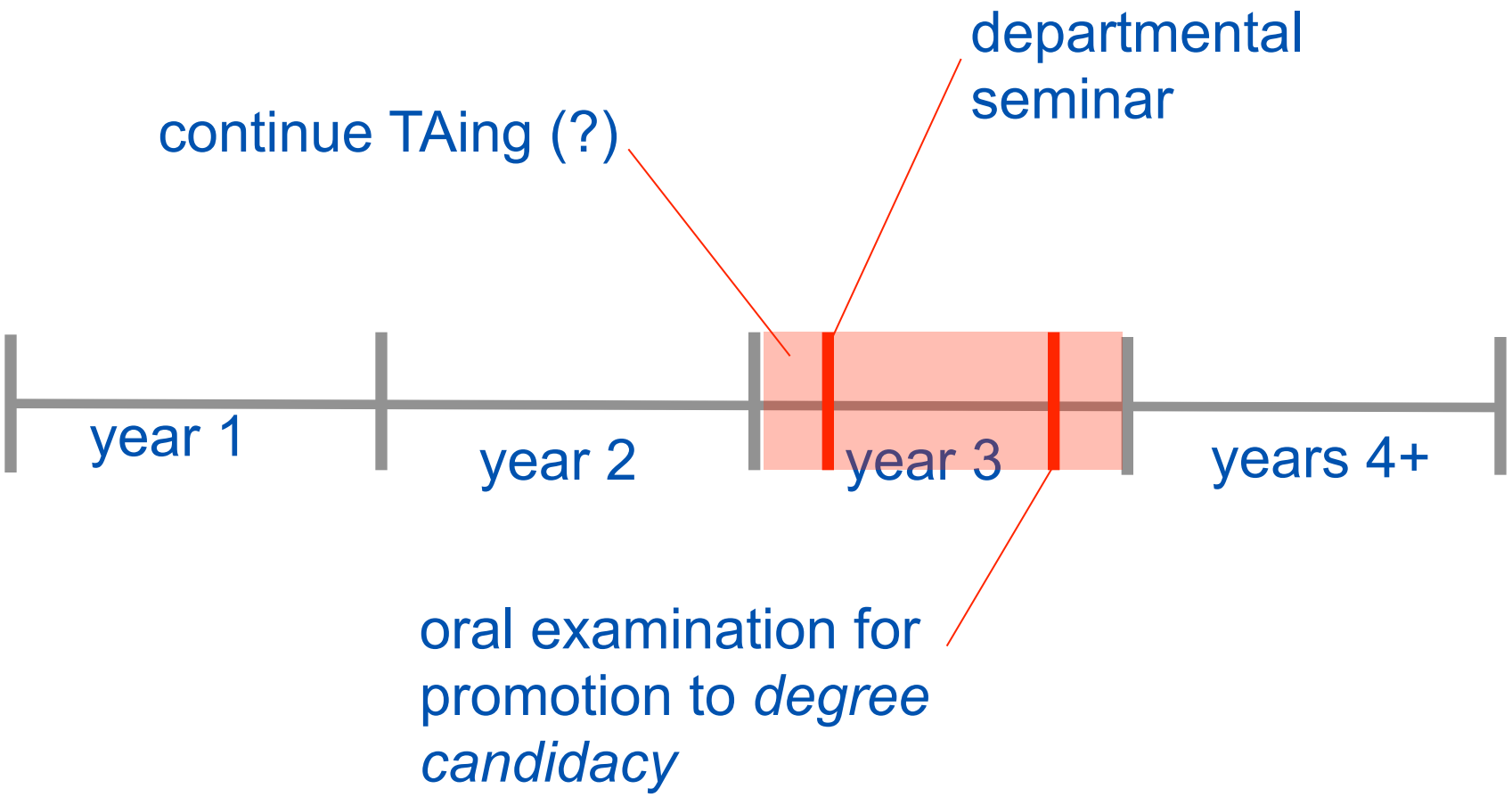
a turning point. time for your mentors to assess your progress and your strengths/weaknesses



begin to take charge of your research. come up with your own ideas and directions. become the expert!

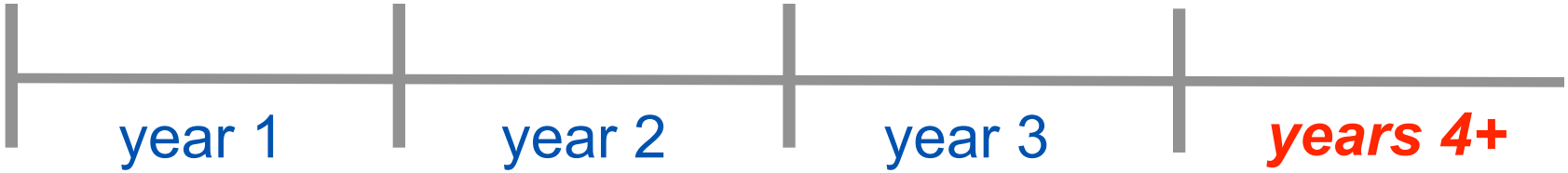
push yourself. the excitement has worn off… but you're not that close to being done

The Grad School Journey



The Grad School Journey

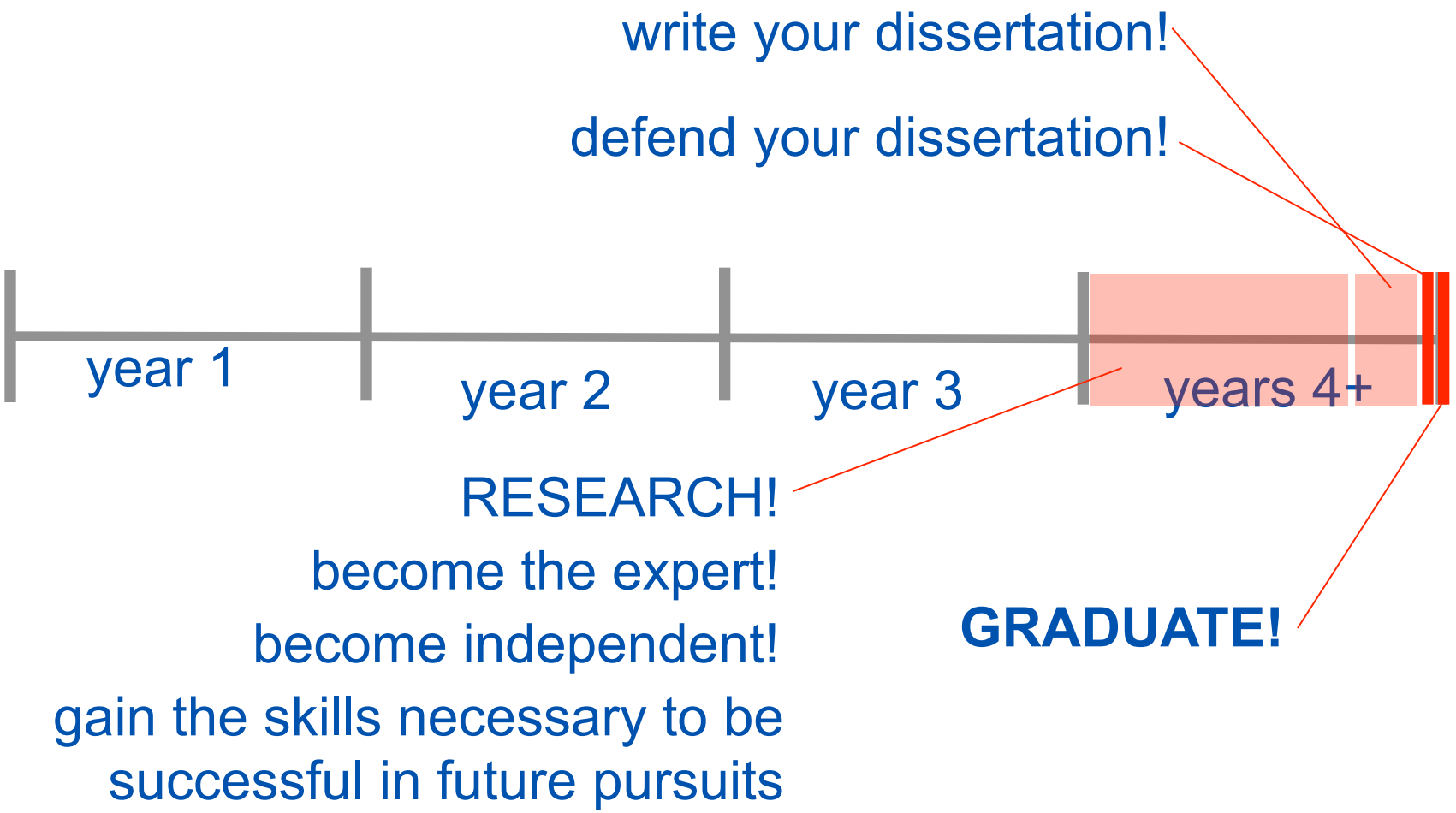
own your research. learn to communicate and promote your work: publishing, presenting talks and posters, write and defend your dissertation



you're the expert. mentor a younger grad student or an undergrad; become the *sensei*

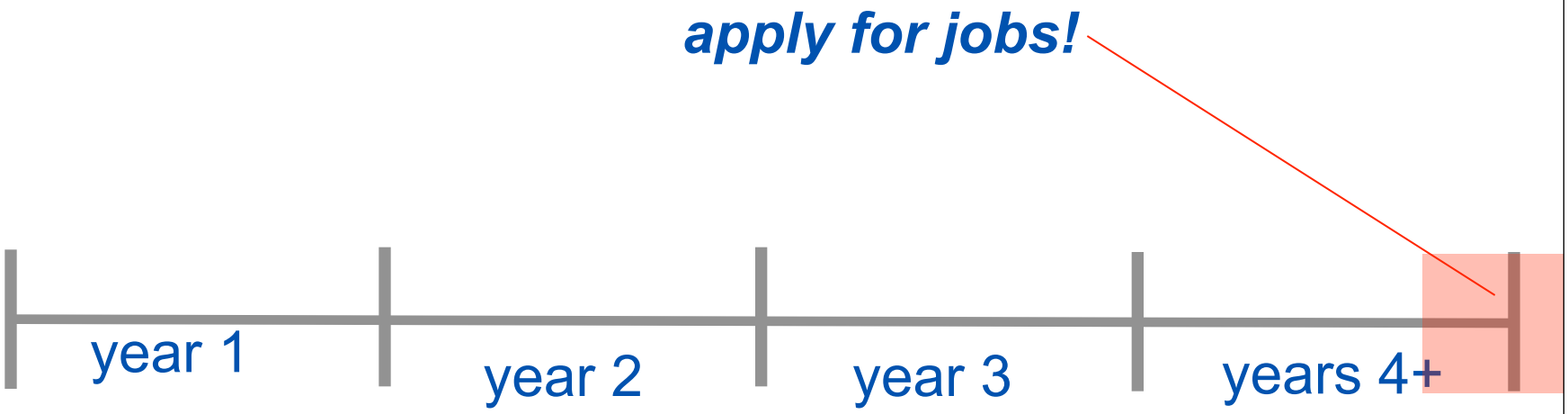
prepare for life after graduate school. engage in professional development activities to supplement your scientific training

The Grad School Journey



The End!!

… or is it?



- how can your mentor and institution help with this?
- get to know other members of the faculty (not just those on your committee)
- NETWORK at meetings/conferences and online!!
- **take advantage of what the ACS has to offer!**

Enjoying Success

- Your graduate cohort will have entered on equal footing
  - the ***tenacious*** will not give up
  - the ***reflective*** will quickly recognize weaknesses and work to strengthen them
  - the ***swashbucklers*** will gain independence quickly
  - the ***good communicators*** will "own" their work
  - those with ***flexibility*** and ***good time management*** will work smart and hard
  - the ***self-motivated*** will do all of the above while the research mentor is out of town
  - those that ***enjoy Science*** will do all of the above with a smile on their face… most of the time!

Time for Questions!

Compose a burning question about the *graduate school journey* on the notecard provided.

Feel Free to Contact Me

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