This is a roadmap for completing a PhD in the McCarley Group. It is written in chronological order for progression to the degree.

There are a few facts that are important for you to consider before we discuss The Path.

Some Facts About The McCarley Group

A. As of November 2023, there have been 41 PhD students who have completed their degree with me; there are currently 2 PhD students for whom I am their PhD mentor. There have been 5 students who chose not to pursue a PhD and 1 who I asked to leave without a PhD;

B. All of the PhD students obtained a position either before or immediately after they defended their dissertation. All have positions at the time of this writing. One is a faculty member a Master's degree-granting university, another a faculty member at an HBCU, and two more are faculty at regional universities. One works for a homeland security laboratory. One is at a Carnegie Research I University. The remaining students have careers in industry. The vast majority had beginning salaries that exceeded mine at the time of their taking their jobs;

C. Our group has produced over 100 peer-reviewed publications, plus roughly 40 proceedings publications, since I started my academic career in 1992;

D. Students have attended ACS, ECS, and Gordon Research Conferences consistently since 1992;

E. A good number of students (8) have received national society awards or graduate fellowships sponsored by the federal government or industry. Four students have received NSF Graduate Research Fellowships, and one was an Honorable Mention;

F. One student received a prestigious National Research Council Postdoctoral Fellowship to carry out work at a national laboratory;

G. The average time to complete a PhD degree in The Group is roughly 5 years. The national average is currently 5.6 years;

H. The average salary of recent PhD students ("0 experience") from The Group entering industrial jobs is $118,000;

I. Our group has several of the most highly cited refereed publications in the department, I have an ISI H-index Impact Factor of 45 (>7000 citations, ~200+ citations/year), and 15 of our publications have been cited by others more than 100 times. You can find this information for anyone by doing an author search with Web of Science and then selecting "Citation Report." Similar information can be found via a Google Scholar search.

In summary, I have high standards so that my students are well trained and can obtain meaningful and rewarding careers, and so that I can obtain funding to carry out the exciting research that we do. It takes commitment, hard work, perseverance, deep thinking, careful experimentation, great communication skills, and a love of science to be successful in The Group. I care a great deal for my students, and I will always be there for you as long as you are there for me and *you*. Now, what does that mean? That is what I refer to as The Path, which follows.

The Path to a PhD in The McCarley Group

Year 1 – *The Salad Days* (Shakespeare's *Antony and Cleopatra*, 1606 *or* Coen brother's *Raising Arizona*, 1987)

Act I – 1st semester in residence

Student enters PhD program and takes courses the 1st semester with advising from Admissions Committee.

- Student signs up for written PhD examinations and takes each and every exam that is offered.
- Student may take exams in two areas of chemistry, with 3 passed in their area of expertise and 3 in one other field (do not take a "multiple choice" approach to written exam taking).

Student selects RLM as advisor via a mutual agreement, and this is confirmed at the end of the entering semester.

Act II – 2nd semester in residence

Student enrolls in and completes coursework for second semester of residence that RLM and student agree to.

- Additional coursework may be required depending on the student's project.
- Student also may need to give a required seminar (for example, a mechanisms talk in Organic Seminar).

Cumulative examinations.

- Student should have passed 5 exams by the end of their first year in residence. If there are difficulties in attaining this milestone, the student shall seek out help from RLM and others.

Student carries out shadowing in the lab to learn what others are doing, then a mutually-agreed-upon dissertation project is undertaken (I do not give students "trial projects" to test them – I do not believe in this).

Act III – 1st summer semester in residence

Gaining experience. The first summer provides students with an intense experience with research to gain their headings and learn what skills they have and those they need to improve upon during their PhD training.

- Written, monthly reports are required from this point on, as is participation/attendance in Group Meetings.
- Reading literature should be roughly 15+ hours a week (try it in your "easy chair" in your domicile in the late evenings).
- *A student should be doing and/or thinking about chemistry 60+ hours a week.*
- Lack of progress at any point in the student's career will result in a Chem 9000 grade of U with termination of assistantship (*I* do not petition for re-establishment of assistantships).

Year 2 – *The Engagement and Proto-doctor-granting Ceremony*

Act I – 3rd semester in residence

Student continues to mature their understanding of the PhD project.

- Laboratory work, reading, attending division and colloquium seminars, analyzing data, writing monthly reports are the things that a successful student will be doing their entire time in The Group.
- As you spend more time doing these things, you will learn to become more efficient, permitting your capabilities to grow, and thus your accomplishments to do so as well.

Student gives literature seminar.

- The slides should be reviewed by 3 others (the Rule of Three, see later) before being given to me.
- Slides should be semi-finalized 10–14 days before the seminar is to be given.
- Your practice presentation to The Group should be a minimum of 7 days before you give your seminar.
- Provide your abstract to the seminar director 14 days ahead of time.
- You should try very hard to select a topic that you can use for your independent – this is not required, but it makes your general exam independent topic easier to deal with if you do so.

Student is working on selection of a topic for the general examination independent proposal – this should be achieved by the end of the third semester.

- Students should be reading roughly 10 hours a week in journals that provide you with exposure to a very broad spectrum of chemistry/science; this reading should be carried out in addition to the 10-15 hours a week you are reading for your research project. *Research will not suffer during this time.*

Once again, time spent thinking and/or doing chemistry should be 60+ hours a week (we will re-visit this later). This will allow you to begin writing your research proposal for your PhD project and outlining your proposal for your independent.

Cumulative examinations.

- Student should have passed all PhD written exams by the end of their 3rd semester.
- Historically, all McCarley Group members have done so; thus, petitions after 4 semesters in residence are not needed and will not be supported by RLM.

Year 2 – *Engagement and Proto-doctor-granting Ceremony (continued)*

Act II – 4th semester in residence

Student continues preparing general examination documents and carrying out research at a pace that will continue to allow for timely completion of milestones, which includes taking and passing the general examination by the end of the 4th semester of residence.

- Scheduling of the general examination will be accomplished by the deadline put forth by the graduate school.
- Multiple examinations from the McCarley Group in the same semester will be spaced out a minimum of 2 weeks apart and will not be at the very end of the semester (you do not want irritated faculty members on your committee).
- Well in advance of the examination, the student will write a 1-page Project Summary for both their PhD and independent proposals, and then these will be submitted to their committee members for their approval, which you must obtain in writing before proceeding with your documents (to ensure that there is no overlap between your PhD and your independent proposals). Writing the Project Summary of your proposals *first* makes you think about how you will attack the challenges/problems of your projects in outline format; that is, you will tend to initially focus on the big issues (specific aims) and their impact instead of the details of the experiments (objectives), thereby making writing the document much easier. Organization is key when writing, so make sure that it is done before you start writing.
- Documents are to be reviewed by a minimum of 3 others ("The Rule of Three" - preferably postdocs and senior graduate students, and possibly the Writing Center) before I will examine them; if I find a significant number of grammatical errors or poor organization within the first few pages of the documents, I will return them to the student without further corrections. This will continue until the student has provided a set of documents that I deem acceptable. Remember, students have a baccalaureate degree (or higher) at this stage and should be able to write in a clear, organized fashion. Examples of proposals must be obtained from me.

Keep an up-to-date resume/CV.

- All through your professional career, you will need a current resume/CV for award nominations, job promotions, career moves, etc. You should start keeping such a document as soon as you enter graduate school, but certainly by now it should be put together.
- Get help from the ACS web site, resume-writing aids such as popular books, etc.

Annual Report to Committee Due.

Act III – 2nd summer semester in residence

Student continues with all the responsibilities and skill building provided to them by passing the general examination so as to meet the goals of their research proposal in a timely fashion.

- This is the time when you should be going full-throttle with your research efforts on all fronts. You have the opportunity to become THE expert on your project, so why not do it as quickly and as well as is possible? The payoff will be big in many ways! Use your research plan and think about manuscripts for the different specific aims of your work.

- Begin thinking about conferences to attend in the coming year and gather information on them, and apply with the advice of RLM.

Year 3 – *The Short Honeymoon*

Act I – 5th semester in residence

Keep up the work, and you will reap the benefits.

- Stick with your research plans as close as possible, but realize that there may be detours and road blocks. Perseverance is key! As my mother used to say to me, "There is a reason they call it re-search."
- A couple of hours in the library will often times save you a couple of weeks in the lab. Completion of the objectives (experiments) of your research proposal hinges on many things, but proper planning is one of them, so reading the literature and understanding it before you do things in the lab is vital. However, do not over plan experiments, as this can often lead to frustration if things are unsuccessful. I often times refer to my approach as "schlocking in the lab" when I do careful enough experiments but not too painfully careful so that a negative (which can be good) outcome does not bring me down.
- By the end of this semester, you should probably have a pretty good outline filled in for a manuscript, and you may even have one submitted. That is, you should have enough experiments that provide superstructure to your manuscript so that a story can be seen, and only the details need to be filled in – those are your experiments that will need to be done to make the story whole.

Act II – 6th semester and 3rd summer in residence

Keep up the work, and you should have a manuscript submitted soon, as well as attending a conference.

- You now have learned a great deal about a given specific aim of your research proposal and have filled in a good number of blanks by completing many of the objectives for that aim. You have a manuscript that is getting close to a real draft version. We may be experts, but there is a reason that we talk to other scientists, which leads us to…
- Attending a conference and telling the story you have laid out in your manuscript in terms of your overall goals for your research will afford you a great opportunity to gain communication skills, but more importantly, you will get feedback (yes, criticism!) on what you have done. This will help solidify some aspects of your work and also bring forward questions that we may not have thought of.
- Addressing questions that RLM and others (such as from your conference) have will allow you to get your first manuscript in draft form, possibly ready for submission by the end of your 3rd summer. Some projects may not work out this way, so do not get disappointed. However, get disappointed if you know that not meeting this milestone at this time is the result of lack of effort.

Annual Report to Committee Due.

Year 4 – *Growing Pains and the Seven-year Itch*

Act I – 7th semester in residence

It is during this time that you are developing into a mature scientist, but you may have doubts and questions about what you are doing and why.

- You should now have a manuscript in review or accepted for publication unless your project has prevented this.
- Two other publications from your efforts on your PhD project should be in an outline form. Others may be coming forth from other efforts.
- This is an exciting time, but the light at the end of the tunnel may seem far in the distance. Ask me to see my ponderings at this stage of my career, and you'll be surprised, I guarantee it.
- Keep on track – keep the thinking/doing chemistry rule in mind, attend seminars, read, submit abstracts for conferences and attend them to flesh out your work and show off your accomplishments as well as network with people of all sorts. Networking is a very important thing, as you never know who may be your employer, employee, or colleague some day.
- Realize that you have much to give and much to learn – this is a life-long philosophy that every scientist should adopt.
- You should sign up for on-campus interviews if interested in an industrial position. Begin looking into faculty you would want to work with as a postdoc if that is a direction you want to head. You must get my permission to do so, though, in both cases.
- You will need to spend about 5-10 hours a week in your employment-seeking endeavors starting somewhere about mid-7th semester in residence until you have secured employment. This applies for postdoc positions as well.

Act II – 8th semester in residence

Annual Report to Committee Due.

Graduation is not that far off, and you should begin thinking in a retrosynthetic mode in your planning for that event and the associated responsibilities and opportunities.

- Data defense before your PhD committee (exclusive of dean's representative) should be done roughly 6-8 months ahead of the target date for your dissertation defense. This is not achieved by your research seminar, which should be done in your last semester of residence.
- Plan your dissertation outline with RLM.
- You should be using your networking contacts to send out feelers for potential employment opportunities. In addition, attend ACS and Pittcon meetings – sign up for their job fairs. Make sure to give a talk and/or poster at these meetings so you can show off your work and you. By the time you reach this semester, you should be well into looking for a job.

- Your two manuscripts should be close to being submitted to journals by the end of this semester or by the 4th summer in residence.

Act III – 4th summer in residence

This is a very busy time in your career as a graduate student, so use your time efficiently and wisely.

- There may be some wrapping-up experiments that need to be carried out late in this summer based on feedback from your data defense and conference talks/posters. Plan them out well and execute them, as well as evaluate the data generated.
- Finish writing up your draft manuscripts and get them reviewed internally (The Rule of Three) before giving them to RLM. There may be more experiments to do once I have reviewed them, so be prepared for those. In fact, you probably will have the scientific maturity to know what others will ask of you, so show us that is the case by taking the initiate of doing those experiments.
- Keep the employment search activities at a high level (maybe 10+ hours per week from here on out) if need be.
- Read as much as you can about your research area and the general literature. The latter is important, for you will need this information (which should also be garnered from colloquium seminars all through your graduate career) when you go on job interviews – they want to know how up to date you are and what your level of interest is in science!
- Plan for your dissertation defense date in a retrosynthetic fashion.

Year 5 – *How will RLM know that I am ready to defend?* Or *Am I Smarter than a 20th grader?*

Act I – 9th semester in residence

"You are ready to receive a PhD when you know you are ready." –RLM, ca. October 1996

- If you ask the question above and can honestly answer it by comparing yourself to others at your home institution and elsewhere pursuing a PhD, then you know you are ready when you know you are ready.
- Research seminar should be given this semester. In some cases, it may be in your 8th semester.
- Dissertation defense cannot be scheduled until your manuscripts have been accepted for publication. In addition, your dissertation should be completed one month in advance of the defense date. This document is a work of art that describes what you have accomplished in the laboratory, but reflects your other skills you have gained over the past 4-4.5 years. So, it should not be put together hastily. Enjoy writing this document!
- Prepare a 25-minute presentation that gives an overview of your dissertation project, reflecting back on your goal and aims of your research proposal document. This is going to be a shortened version of your on-site interview talk, but with the same "punch" on the importance and novelty of the project.

- Make the required corrections to your document and submit to the graduate school electronically. Ask to keep the document from public disclosure for 1-2 years if you have a manuscript that may not yet have been published or if patent issues are pertinent.

Act II – 10th semester in residence

Not all PhD projects are created equal.

There may be situations that cause delays in your PhD project that are beyond your control. We will attempt to address those as you move along in your tenure. However, my expectation is that you should complete all requirements by the end of your 5th year. I will not support requests for financial support of a student who has been here more than 5 years.

A summary of requirements/milestones/upshots:

0. You must always wear safety glasses in the laboratory;

1. Be thinking and/or doing chemistry 60+ hours per week;

2. Monthly reports on progress toward obtaining research goals and aims are due on the 1st of each month;

3. Cumes will be passed and required, non-research seminars will be completed by end of 3rd semester;

4. General examination will be successfully passed by the end of the 4th semester;

5. Data defense will be completed by the end of the 8th semester in residence;

6. Lack of progress will result in a Chem 9000 grade of U with termination of assistantship (I do not petition for re-establishment of assistantships);

7. Minimum of three refereed publications submitted and accepted before your dissertation defense is scheduled in your 9th or 10th semester; and

8. Protect any intellectual property that has not been disclosed in publications by barring electronic access to your dissertation for a minimum of 1 year.

What follows is a nice excerpt from a document that Samuel Douglass Gilman (my academic great nephew) gave me in 2007. I think the point it makes is quite nice.

WORK HABITS AND TIME TO GRADUATION

I don't demand that students arrive and leave the laboratory on a schedule set by me. One of the perks of graduate school is a flexible schedule. I do expect students to show up for group meetings, seminars, classes and teaching assignments. You should also be sure that your schedule overlaps with mine at least a few hours each day so we can communicate regularly.

I expect most students to complete a Ph.D. in 4-6 years, and I would like the average to be closer to 4 rather than 6. It is important to realize that completing a Ph.D. depends on completing research and writing manuscripts and a dissertation. Simply being in the Ph.D. program for 4-6 years is not sufficient – work completed is the key.

It is unrealistic to think that working 40 hours per week is enough to complete a Ph.D. in a reasonable period of time. Few college graduates go on to earn a Ph.D., and one reason is that it requires hard work and focus. The number of hours per week needed to complete a Ph.D. in a reasonable period of time is heavily dependent on how efficiently you work. Some students can get a lot done without working long hours, and others can work many hours and still accomplish little. Consider the following scenario:

Student A	**Student B**
Spends 45 hr/wk in the Chem building	Spends 55 hr/wk in the Chem building
Takes 5 weeks off each year	Takes 3 weeks off each year
Spends 12 hr/wk on non-work activities (during hours in the Chem building)	Spends 7 hr/wk on non-work activities (during hours in the Chem building)

If student B completes a Ph.D. in 4.0 years, it will take Student A 6.1 years to complete the same amount of work! Student B will be more productive in a shorter period of time and will likely have better job opportunities plus will be earning a better salary two years earlier!