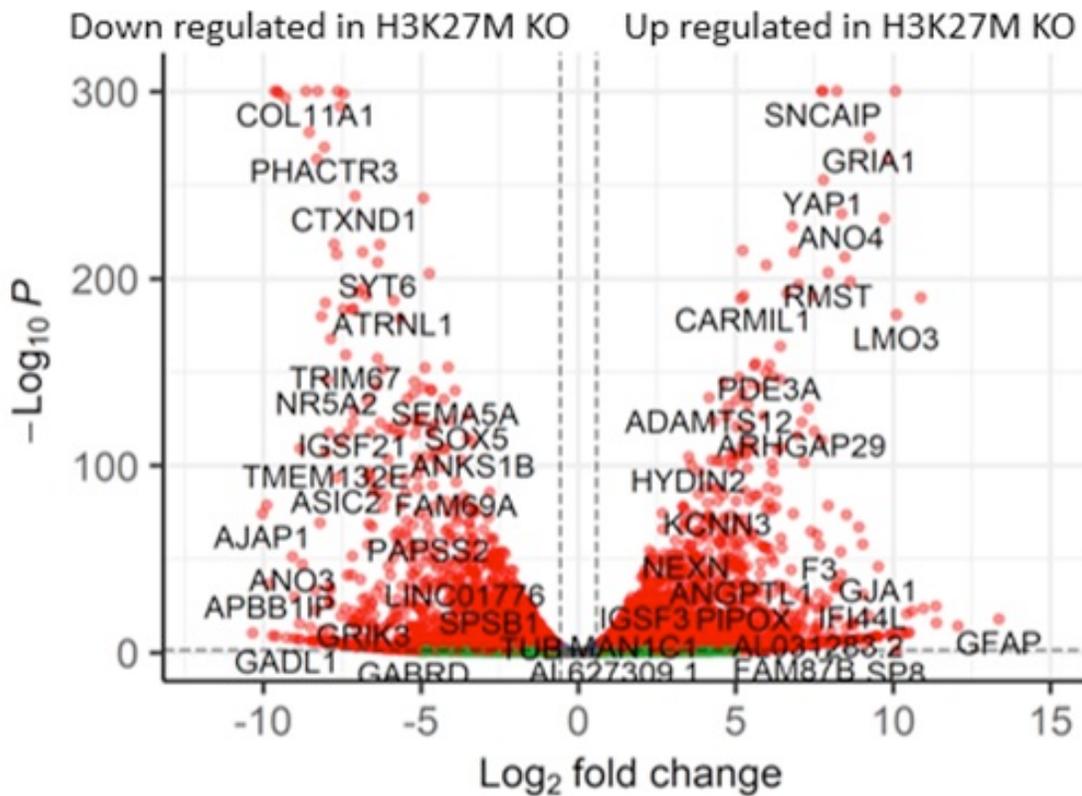




## **BIOLOGICAL CHEMISTRY**

### **MASTERS PROGRAM**



## **STUDENT HANDBOOK**

### **2022-2023**

## About the Cover

### **Volcano plot of genes upregulated and downregulated in H3K27M KO cells from Diffuse Intrinsic Pontine Glioma (DIPG)**

Diffuse intrinsic pontine glioma (DIPG) is a brain tumor found in a part of the brain stem called the pons. DIPG affects children almost exclusively. Approximately 200-400 children in the United States are diagnosed with DIPG each year. These children are typically between the ages of 4 and 11. DIPG accounts for roughly 10-15% of all brain tumors in children. A glioma cell line from a DIPG patient was modified to change the lysine residue at position 27 on histone H3 to methionine to render this position unable to be modified by acetylation. The parental glioma line and the H3K27M KO line were compared using BruSeq to determine genes that were altered in terms of transcriptional activity. Large transcriptional changes were observed for the genes identified. These results were generated by Jeanette Cruz (MS 2022) in Dr. Stefanie Galban's laboratory in collaboration with Drs. Mats Ljungman and Brian Magnuson.



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## MASTERS PROGRAM ADMINISTRATION

Master's Program Directors	Dr. Michael Uhler	(734) 647-3188; <a href="mailto:muhler@umich.edu">muhler@umich.edu</a>
	Dr. Debra Thompson	(734) 936-9504; <a href="mailto:dathom@umich.edu">dathom@umich.edu</a>
Graduate Programs Manager	Ms. Beth Goodwin	(734) 764-8594; <a href="mailto:egoodwin@umich.edu">egoodwin@umich.edu</a>

## PROGRAM OVERVIEW

The Department of Biological Chemistry offers the one-year Masters Program designed to broadly train tomorrow's leaders in biomedical sciences. Our graduates are well prepared for matriculation into elite graduate or medical programs as well as for employment in industry. Two tracks of study are offered, depending upon the goals and interests of the student. Tuition costs for the 2020-2021 academic year (two terms) were approximately \$25,000 for in state students and \$49,000 for out of state students.

**Masters in Biochemistry-Research Track:** This one-year (two-semester) program of didactic coursework in biochemistry includes an intensive research experience and a written research thesis. This program is intended for individuals seeking to increase their skills and research experience for employment opportunities, or for application to highly competitive Ph.D. or medical professional degree programs. Research track students are encouraged to begin work in their mentor's laboratory prior to the beginning of Fall term, particularly if they will be applying to graduate schools during the Master's program.

The intensive research experience is a key feature of the research-track. Our [faculty members](#) conduct research at the cutting edge of modern biochemistry and molecular biology. Current areas of research include structural biology, protein biochemistry, enzyme reaction mechanisms, molecular genetics, signal transduction, neurobiology, cell and developmental biology, and bioinformatics. Students match with faculty research advisors after advisement by the directors and by mutual consent with the faculty, either before arrival on campus or immediately thereafter. The capstone of the research experience is the thesis dissertation.

**Masters in Biochemistry-Coursework Track:** This one-year (two-semester) program of didactic coursework in biochemistry and related fields is designed for students who plan to attend medical, dental, veterinary, law, or other professional programs. Students on this track take two semesters of rigorous, graduate-level, coursework. In addition, students will conduct a mentored literature review in a selected area of interest, working one-on-one with a research faculty, and culminating in a scholarly review article. Students on this track are exposed to an impressive array of modern research topics and methodologies through seminar programs, a critical analysis course, and interactions with our faculty, and are well prepared to succeed in professional programs.

## CURRICULUM

Coursework in both tracks consists of required and elective components. To maintain academic standing, advance to the second semester of the program, and to be awarded the M.S. degree, a B- or better is required in all coursework. Students experiencing difficulty in any course should contact the Master's Program Directors early in the term and tutors can be identified to assist the M.S. students.

## Master's Graduate Curriculum

***A typical credit load is 14-15 credits per term for a minimum total of 29 credits, including 4 cognate credits, and development and completion of a written research review (Course Track) or thesis (Research Track).***

### **A. Biological Chemistry Required Courses:**

BIOLCHEM 655 Molecules of Life: Protein Structure, Function & Dynamics (3 Cr, F)  
(for most students with advanced standing in biochemistry, e.g. biochemistry UG degree)

OR BIOLCHEM 515 Introductory Biochemistry (4 Cr, F, W)

BIOLCHEM 597 Critical Analysis (3 Cr, W)

BIOLCHEM 711 Graduate Seminar (1 Cr, F; 1 Cr, W)

BIOLCHEM 712 Biological Chemistry Seminar Series (1 Cr, F; 1 Cr, W)

PIBS 503 Research Responsibility & Ethics (1 Cr, F)

### **Research Track**

BIOLCHEM 600 Independent Study (Master's thesis research) (5-6 Cr, F; 5-6 Cr, W)

BIOLCHEM 601 Tools of a Scientist (2 Cr, F) –(optional for 2021-22)

### **Course Track**

BIOLCHEM 601 Tools of a Scientist (4 Cr, F)

BIOLCHEM 603 Literature Review and Analysis (1 Cr, F; 3 Cr, W)

### **B. Biological Chemistry Advanced Electives (2 credits minimum):**

#### **Fall**

BIOLCHEM 650 Eukaryotic Gene Transcription (2 Cr, F)

BIOLCHEM 690 Biochemical Regulatory Mechanisms (2 Cr, F)

BIOLCHEM 713 Emerging Areas of Biochemistry (1 Cr, F)

#### **Winter**

BIOLCHEM 528 Biology and Chemistry of Enzymes (2 Cr, W)

BIOLCHEM 602 Protein Crystallography (3 Cr, W)

BIOLCHEM 640 Regulatory RNA and Control of Gene Expression (2 Cr, W)

BIOLCHEM 673 Enzyme Kinetics (3 Cr, W)

BIOLCHEM 675 Biochemistry and Cell Biology of Membranes and Organelles (2 Cr, W)

### **C. Additional Electives\* (3 credits minimum):**

#### **Fall**

BIOINF 527 Introduction to Bioinformatics and Computational Biology (4 Cr, F)

BIOINF 528 Advanced Applications of Bioinformatics (3 Cr, F)

BIOPHYS 520 Biophysical Chemistry I (Methods and Techniques) (3 Cr, F)

BIOSTAT 501 Introduction to Biostatistics (4 Cr, F)

BIOSTAT 521 Applied Biostatistics (4 Cr, F) [calculus prerequisite]

CDB 530 Cell Biology (3 Cr, F)

CDB 581 Developmental Genetics (3 Cr, F)

HUMGEN 541 Molecular Genetics (3 Cr, F)

PHYSIOL 502 Human Physiology (4 Cr, F)

**Winter**

BIOINF 524 Foundations in Bioinformatics & Systems Biology (3 Cr, W)

BIOPHYS 521 Biophysical Chemistry II (Theories) (3 Cr, W)

CDB 550 Histology (4 Cr, W)

CDB 582 Stem cells: Organogenesis to Regenerative Biology (3 Cr, W)

CHEMBIO 502 Chemical Biology II (3 Cr, W)

MICRBIOL 504 Cellular Biotechnology (3 Cr, W)

PATH 581 Tissue, Cellular and Molecular Basis of Disease (3 Cr, W)

\*This is a partial list. Consult your research mentor and academic advisor if you would like to take an elective course or courses not listed above.

## Thesis and Thesis Advisory Committee – Research Track

Thesis research will be done in the Fall and Winter terms and culminate in the writing of a Master's Thesis. The thesis is expected to be a synthesis of scholarly background and discussion of the research project, in addition to an original experimental or theoretical contribution to the field. By the end of October, students are expected to form their Thesis Advisory Committee, composed of the research advisor and two additional Biological Chemistry faculty members. By the end of November, students are expected to meet with their Advisory Committee. The student should provide an overview of the research project, summarize progress to date, provide an outline of planned experiments and a timeline for completion of the dissertation. Monthly consultation with the Master's Program Directors is also expected. A second meeting of the thesis committee is required during the Winter term and it is expected that the research will be completed by the end of the academic year in most cases, with the written thesis submitted no later than the end of Spring/Summer term. The student's Advisory Committee will evaluate the submitted thesis. The Master's degree (MS) will not be awarded until all required revisions are completed and approved by the Thesis Advisory Committee, the Department, and the Rackham Graduate School.

### Key Dates - Research Track

Throughout fall and winter terms, attend lab meetings and seminars/symposia recommended by your research mentor. Talk to your research mentor about work/research expectations.

Aug 26 Have mentor identified and completed mentor agreement turned in to Beth Goodwin

Sept 16/17 Departmental Retreat at Kellogg Biological Station

Oct 3 Apply for Rackham Research Grant  
<https://rackham.umich.edu/funding/funding-types/rackham-graduate-student-research-grant-2/>  
*(List Anne Vojtek [avojtek@umich.edu](mailto:avojtek@umich.edu) as Departmental Program Chair, and Beth Goodwin [egoodwin@umich.edu](mailto:egoodwin@umich.edu) as Graduate Coordinator on the online application)*

Oct 28 Form Thesis Committee and submit completed form to Beth at [egoodwin@umich.edu](mailto:egoodwin@umich.edu)

Nov 23 Schedule your first committee meeting **prior** to Thanksgiving break.

- Send an abstract to your committee members by email at least two days prior to your scheduled meeting.
- Prepare a powerpoint presentation for your committee meeting:
  - *Introduction of research topic*
  - *Outline your goals*
  - *Present hypothesis*
  - *Discuss experimental plans and data*
- Provide a draft of your presentation to your research mentor **at least one week** prior to your committee meeting and meet with him or her to get input on the presentation.

Dec 9 Departmental Poster Session\* (*date to be confirmed*)

Jan 27 Submit a draft of your thesis introduction to mentor; copy [egoodwin@umich.edu](mailto:egoodwin@umich.edu)

Feb 24 Convene your second thesis committee meeting. Submit mtg progress form to [egoodwin@umich.edu](mailto:egoodwin@umich.edu)

March 31 Submit experimental chapters to mentor; copy [egoodwin@umich.edu](mailto:egoodwin@umich.edu)  
(For consideration of May degree)

Apr 14 Present your research at Master's Symposium (*date to be confirmed*)

Apr 24 Final revised Research Thesis due to Program Directors and [egoodwin@umich.edu](mailto:egoodwin@umich.edu)

## Literature Analysis & Review Article - Course Track

Course track MS degree students will take an advanced literature analysis course (Biolchem 603), in which each student will focus on an important area of current research, review the research literature in that area in depth, and analyze this research thoroughly. Each student will produce a concise and impactful review of the subject, complete with thoughtful suggestions for future directions, suitable for publication. In the course of preparing the review, the student will become expert in the literature of the chosen area.

The preparation of these reviews will be supervised by the course track faculty mentor. Each student is expected to meet formally with their mentor each week, or more as deemed necessary, so that the mentor may guide the work, and additional contact by email will frequently occur for communication of draft versions, background papers, and notes. Monthly consultation with the Master's Program Directors is also expected. During the preparation of manuscripts, both the mentor and the student may need to consult with additional faculty members to obtain expert opinions.

### Key Dates – Course Track

- Aug 26            Student Mentor Agreement Form Due. Provide Beth with a copy at [egoodwin@umich.edu](mailto:egoodwin@umich.edu)
- Sept 16/17      Departmental Retreat at Kellogg Biological Station
- Nov 27            Outline of Paper Due – submit to your Mentor and copy the Program Directors  
[dathom@umich.edu](mailto:dathom@umich.edu) and [muhler@umich.edu](mailto:muhler@umich.edu)
- Oct–Apr          Present your 711 Seminar after choosing a paper with your mentor and 711 faculty
- Dec 9             Departmental Poster Session\* (*date to be confirmed*)
- Jan 27            Submit a draft of Introduction to your mentor (copy Beth at [egoodwin@umich.edu](mailto:egoodwin@umich.edu))
- Mar 31            Submit draft of entire paper to your mentor and the Program Directors  
[dathom@umich.edu](mailto:dathom@umich.edu) and [muhler@umich.edu](mailto:muhler@umich.edu)
- Apr 14            Present your research at Masters Symposium (*date to be confirmed*)
- April 24          Submit Final Version of your paper to your mentor and the Program Directors; copy Beth  
[dathom@umich.edu](mailto:dathom@umich.edu) and [muhler@umich.edu](mailto:muhler@umich.edu)  
[egoodwin@umich.edu](mailto:egoodwin@umich.edu)

## **RACKHAM AND BIOLOGICAL CHEMISTRY ACADEMIC POLICIES**

Students in the program are expected to familiarize themselves with Rackham's Academic Policies including the Academic and Professional Integrity Policy (see <http://www.rackham.umich.edu/policies/gsh/>) and the "Compact of UM-Biochemistry Graduate Student Commitments" (see page 11).

### **ACADEMIC PERFORMANCE**

The Rackham Graduate School requires students to maintain a grade point average of B (3.0 on a 4.0 scale) and additionally the Department of Biological Chemistry requires all students to receive grades no lower than a B- in all courses, required or elective. In order to maintain good academic standing, you must at minimum be making satisfactory progress towards your degree and maintain a GPA of 3.0 or higher. A student whose cumulative GPA falls below a B, who is not making satisfactory progress toward the degree, or who is failing to demonstrate an ability to succeed in his or her plan of studies, will be formally notified in writing and may be denied permission to register, required to withdraw, or dismissed from the program. The Biological Chemistry Graduate Program Committee will review the student's progress and make the final determination as to whether the student can continue in the program. Students must be in good academic standing to submit a written Master's thesis/paper for evaluation. Work with your course directors or instructors if you are having difficulties and ask if any remediation is possible. A student receiving lower than a B- in a required course may petition the Graduate Program Committee to repeat the course during the next term that the course is offered. A student receiving lower than a B- in an elective course may petition to take another elective course. A maximum of two courses can be petitioned for any Master's student. If a petition to repeat or substitute coursework is not approved by the Graduate Program Committee, the student will be dismissed from the Master's program.

### **BIOLOGICAL CHEMISTRY SEMINAR SERIES**

The Department of Biological Chemistry sponsors a weekly seminar program during the Fall and Winter terms that attracts outside speakers of international reputation. The seminars are held each Tuesday at Noon and all biochemistry students are required to attend. Students are invited to share lunch and conversation with the speaker following the seminar. In addition to the weekly seminar program, the Department sponsors an annual Distinguished Alumni Lecture and five endowed lectureships: the Irwin Goldstein Lectureship in Glycobiology, the G. Robert Greenberg Lectureship in Biological Chemistry, the William E.M. Lands Lectureship in the Biochemical Basis for the Physiology of Essential Nutrients, and the Martha L. Ludwig Lectureship in Structural Biology, and the Rowena Matthews Lectureship in Biological Chemistry.

### **FALL POSTER SESSION**

Research track students will present their research at a poster session held at the conclusion of the Fall term. Course track students will also present a poster as part of the BC 601 course near the end of the Fall term.

### **STUDENT CHALK TALKS**

Students in the Department of Biological Chemistry meet approximately twice each month for lunch, conversation, and an informal research talk. This gathering provides an opportunity for students to keep in touch with their colleagues and to share scientific expertise and advise. The chalk talk schedule can be found on our website.

### **WORK HOURS AND VACATION GUIDELINES**

Students should consult with their mentors regarding specific laboratory policies on research hours, vacations, and planned absences. Request for time off from research must be done in advance and in consultation with the student's mentor.

### **DEPARTMENT SOCIAL EVENTS**

#### ***Monthly Happy Hour***

Once a month, members of the department are invited to gather together to enjoy conversation and appetizers.

## **WEB RESOURCES**

**OGPS – OFFICE OF GRADUATE AND POSTDOCTORAL STUDIES IN THE MICHIGAN MEDICAL SCHOOL**

<https://ogps.med.umich.edu/>

**RESOURCES FOR GRADUATE STUDENTS**

<http://www.rackham.umich.edu/current-students>

**WELCOME MATERIALS FOR NEW GRADUATE STUDENTS**

<http://www.rackham.umich.edu/current-students/life-at-michigan/after-you-arrive-on-campus/welcomematerials>

**LABORATORY SAFETY AND TRAINING**

**OSEH – Occupational Safety and Environmental Health**

<https://ehs.umich.edu>

**RACKHAM ACADEMIC POLICIES**

<http://www.rackham.umich.edu/policies/gsh/>

**INTEGRITY IN SCHOLARSHIP**

<http://www.rackham.umich.edu/current-students/policies/academic-policies/section11>

**HEALTH AND WELLNESS RESOURCES**

<http://www.rackham.umich.edu/current-students/life-at-michigan/health-wellness>

**HOW TO GET THE MENTORING YOU WANT**

<http://www.rackham.umich.edu/downloads/publications/mentoring.pdf>

**WRITING SUPPORT**

<http://www.lsa.umich.edu/sweetland/>

**PROFESSIONAL DEVELOPMENT**

<http://www.rackham.umich.edu/current-students/graduate-student-success/pd>

<http://alumni.umich.edu/students/career-resources>

**PARENTAL ACCOMMODATION POLICY**

<http://www.rackham.umich.edu/current-students/policies/parental-accommodation-policy>

**FINANCIAL ASSISTANCE (Available Financial Assistance is very limited and nearly all students pay the full cost of attending the program)**

**Emergency Funds**

<http://www.rackham.umich.edu/prospective-students/funding/student-application/graduate-studentemergency-funds>

**Fellowships, grants and scholarships**

<http://www.rackham.umich.edu/prospective-students/funding>

**Rackham Student Research Grant**

<http://www.rackham.umich.edu/prospective-students/funding/student-application/graduate-studentresearch-grant>

**Rackham Conference Travel Grant**

<http://www.rackham.umich.edu/prospective-students/funding/student-application/rackham-conferencetravel-grant>

## **Mentoring Plan**

### **UM-Biochemistry Graduate Student Commitments**

- I acknowledge that I have the primary responsibility for the successful completion of my degree. I will be committed to my graduate education and will demonstrate this by my efforts in the classroom and the research laboratory. I will maintain a high level of professionalism, self-motivation, engagement, scientific curiosity, and ethical standards.
- I will meet regularly with my mentor and provide him/her with updates on the progress and results of my activities and/or experiments.
- I will work with my mentor to develop a thesis project or paper. This will include establishing a timeline for each phase of my work. I will strive to meet the established deadlines.
- I will be knowledgeable of the policies and requirements of my graduate program, Rackham Graduate School and the University of Michigan. I will commit to meeting these requirements.
- I will work together with my mentor and the program directors to fulfill all program requirements according to my graduate program guidelines. I will be responsive to the advice of and constructive criticisms from my mentor and directors.
- I will attend and participate in laboratory meetings, seminars and journal clubs that are part of my educational program.
- I will comply with all UMMS and Rackham Graduate School policies, including academic program milestones. I will comply with both the letter and the spirit of all institutional safe laboratory practices and animal use and human-research policies at my institution.
- I will participate in the UM Responsible Conduct of Research Training Program (PIBS 503) and practice those guidelines in conducting my research.
- I will be a good departmental and laboratory citizen. I will agree to take part in shared laboratory responsibilities and will use laboratory resources carefully and frugally. I will maintain a safe and a clean laboratory space. I will be respectful of, tolerant of, and work collegially with all departmental personnel.
- I will maintain a detailed, organized, and accurate research notebook. I am aware that my original notebooks and all tangible research data are property of my institution but that I am able to take a copy of my notebooks with me after I complete my thesis.
- I will discuss policies on work hours, sick leave and vacation with my mentor. I will consult with my mentor and notify fellow lab members in advance of any planned absences.
- I will discuss policies on authorship with my mentor. I will work with my mentor to submit all relevant results in a timely manner prior to my graduation.
- I acknowledge that it is primarily my responsibility to develop my career following the completion of my degree. I will seek guidance from my research advisor, dissertation committee, other mentors and any department resources available for advice on career plans.

*Adapted from the Association of American Medical Colleges and UM-PIBS.*

## Advice from former MS Students

### From Jeanette Cruz (Class of 2022)

**Trust the process-** When I came into the program I felt incredibly nervous. For me it had been years since I attended university full time. Initially, I had imposter syndrome, but my success in the program proved to me that I belonged and had the stuff to be there, and that the process works.

**Accept assistance when you need it.** Taking on courses of this rigor can be trying. Reach out to professors, attend office hours, and ask for a tutor if you are struggling. Asking for assistance doesn't stop with the course work. Take advantage of the mental health resources if you are having a difficult time.

**Build a relationship with your mentor.** Your mentor can be your biggest cheerleader and can guide you through a variety of challenges.

**Don't be afraid to follow your passion.** In the program, I found that I became excited about certain topics. There were many opportunities to follow up with those topics, so take advantage of them.

**Make time for your support group.** Even if it is only one evening a week, make time for the people supporting you inside and outside of the program.

### From Deepa Raghavan (Class of 2021):

For me, this M.S. program was the most rewarding experience of my education so far. It sounds really scary to register for 7 classes in a term and take on a lot of responsibilities, but understanding that my professors, mentors, the course directors, and my classmates were there to support me made the program very manageable. They really will be there for you every step of the way. Be prepared to work hard, but know that it's 100% ok to ask for help or advice whenever you need it. You will accomplish a lot in a short time and you will be proud of it! Good luck! :)

### From Madeline Motsinger (Class of 2020)

1. **Trust in yourself:** This program flies by in an instance, and because it is only one year you are thrown into the deep end right off the bat. Trust in yourself and your abilities, Mike and Alex have confidence that you can handle the academic and research rigor you face, so do yourself the favor and believe in yourself too. It will not be immediate or easy, but with time you will slowly find the ground under your feet and start understanding more than the first 5 minutes of a seminar. It will take time and dedication to learning, but you will soon find confidence in discussing the expansive research.
2. **Maximize your resources:** There will be many challenging times, whether it be in your own research, the 711 presentation, or your classes, but the resources are there if you choose to seek them out to provide you the tools and support to succeed. This includes your professors' office hours or stopping into their labs to discuss and clarify class content or research techniques.
3. **Connect:** As I said the year flies by and in the end I promise (or really hope given our year's results were 10/10) that you will look back with joy and admiration for all that you accomplished. Keep an open mind, you never know when a new opportunity or professional relationship will arise. Create relationships with the PhD students, they'll provide unique and insightful perspectives and knowledge.
4. **Thesis:** Abide by Beth, Mike and Alex's tentative timeline! You will be so glad.