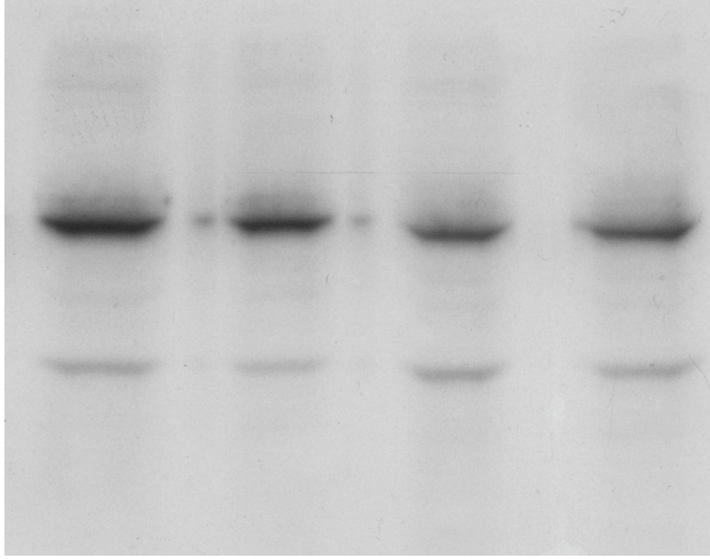
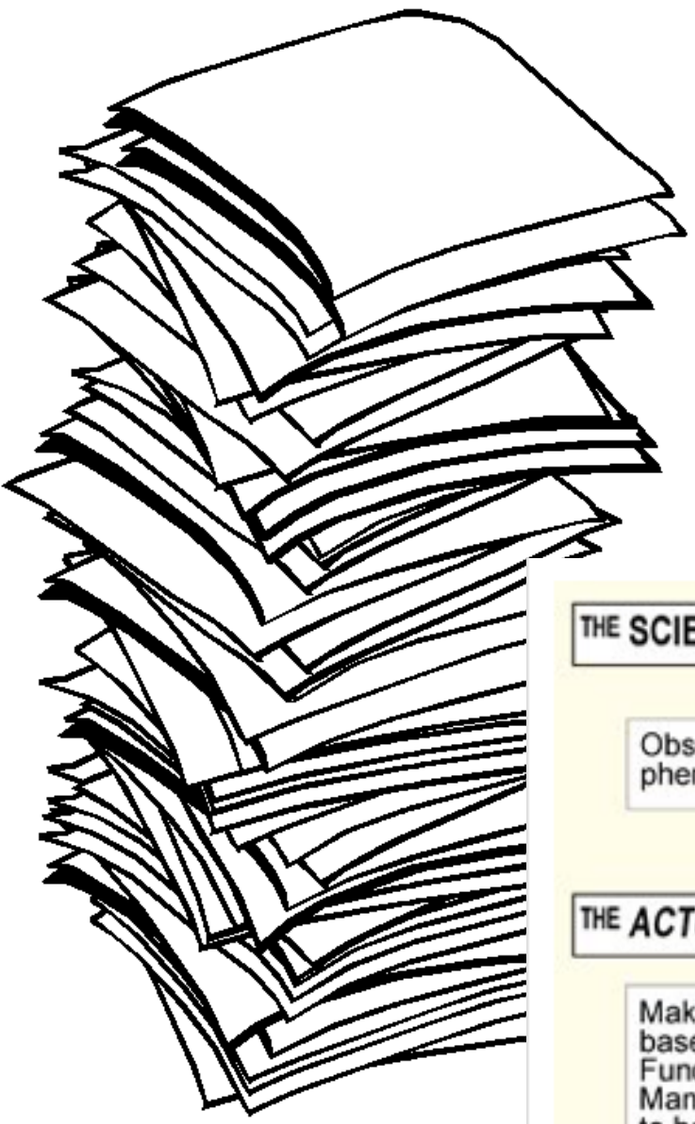
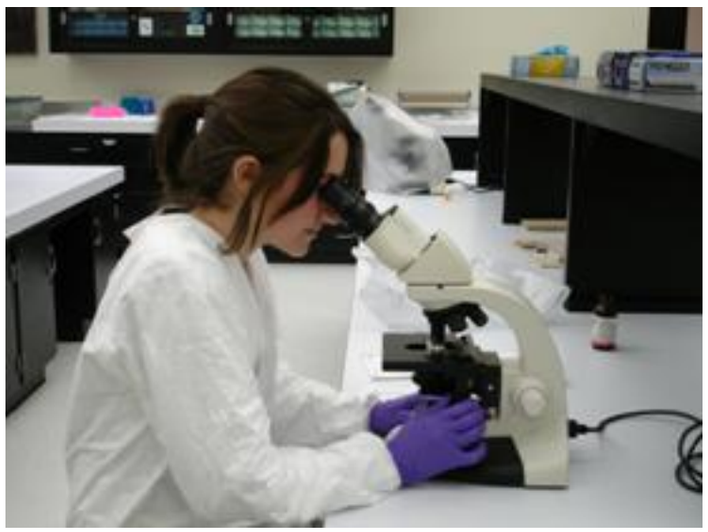


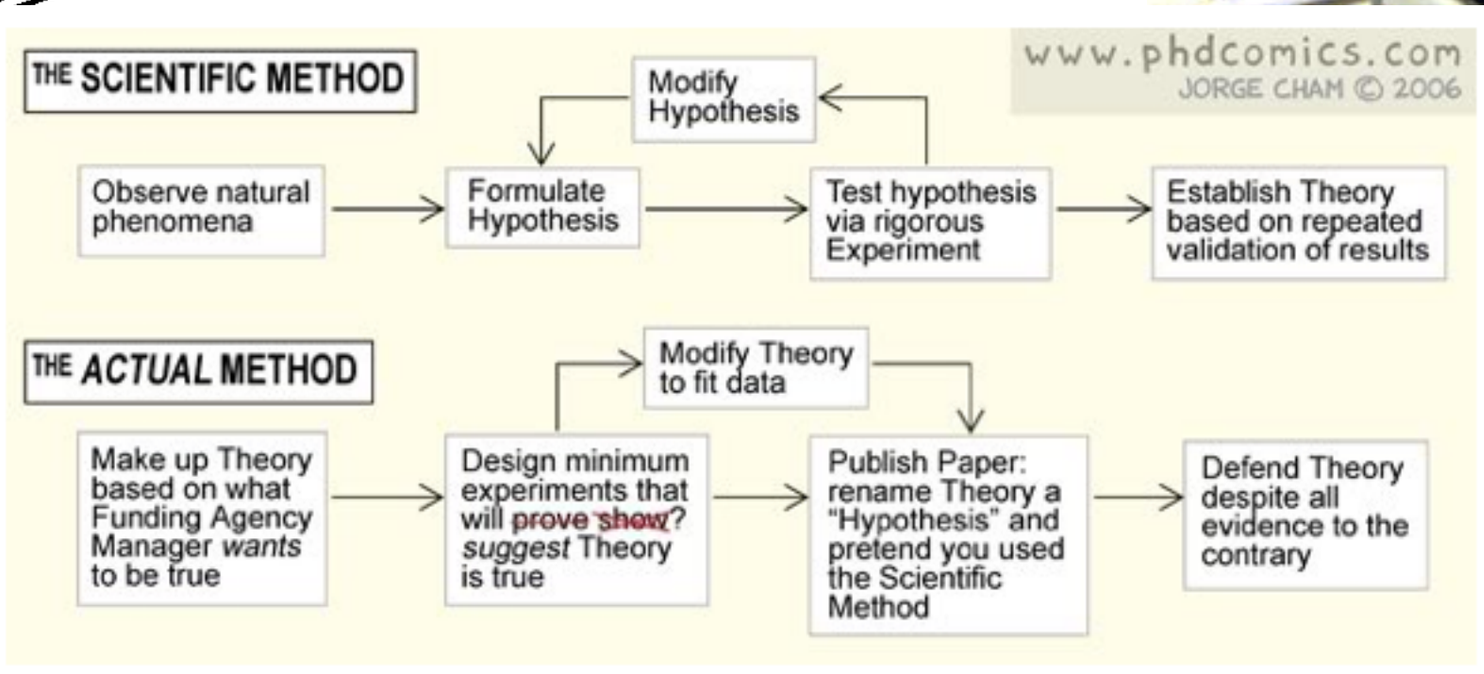
Senior thesis meeting











August 2, 2017



Senior thesis celebration

~~August 2, 2017~~

March 9, 2018

5 PM







Today's Meeting

- Deadlines
- Thesis grading
- Thesis structure
- Formatting & Style
- What you should be doing now
- What to avoid
- Support

Timeline

- All thesis writers must turn in a partial rough draft on Wednesday, December 6, 2017
- Senior abstract form due study card day of spring semester: Friday, January 26, 2018
- Complete rough draft due on Friday, February 23, 2018
- Thesis is due by spring break of senior spring: Friday, March 9, 2018

**These dates are in the guide and on the 'Neuro Forms' page

Partial rough draft – due Dec. 6th

- 6-10 pages (double spaced)
- a rough draft of:
  - the thesis Introduction

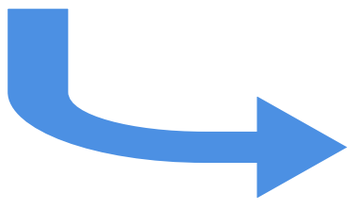
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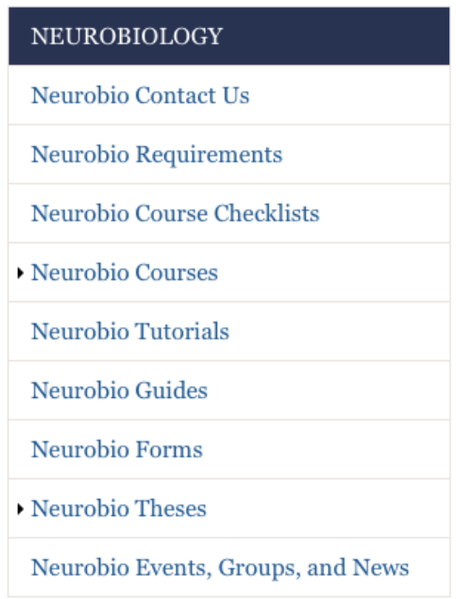
  - the Results section

  AND a list of completed/pending experiments
- email to your lab director & jp@mcb.harvard.edu
- also serves as the final paper for those in the independent research course (Neuro 91)
- ***strongly encourage*** you to have the methods drafted for the completed experiments (don't have to turn in)

Thesis abstract – due Jan. 26th

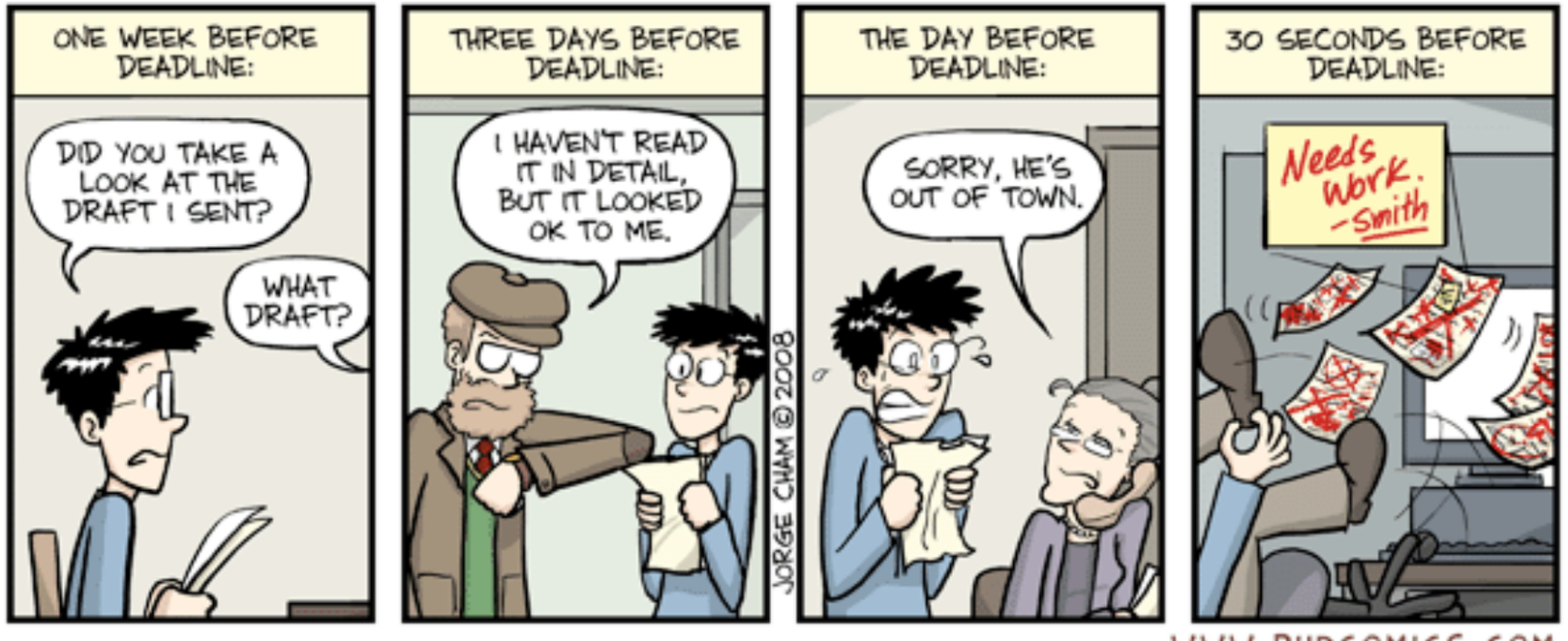
- due on course registration day of spring semester (January 26, 2018)
- abstract does not need to be in final form - mainly used to attract faculty readers for your thesis
- suggest 3 readers
- abstract form also doubles as your registration for Neuro 99 (optional registration)





Rough draft – due Feb. 23rd

- Rough draft of entire document is due on Friday, Feb. 23, 2018.
- This is 2 weeks before the final thesis deadline.
- Email to your lab director & jp@mcb.harvard.edu
- Ask for feedback by Friday, March 2nd. That will give you one more week to revise, finalize and print your thesis.



Final thesis – due March 9th

- Thesis is due the Friday before spring break -
  * March 9, 2018 *
- 5 PM SHARP; champagne party at 5:01 PM
- You will turn in 1 printed, bound copy and 1 digital version in PDF format (email jp@mcb).
- You may need up to a day to print and bind the thesis. Imagine in your mind that it is due on the 8th.

Timeline Recap

you were here

Now you're here

2016

2017

November

Su	Mo	Tu	We	Th	Fr	Sa
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December

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Find a lab

January

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February

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Neuro 91 registration

March

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May

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August

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October

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2018

November

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January

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Thesis due

Thesis Timeline

Neuro 91 registration

2017

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29	30	31				

partial rough draft due

abstract due

full rough draft due

thesis due

2018

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Thesis grading

You receive two separate grades on your thesis:

1. Neurobiology 99 grade on transcript
   - optional (recommended)
   - letter grade assigned by PI, similar to Neuro 91 grading

2. Latin grade determined by Neurobiology Standing Committee
   - based on anonymous faculty review
   - influences honors recommendation in field, but grade not printed on transcript

Thesis grading

Completeness of data

vs.

Writing, presentation, analysis

Thesis grading

Do I need publishable results in order to do well on my thesis?

NO!

- Results from undergraduate theses are not expected to be perfect.

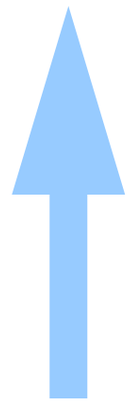
- Grade is weighted heavily on how well the thesis is written, presented, and analyzed.

- Negative results can be discussed heavily in the discussion, making it clear that you understand how the experiments might be redone, future directions to improve, etc.

Thesis grading

Latin grading determined by Neurobiology Standing Committee:

Summa
High Magna
Magna
High Cum
Cum
Commendable
No credit



These Latin thesis grades are different from Latin honors from the college, but thesis grades do affect English honors in your concentration.

Thinking about writing

You should be able to complete the following sentence:

"The goal of this thesis is _____."

What are your specific questions?

In your mind, these questions should be the focus of every section of the thesis. How does each experiment fit into the overall plan?

Thesis structure

Essentially structured like a *Journal of Neuroscience* or *Neuron* paper

- more lengthier Introduction & Discussion sections
- additional formalities – title page, etc.

Thesis structure

Title page (1 page)

Honor code (1 page)

Acknowledgements (1 page)

List of Contributions (1 page)

Abstract (1 page)

Table of Contents (2-3 pages)

List of Figures/Tables (1 page)

Abbreviations (1 page)

Intellectual parts

- Introduction (~7-12 pages)
- Materials & Methods (~3-5 pages)
- Results and Figures (~7-15 pages)
- Discussion (~4-8 pages)

References

Thesis structure

Title page

Honor code

Acknowledgements

List of Contributions

Abstract

Table of Contents

List of Figures/Tables

Abbreviations

Introduction

Materials & Methods

Results & Figures

Discussion

References

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

What questions or debates currently exist in the field?

Explain your scientific question(s) to be addressed. (Should flow naturally from how you've introduced it above.)

Explain the aim of the current study and list specific objective(s) for the current study.

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

What questions or debates currently exist in the field?

Explain your scientific question(s) to be addressed. (Should flow naturally from how you've introduced it above.)

Explain the aim of the current study and list specific objective(s) for the current study.

During embryonic development, the mammalian brain undergoes an intense period of cell proliferation, which leads to a rapid expansion of the cerebral cortex. [Explain.] Understanding the specific mechanisms that underlie embryonic neuronal proliferation is crucial in understanding how development goes awry in disorders such as [X, Y, and Z].

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

What questions or debates currently exist in the field?

Explain your scientific question(s) to be addressed. (Should flow naturally from how you've introduced it above.)

Explain the aim of the current study and list specific objective(s) for the current study.

During embryonic development the mammalian brain undergoes an intense period of cell proliferation, which leads to a rapid expansion of the cerebral cortex. ...

Several previous studies have helped to clarify the various steps of cortical development. For example… [explain key studies and lines of thinking]. However, the specific signals that lead to precisely timed neuronal proliferation are not well understood.

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

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Explain the aim of the current study and list specific objective(s) for the current study.

During embryonic development the mammalian brain undergoes an intense period of cell proliferation, which leads to a rapid expansion of the cerebral cortex. ...

Several previous studies have helped to clarify the various steps of cortical development. For example… [explain key studies and lines of thinking]. However, the specific signals that lead to precisely timed neuronal proliferation are not well understood.

Some evidence shows that calcium signaling is important in the development of the non-mammalian brain and in the retina. [Explain] To date, however, there has not been evidence of instructional calcium signaling in the mammalian cortex.

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

What questions or debates currently exist in the field?

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Several previous studies have helped to clarify the various steps of cortical development. For example… [explain key studies and lines of thinking]. However, the specific signals that lead to precisely timed neuronal proliferation are not well understood.

Some evidence shows that calcium signaling is important in the development of the non-mammalian brain and in the retina. [Explain] To date, however, there has not been evidence of instructional calcium signaling in the mammalian cortex.

Here, we ask specifically whether calcium signaling occurs in the embryonic mammalian brain and whether it can influence neuronal proliferation.

Introduction

Introduce and motivate the broad, general topic

What is currently known and how has this evolved with research over time? What studies were crucial?

What questions or debates currently exist in the field?

Explain your scientific question(s) to be addressed. (Should flow naturally from how you've introduced it above.)

Explain the aim of the current study and list specific objective(s) for the current study.

This thesis investigates the role of calcium waves in the development of the embryonic mammalian cortex.

Specifically, we will:

1) use calcium imaging techniques to characterize the morphology and frequency of calcium waves that occur spontaneously in embryonic cortical slice preparations;
2) demonstrate electrophysiologically that calcium waves can be recapitulated with extracellular stimulation;
3) demonstrate pharmacologically that calcium waves are dependent upon ATP receptors; and
4) use a cell proliferation assay in embryonic brain slices to demonstrate that calcium waves are crucial to embryonic neurogenesis.

Thesis structure

Title page

Acknowledgements

List of Contributions

Abstract

Table of Contents

List of Figures/Tables

Abbreviations

Introduction

→ Materials & Methods

→ Results & Figures

→ Discussion

References

Results

- Present experiments in a logical order (not necessarily the order that you did them). Try to tell a logical story.
- Do not interpret here – just describe in words (save interpretation for Discussion)
- Do not just list experiments monotonously. Use explanatory key phrases that remind us of the overall scientific question. For example:

  NO: “Next, we used antibodies against calcium binding protein X at three different time points.”

  YES: “Next, to determine whether key calcium binding proteins might be expressed in the developing cortex at the appropriate stage of neuronal proliferation, we used antibodies against protein X at various postnatal ages.”

- Negative results are OK to include
- Separate sections/chapters are OK for ~unrelated projects.

Figures

- Consider one figure for each main point that you make (including in Introduction, Discussion, etc.).
- Clear, well-labeled, easy to read
- Figure legend for every figure. Consider titling each figure.
- How to include within text (in-line vs. separate page)
- Number each page in sequence with text
- If you include someone else's data, give them credit!
- Read thesis guide for many formatting details.

Discussion

Summarize and analyze results

Interpret results - consider multiple interpretations

Strengths and weaknesses of your work. How to improve upon what went wrong.

Agree with previous literature? How did view change with this new data?

What does all of this tell us? What should future work address? How?

References

Very specific guidelines. See thesis guide.

Match Journal of Neuroscience format.

Do NOT use footnote or numbered format.

Thesis structure

Title page

Acknowledgements

List of Contributions

Abstract

Table of Contents

List of Figures/Tables

Abbreviations

Introduction

Materials & Methods

Results & Figures

Discussion

References

Typical thesis is 30-50 pages. Your thesis should not exceed 100 pages.

Neurobiology content requirement

Students in Psych, Cog Sci, Immunology, and Sleep labs…

Your thesis is an opportunity to bridge the gap between your lab and your studies of neurobiology…

- what is happening at the level of the neurons?

1. Two-three pages of Intro must include neurobiological context/background

2. One-two pages in the Discussion must include how your results relate to the underlying neurobiology.

* If you need help identifying appropriate articles/references in your field, contact Laura or Ryan (sooner rather than later).

Consider your audience

- Any general neuroscientist should be able to easily follow your thesis without needing to refer to other readings.

- Explicitly explain concepts that may seem obvious to you but are not common knowledge to someone outside of your field.

- This is often difficult for thesis writers, who tend to focus on the details rather than educate the reader about the basics.

Refer to the thesis guide for information on style, formatting, etc.

What you should be doing now

- Read this entire guide carefully
- Start writing NOW (intro, M&M, sketching out figures)…especially if interviewing for med school in the fall!

But wait…how the @#$ do I even get started?

- tried and tested method
- There are samples to view & people to turn to:
  - Ryan and Laura
  - Your PI & lab members
  - Fellow thesis writers (listserv?)
  - The writing center
  - Thesis writing workshops

Also, learn by doing!



Support

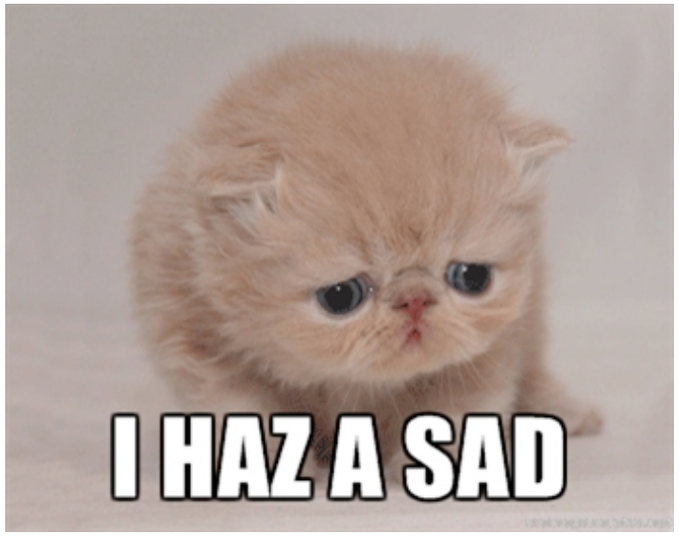


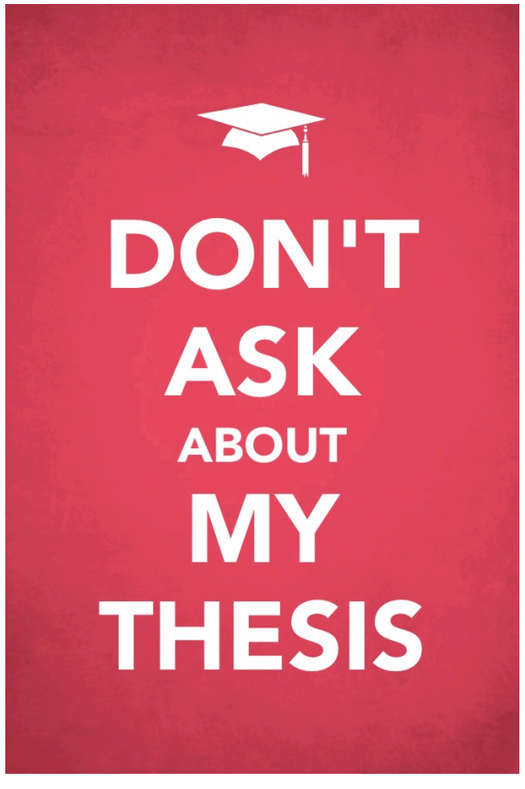
Many students become frustrated at the end of the summer when they have not met their goals.
This is completely normal.

Don’t assume you can’t finish the thesis. Come and talk to us first. It may not end up as you expected.

Although at times you feel like this:







Eventually you will feel like this!





Ryan Draft
Advisor



Laura Magnotti
Advisor



Venki Murthy
Head Tutor



James Poolner
Program Coordinator

Want to talk more about writing a thesis?

Come visit!

Final words of encouragement

Dear Juniors,
Pro-tip #1: don't stress out. Chances are you aren't going to win a Nobel, so don't set your expectations too high. Think about your figures – we learned in tutorial most scientists only care about the figures anyways. That said, you should be excited – you're doing f**king brand-new sh*t here! Things no one on earth knew before you did. SCIENCE IS COOL!

Dear Juniors,
Let's just get it out there on the table – theses are intimidating. But they are also rewarding and so much fun! (Honestly!) Stick to the deadlines and you'll be all set. Take advantage of your PI and your mentors – they have so much wisdom to share! Pour your heart into your work and you will never, ever regret it! Take a deep breath, enjoy the process, and don't forget to celebrate!

Dear Juniors,
A thesis is like a roller coaster ride → there are so many highs and lows. You might love your research one minute and hate the lack of significant data the next. You will love the look of your fancy figures but hate editing 50+ pages of text again and again. Overall, your final project will be something to be proud of, I'm sure. There is no other pain or joy like writing a thesis, but its definitely a worthwhile journey. Best of luck on your adventure.