



HOW TO
COMPLETE
A SUCCESSFUL PHD

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INTRODUCTION

Do you ever think about quitting your PhD, calling it a day and leaving all your worries and troubles behind? Ever wonder how so many before you made it through with charmed PhDs and churned out papers like no tomorrow? Well maybe that's because they've read this e-Book written by a PhD survivor.

This eBook aims to help you navigate those troubled PhD waters, dealing with everything from how to write a PhD thesis, keeping your lab book up-to-date to dealing with stress and improving your relationship with your PI.

You might think to yourself "Hey what does this person know about what it takes to complete a PhD" - well in fact quiet a lot. After studying Genetics in Trinity, I went on to do a PhD in the Conway Institute, University College Dublin. My research investigated how the pro-apoptotic Bcl-2 family member, Bim, is phosphorylated following prolonged mitotic arrest. I loved the lab and my project; however, my PhD took me 5 years to complete, which was a huge mistake on my part and really should have set alarm bells ringing.

I wrote this eBook to provide you with a guide for writing your PhD based on my own experiences and those of other PhD graduates. This e-Book should provide you with ways to keep your research efficient and complete your PhD with minimal stress and on time.

I believe this eBook will empower you to complete your PhD and also offer support throughout the process. Now, let's get started.



WHY I SUCKED IN THE LAB

For most scientists feeling like they suck in the lab is pretty common, experiments never work, progress is really, really slow and positive results can be hard to come by. This was definitely the case for me. I spent 5 years doing a PhD at University College Dublin and 8 months doing a PostDoc at the University of Cambridge, which resulted in thousands of failed experiments, late nights and two papers for my efforts.

For the most part, I always thought I was going to succeed in academia, one day become a PI and get tenure in some University... like this is an uncommon thought. Millions of people think the same, millions of articles have been written about this topic and about the shortcomings of disgruntled postdocs and "why o' why" they never secured tenure and had to get a supposedly real job.

Science magazine careers section focusses on tenure and PI career paths at least once a month and provides the latest statistics on what your chances are of succeeding. Recently the American Society for Cell Biology published an infographic showing that less than 10% of PhDs will become tenure track faculty.

Why I left academia

After thinking about why I left academia (or didn't get as far as tenure track) I realised it was ultimately because I sucked in the lab. To be honest I was average, it took me a long time to get the result I was looking for, mistakes were really common within my work. Even though I worked extremely hard and put in long hours, I didn't work smart. I spent too much time watching YouTube videos or reading the latest Reddit post instead of reading papers and focusing my thoughts and actions.

However, even though I encountered constant disappointment, failed PCRs, Western Blots etc. I always thought this was the route of a scientist. As Samuel Beckett put it in *Worstward Ho* "Ever tried. Ever failed. No matter.

Try again. Fail again. Fail better.” I always thought science was not meant to be easy, bad results were part of the norm and eventually I would get the result I was looking for and my experiments would work. I would tell myself “this is a difficult question you are trying to answer so it will take time and failure is inevitable”, but really was it? Should I have failed as often as I did?

Where I went wrong

To analyse this and find out where I went wrong, I thought back on what I was like in the lab to see how I could have done things differently and better (remember I did leave the lab in 2011), so I will try and not romanticise the past. So, what went wrong? For many projects, I had no experience in any of the steps, my PI had never done any of the protocols before and none of my lab members had either - this is something that a lot of researchers would think is the problem. However, this can be pretty common and not a reason for why your experiments failed. Granted, experience within the lab helps immensely with the start of projects/protocols, especially when there is an experience gap. But this is not why projects get off to a bad start. For this project everything was rushed, if something failed it was repeated and if it worked I moved forward without carrying out any real critical thinking. I know this is not the right approach. I failed by not taking the appropriate time to review errors and why the experiments were not working from an experimental and theoretical standpoint. When projects didn't work as fast as I wanted I found faults in potentially the wrong places (reagents and tools) always looking for a quick answer to solve a hard problem. This was how I did science: “quick answers”, however, looking for these quick answers resulted in sloppy work, nothing was ever learned correctly and time and money was spent carrying out projects.

Critical Thinking

Not until I moved to my postdoc did I really find out what critical thinking was. My boss was a relatively new PI who had just started her lab in Cambridge University Genetics Department and had come from a postdoc at MIT/Harvard. Although she hadn't done some of the protocols I was launching in the lab she had the critical insight to see what was going wrong and how I could optimise to resolve these steps and move forward.

For me, this is what makes a great scientist, someone who looks at the simplest Occam's razor approach to solve a problem and has the patience to do so. Until this training and guidance, I was the “shot gun, coffee pumped, end result type” of scientist and not “the analytical thinker, meticulous note taking, one small step at a time” type of scientist. I think the difference in these two approaches is why some scientists succeed and why some fail. Teaching how to analyse failure might have helped to develop my scientific skills to become a better scientist.

What I think the right approach is to perform scientific endeavours correctly, is to properly research protocols, reagents and troubleshooting tips before beginning the experiment. Positive and negative controls should also be considered at length so all bases are covered for a successful experiment. Without the correct positive and negative controls, true analysis of results can't be carried out and nothing will be learned from failed experiments. Looking at other peoples' data also helps, whether its data from your colleagues, an online publication or blog post, finding precedence in results, whether they succeed or fail always helps in carrying out research.

A photograph of a glowing lightbulb resting on an open notebook with blank pages, set against a rustic wooden background. The lightbulb is positioned on the right side of the notebook, and its glow is visible through the glass. The notebook is open, showing two pages. The wooden surface is made of dark, weathered planks.

WHY YOU NEED TO KEEP YOUR LAB BOOK UP-TO-DATE

When PhDs and Post-Docs start in a new lab they have the best intentions to keep their lab books up to date with notes, new research methods, data, and protocol information. These best efforts usually last for about a week, or for as long as they can see their professor walking about the lab. However, sooner or later diligence is lost and maintaining up to date notes on research methods and protocols happens once every blue moon.

Suddenly, stacks of western blots and PCR gel print-outs build up in drawers, lab books and lab benches, with barely legible labels, saved only by the dates from the PCR gel print-outs. Eventually, a random inspection from your professor or a looming lab meeting inspires you to dust off your lab book, get out the glue and fill it in. Therefore, I thought these few pieces of advice might help to motivate you to keep your lab book up to date:

- **Bad Habits:** Not keeping your lab book up to date will eventually introduce bad habits, which will lead to a lot of frustration further down the line. Like a marathon runner, training every day to reach those goals it is a necessity. Not keeping your notes up to date will result in failings in other parts of your research. Consistency is key, updating your lab book will improve your critical analysis, efficiency and motivation to succeed as a scientist.
- **Optimisation:** To optimise an experiment you have to know what went wrong previously. Plus, since science is 99% optimisation, keeping your lab note book up to date precisely with every microlitre, mole you or degree you change in your research methods will prevent mistakes being repeated. Furthermore, keeping an up-to-date lab book will allow you to review data and let you deduce what is going wrong with your optimisation steps.
- **Lost data:** Considering that most molecular/cell biology and chemistry experiments can take as little as 1

hour or up to 2 years, losing data is not an option. Especially since it only takes one experiment to see your hypothesis in a new light. Even if you don't keep your lab book up to date, try and store your data (Computer files included) in a safe place and logical order. When saving computer files creating a system of data labelling will ensure data is never lost and easily retrievable. Some great platforms are available out there for storing data for free and include Dropbox.com and Google Drive. I personally use Google Drive and find it really useful to share my research with other members of the lab and track progress with projects. Other options also include digital lab books like sciNote.

- **Reproducible experiments:** When devising a new research method or protocol, keeping your lab book up-to-date with the latest experiments and research methods is crucial. New experiments take time to establish, since a lot of grad students end up trying to reinvent the wheel before making any progress. Your greatest observations only become results once they are reproducible and maintaining your lab book is one way of ensuring that you produce great data.

3 Key points:

1. *Be consistent, write in your lab-book every day*
2. *Be exact in your note keeping – this will help optimisation*
3. *Store your data properly ie googledrive*

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HOW TO BE MORE PRODUCTIVE DURING YOUR PHD

When you look back at some weeks in the lab, it seems like you have achieved nothing. Your cloning hasn't worked or your mice just won't mate. Or sometimes you are just allergic to working in the lab and before you know it another year has gone by; your funding is running out and you are wondering where you are going to find the time to finish those critical papers that will make your grant application.

Typically, I would mostly start work at 10 am, take coffee at 10.30 am and decide to really start work at 11 am. Most likely I would leave the lab at 9 pm or 10 pm that night. Looking back on my time spent in the lab and how much I wasted, I definitely feel that I could have done my PhD within a shorter time period, published more papers and have had more of a social life during my PhD.

Unfortunately for many PhD students it's too easy to get into these bad habits of working in the lab, staying late, losing track of reality and focusing all of your efforts on work.

If you look beyond academia there are now hundreds of blogs, podcasts and books that focus on increasing your day-to-day productivity and many of the rules within these blogs can be applied to working in the lab.

Two books that I did find inspirational and helped me to focus a lot during my postdoc were the 4 Hour Work week by Tim Ferris and Get Shit Done by Niall Harbison. The 4 Hour Work Week was aimed at releasing oneself from the shackles of corporate life, which is something not too different from working in the lab and finding ways to automate or delegate tasks that aren't that important. One of my favourite tips from the book and the simplest is when to check your emails. For me, checking my emails and social media numerous times a day really slowed my progress down. If possible **try and set times for social media and emails and reduce the time you waste meaninglessly surfing the web.** Some other great

blogs you might find interesting for focusing is Zenhabits.net, which is a blog aimed at relaxation and focus, something we all need a little help in. timemanagementninja.com might also be of interest when looking to squeeze the most out of the day.

Applying some rules to your working week will hopefully increase your lab output and makes those hours spent in the lab more productive. Here are **five small tips to increase your productivity** and transform you into that paper machine you know you really are:

1. Write down a schedule for your lab workload:

It may seem obvious and you might think it's a waste of your time, but preparing a schedule for your working week will instantly set goals. If you think planning out the week ahead might be a stretch, writing down what you would like to achieve for the coming day also helps and motivates you to tick off all the goals you have set. With everything there is a caveat, and lists are no exception. Always be mindful that what you need to include is achievable but pushes you to a limit. Just like your experiments there will be errors, so include error bars in your checklist to account for delays or mishaps. Put a diary in your phone that alerts you when you need to be carrying out a certain task at the certain time. Having your phone buzz or ring every time you need to make something happens creates focus, urgency and allows you to move off tasks that are wasting your time (checking emails) or reducing your productivity. What I also like about having my calendar on my phone is that I can always check what is ahead of me during that day and keep work on track. Including breaks and times that you should be finishing work is also really important and will help create a work-life balance that you might be missing with working too many hours a day. If it only takes 15 mins a week to place appointments in your diary I think it is definitely worth it in the long run and will also make you feel like you have accomplished something that day, even if it is ten small tasks.

2. Set core hours for working in the lab:

A very common misconception is that working for long hours means that you are working hard. However, being surrounded by people that work for lengthy periods has thought me that some people are just good at procrastinating and work for long hours just to please their boss with late night lab stories. Arriving to work at 9 am and leaving at a set time of 6 pm will encourage you to pack as much as you can into one day.

3. Set times for the checking emails outside experiments:

With so many emails about lab meetings, collaborators, conferences and checking to see have the reviewers got back to you, the whole day can be spent without going near the lab. 99% of the time, replying to your emails is not that important but for some reason you prioritize it over your experiments. Just think, if your PI wants you that badly they will walk into the lab. Therefore, instead of wasting time with emails, set aside a half hour during the day to answer emails (preferably after 2 pm to allow emails to build up), this will remove to constant need to check emails/Facebook and increase your productivity.

4. Set agendas for your lab meetings:

Set an agenda for your meetings. Sometimes meeting with your PI can drag on for hours, talking about impossible experiments or who might be doing similar work that is going to scoop your big paper. Resulting in a day lost dreaming instead of talking action.

5. Read scientific papers:

With the amount of pressure to get experiments done, losing sight of what is being published in your field happens to all PhDs and post-docs. Although you might print the papers you intend to read, actually reading them can be a different matter. Bringing papers to your bench and reading them between centrifuge spins, running blots or waiting for reagents to melt will hugely increase the amount of reading you get done during the week and increase your knowledge of the area.

3 Key points:

1. *Schedule your workload*
2. *Establish core lab working hours*
3. *Set agendas for your meetings*

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DEALING WITH LAB STRESS

No matter what day of the week it is, whether it's Monday and you have just arrived into the lab or its Saturday night and you still haven't left the lab, the stress of experiments never leaves you. Mainly due to experiments not working, deadlines or lab meetings inching ever closer, the cycle of stress associated with experiments can soon consume your thoughts. Endless thought cycles of whether your experiments will work, what you might need to do to optimize them or what experiment you will have to do next after your current experiment is completed. Therefore, managing your stress levels can be key to maintaining a clarity of mind.

The 80:20 rule

To reduce your stress levels, you first need to identify where the source of stress is coming from. Often many post-docs/PhD students undertake multiple experiments at the same time, with the idea of achieving more in a reduced amount of time. However, increasing workload will not directly correlate with an increased output of results, your Nature paper will not come any sooner! Applying **the 80:20 rule** to your experiments may yield greater results and therefore reduce your stress levels. The idea of the 80:20 approach to experiments is to carry out the key experiments that demand 20% of your time but give 80% or results, or make your boss happy 80% of the time! In other words, identify the experiments that are the most important in progressing your project forward or getting closer to your paper and don't stress about the rest.

Changing your lifestyle

Changing your lifestyle can also hugely reduce your stress levels in the lab. Surprisingly, arriving to the lab on time at 9am will be beneficial to your work output. While most postdocs are still in bed dreaming about experiments or on their bike on the way to work, arriving into the lab early will motivate you for the

the day; furthermore, it will motivate you to leave at a reasonable time and fill your day to the max instead of meaninglessly browsing on your laptop. Arriving on time to work will also give you a proper eating routine, instead of spending your day hypoglycaemic stressing about whether the canteen on campus will still be open, having lunch at a regular time will remove one less stress about when you are going to eat.

Leave the lab at a reasonable will time also allow you to have a social life, Skype your family, go out with friends or even go the gym and work out. Working late into the night in the lab surrounded by mice, fish, worms or complaining to your lab mates about your PI or how your experiments have not worked will just stress you even further.

3 Key points:

1. *Arrive early and leave at a reasonable*
2. *Establish a good eating pattern*
3. *Try and identify the source of your stress*

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BULLYING IN THE LABORATORY

The lab can be one of the greatest places in the world to make lifelong friends. Spending countless hours in a tissue culture room late into the middle of the night, sharing similar frustrations when experiments don't work or talking about how your PI does not have a clue what they are talking about can really bring people together. This is also compounded by the fact that you will spend the most formative years of your life with these people. They'll be the first people you see in the morning, the last people you see at night, and the people that you will spend most of your time socialising outside of the lab with. However, pressure in every profession can push people to the edge and increase tensions between lab members and in some cases result in bullying.

Unfortunately, education does not prevent bullying from occurring in academia and is sadly somewhat a regular occurrence within labs. Surprisingly, it is still found to occur at the higher levels among faculty members. For PhDs and Post-Docs, the constant pressure to perform both technically and mentally can be a lot to handle. In some cases this can get the best of people, with envy being a consuming emotion that results in tension between lab members. Resenting other people in the lab due to their success no matter how big or small can result in the abuse or coercion of others and in some extreme cases result in bullies tampering with their victims work and stealing their supplies.

Intimidation from other lab members is not the only place where this mental torture comes from, with many PI's being also guilty of bullying. On many occasions, I have watched group leaders shout openly at their students, berate their work and on more than one occasion throw their lab book out the window. One post-doc that I use to work with would go MIA for a few days after meeting with the PI, just to relieve the tension within the lab. Our adjacent lab would orientate a magnet on their freezer in a certain way

to represent whether the PI was in or not, so much was the fear of dealing with her. On another occasion a PhD student friend of mine suffered intimidation for months from her PI and eventually was fired without cause. When they approached the HR department within the college they were told that the Professor was 'too powerful' and the college could do nothing to resolve their cause, leaving them with no choice but to leave quietly.

If you are suffering from bullying within the lab or know someone who is, directing them towards your University counselling service can always help. If not, lending a helpful ear or discussing your problems with a member outside of the lab might help them/you see the bigger picture and allow you to confront the problem.

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ESTABLISHING A GOOD RELATIONSHIP WITH YOUR PI

After probably a round or two of interviews and a PhD in your pocket you would think that proving yourself in your new lab would not be an issue. After all, they did hire you because you were the best candidate for the position. However, from day one as a new PhD/post-doc in a lab you do have something to prove. Whether it's getting the first experiment right or presenting at your first lab meeting, not making an initial good impression in the lab can lead to some painful scrutiny and hardship in the months to come. If your PI has an unquenchable thirst for papers then you will be under intense pressure from the outset. Therefore, survival in the lab while you wait for the storm to pass can turn into your main goal. However, without crushing your soul in the process, earning respect and restoring your confidence can be achieved with a little extra prep work.

Here are three short tips to earn respect from your PI:

1. Arrive to work on time:

Like any other business, your boss won't like tardiness, even if you were in the lab late the night before, your PI won't care. They'll just think it's part of the job and won't pity you. Arriving back early in the morning will show commitment to the job and an eagerness to succeed, the exact reason they want you there.

2. Reply to all their emails:

Excessive emails from your PI every hour of the day, especially when you are sleeping and trying not to dream about the lab are a common occurrence. Due to the spamming of your inbox, sometimes you can let emails slip and take less notice of their micromanaging, thus sustaining the idea that ignorance is bliss.

However, responding to their barrage of emails lets them know that you listen and want to take their guidance, and soon will help with them listen to your crazy ideas 😊.

Let them see you reading papers:

If there is one thing PIs love, it's seeing you having the same passion and interest in their chosen field. If you can, walk around with papers in your hand, or leave them in your notebook. Keeping them up to date on the latest developments will make their life easier and hopefully yours too.

3 Key points:

1. *Arrive on time*
2. *Reply to their emails*
3. *Let them see you reading papers*

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TIPS FOR SURVIVING YOUR POSTER PRESENTATION

Presenting your PhD or post-doctoral work can be daunting for so many researchers. Standing in that corridor of posters surrounded by researchers can be one of the first real tests of your data and presentation skills. Depending on how far you are into your research project your confidence in your work can vary. After seeing elegant talks from plenary lectures usually with more Nature and Science papers than they know what to do with, comparing your data with them can easily crush your confidence. Whether it's the lunchtime or an evening poster session your judge will have already gone through a series of lectures and be suffering from a sugar low or might be a bit merry if the wine is flowing.

Keeping this in mind here are a few short tips to get the most out of your poster presentation:

- **Keep it simple:** Although you might be attending a conference specifically aimed at your field more than likely your judge will not have a great knowledge of your chosen research topic. Therefore, keeping your presentation simple can be imperative for your judge to understand. A pathway image can always help begin discussion about your work and allow them to reference the pathway as your talk through your poster.
- **Slow down:** The adrenaline pumping through your veins will not help to keep the speed of your voice under control. This coupled with the excitement of discussing your project with a key opinion leader can turn your presentation into an incoherent story. This can be compacted if English is not your native language. Slowing down while you present, will increase the chances of your judge understanding your work. This will increase the likelihood that they will be able to formulate ideas about your work and engage in a decent scientific conversation.

• **Don't compare your data:** One of the seven deadly sins does not escape science and a breeding ground for scientific envy can be the poster session. Unless you know your poster neighbours, you won't know how long they have been putting data together for this poster and who contributed.

• **Read papers on your topic:** Presenting your data is a strong statement that you are knowledgeable about your scientific topic. Instantly your judge will know whether you have a grasp of your field and the protocols you use, this will help them decide on what score you get. Therefore, read as much as you can before the presentation, you never know who you are about to impress!

3 Key points:

1. *Keep it simple*
2. *Slow down*
3. *Know your topic*

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DRINK LESS COFFEE DURING YOUR PHD/POST-DOC

Caffeine or 1,3,7-trimethyl-1H-purine-2,6(3H,7H)-dione 3,7-dihydro-1,3,7-trimethyl-1H-purine-2,6-dione (as it is chemically known according to IUPAC) is the fuel that runs the scientific community. Caffeine helps many scientists get through late nights in the lab, provides them with some extra focus when they are fatigued and provides a common meeting point for Professors, Grad Students and Post-Docs to complain about life in the lab. Not even the lab rats are safe with nearly 5,000 publications found under "Rat AND Caffeine" in PubMed.

Coffee at the conference

Not all of us, but most of us become addicted to caffeine at some stage during grad school or our post-doc. You just have to attend a conference to see the addiction to caffeine is rife throughout the scientific community. Coffee before morning lectures, coffee during the morning break and lunch, and then some more coffee in the afternoon session break. Last year during the American Association for Cancer research, a biotech company that provided free coffee was one of the main attractions at the conference with up to 50 people waiting in line to get their free coffee constantly throughout the day.

Coffee does have some great benefits and has been shown to increase endurance during athletics and increase focus following tiredness. However, not everyone drinks the prescribed doses of coffee every day, with many drinkers consuming a few cups to keep them alert so they can get through the daily slog counteracting some of the benefits associated with coffee consumption.

Coffee and procrastination

During my PhD I became dependent on coffee, without my caffeine kick in the morning at about 10:30 am

I found it impossible to get through the day. Getting that first coffee in the morning was all consuming. It prevented me from starting many experiments and made me make half-hearted attempts to start assays in the morning. The mention of coffee by a lab mate would instantly make me drop what I was doing and run downstairs to the coffee shop and order a double shot Americano. There was no experiment that I would not stop, delay or bin just to get that coffee and potentially a muffin. They had a great deal on of coffee and a muffin for €3.50 so how could I resist! Caffeine, sugar and fat was to power me through the rest of my experiments for the day.

Coffee and my daily lab routine

Following my strong coffee, I would get a rush of adrenaline, feel more anxious and stressed, and look for options around me not to do lab or desk work. Ironically, I was looking for caffeine to give me a boost of energy to perform my experiments, but instead it made me lose focus, become jittery and anxious. According to the NIH too much caffeine can result in:

“Restlessness, anxiety, and irritability. It may also keep you from sleeping well and cause headaches, abnormal heart rhythms, or other problems.”

And that was just morning, by the time 3 pm arrived I would be on the slow and painful caffeine slump, assays were now harder to set up, papers were harder to read and my stress levels were through the roof from not getting my experiments done. So, what better way to combat the slump but go and get another coffee! Having another coffee would allow me to work a few more hours, or even into the night where I could catch up on where I missed out during the day. However, this time I would be more hyped up on caffeine and looking for any other distraction so I wouldn't have to do some lab work.

Like weaning yourself off heroin (over dramatic I know!), the withdrawal symptoms from caffeine can be headaches, anxiety, vomiting, sleepiness, muscle pain, depression and lack of concentration. However, if this meant that you would be less anxious, more focused on lab work and didn't fear the small problems in the lab, it would be worth it in the long run.

Having spoken to numerous PhD graduates about the deleterious affects of caffeine consumption, it was widely accepted that cutting out coffee would have led to greater productivity and potentially saved precious time. And who knows, I might have got that Nature paper!

A woman wearing a black graduation cap and large black-rimmed glasses is reading an open book with a red cover. She is in a library, with bookshelves filled with colorful books in the background. Her right hand is raised to her forehead, with fingers spread, suggesting stress or frustration. The text 'SCIENTIFIC JOURNAL PAPER PUBLISHING UNDER STRESS...' is overlaid on the bottom left of the image in white capital letters on a dark green background.

SCIENTIFIC JOURNAL PAPER PUBLISHING UNDER STRESS...

Most scientists' biggest fear is getting scooped and not publishing their work in a high impact journal. Unfortunately, an original idea in science is a rare thing with most grants requiring people to work on hot topics and therefore reducing originality in research decisions. This can lead to multiple labs around the world competing to publish similar projects with only one successor prevailing and achieving publishing glory as the seminal paper in a high impact journal.

Since everyone seems to have a good scoop story, I thought I'd share my own close call and remind people, someone is always on your tail! Like most PhDs, projects can take some time to find direction and mine was no different. After two years, I had finally established a hypothesis and thought with one year left on my PhD funding I had to complete a few experiments and a paper would be mine. At the time, I knew there were labs currently working in the field on similar proteins related to the pathway, but none that I could find that were working on the exact same protein, therefore I thought I was safe and I would be the first author to make this scientific observation, scientific glory was mine!

After two more years of research (one of which I wasn't being paid) and four years into my PhD, I was no closer to publishing in a journal. Therefore, since my PI was head of our department's scientific seminar organising committee we thought it might be good idea to get over one of our possible competing labs from Scotland to see what they were working on. Since we never met this PI before, our meeting started politely and we discussed what was happening in the field. However, soon it came around to research projects. Like every researcher's worst nightmare, the competing PI drew graphs and described Western blot results they had with custom made phospho-antibodies and residues they had identified, miles ahead of my progress with the project, leaving me with the feeling that all hope of publishing in a journal was lost.

I walked out of the meeting devastated, I believed we were going to be scooped and all our scientific dreams would be crushed.

Since it was also coming to the end of my PhD I applied for post-doctoral positions in Cambridge using a different approach. As we worked on the same pathways, I felt that these labs would be a perfect place for me to complete my post-doc. A few weeks later I called into Cambridge to meet a PI that thought my CV was interesting. After a tour of the lab and the institute I was brought into the PIs office to chat about my CV and my work interests. No sooner had I sat down when he pulled up results from his lab...they were working on the exact same project...TWO competing labs!! I finally felt that all was lost. My lab books were full of wasted work and I was certain to be scooped. To compound my misery, I was told they have submitted the paper and had received a good response from a reviewer!

I got into the taxi and rang my boss, we had to move fast! That summer I had made some progress so I had enough data to submit a paper to a reputable journal. A few weeks later I received an email from Cambridge. They had their paper accepted but we still hadn't heard anything. I felt my scientific space race was over, Cambridge had beaten us and with no news from the PI in Scotland, a bronze publishing medal was likely. I had accepted defeat, with no grounds for original publication my paper would be thrown into the editor's thrash. However, no more than 24 hours later our editor responds, "Accepted"! Not only that but our paper would be published first! My name in lights, and science was back on track!

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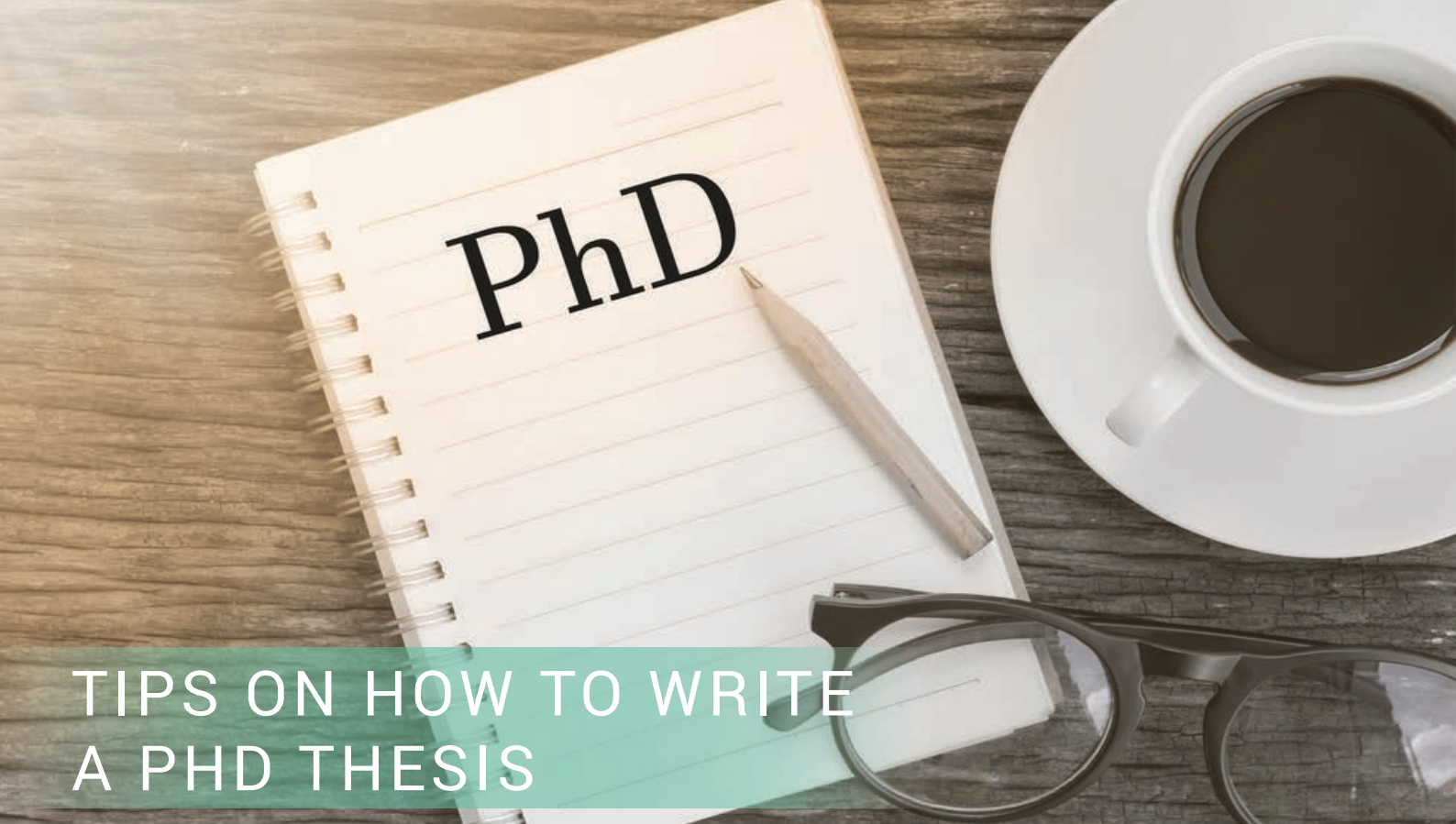


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TIPS ON HOW TO WRITE A PHD THESIS

For most PhDs, there can be huge optimism associated with the time it takes to write a PhD thesis. Leading up to Christmas I expected to wrap up my experiments and begin writing in the January, submit by the end of February, and have started my first post-doc by the start of March! However, in reality I was still the lab in April, not being paid and nowhere near submitting. Eventually I submitted my thesis in July (the 19th to be exact) with the realisation that I did it the hard way.

After thinking through the experience, I decided to create the PhD thesis writing cycle which can also be applied to dissertation writing. The writing cycle is to help you plan this task, break your write-up into definable units and repeat these units for success so you can complete your thesis or dissertation within an acceptable time frame. I believe this approach will allow you to structure your thesis write-up and give you the platform you need to succeed.

Set your PhD thesis writing goals

By the time you write your PhD thesis, a few years may have passed since you last composed a piece of scientific writing. Maybe you have written a paper in the meantime which will be a huge help and give you the right start to putting your PhD thesis together. However, if you haven't wrote a significant piece of scientific writing in a long time this may affect your writing style and can result in an uphill battle to get words down on paper or the computer screen.

What can help is setting a **reasonable goal** of 500 words a day which will help get your wordsmith juices flowing. Some days you may only write 400 words, maybe even 100 words or a sentence which I just about managed on many occasions during my PhD write up; however, some days you will write 2,000 words

if not more and you will steam through your PhD thesis write up.

Keeping your motivation while writing is extremely important and if you are not making significant progress, this can be a huge stumbling block. Sometimes graphing your word count can help to motivate. This is especially useful information when you have had a slow day and gives you a target to readjust to for the next day's writing.

Finding time to **write while you are on the go** will also be hugely helpful. If you have time while waiting for a bus or a train, why not write a few words and email them to yourself. Every little helps to get you over the line faster.

Set a thesis/dissertation submission deadline

In many cases, you will be given a thesis submission deadline which can be based on when the academic year finishes or when your PhD grant runs out. However, in some cases this is just a mythical deadline. Anecdotally, some Professors secretly extend the deadline to force students to carry out more experiments or in order to allow them to delay correcting due to more "important" issues.

If possible you should try and work towards a final deadline, so as to avoid problems with having to re-register. However, working towards a long-term goal won't be as easy as just writing and submitting on the day, you will need to incorporate more short term goals to keep your motivation up and project how hard you need to work as you come to the finish line. If possible try and **break your chapters or segments of chapters into chunks** and work towards writing those chunks in a defined period of time. Getting these chunks together and corrected will keep your motivation up and ensure you stay on the right track.

Something you will also need to do is **give yourself some breathing space** at the end, you do not want to be getting corrections in the days or week before submission as you will still need to find the time to print your thesis, collate and submit it to the University. I had to print my thesis three times before I submitted the final copy, which was down to how I still had to make corrections and print.

Printing your PhD thesis will also be an expensive day at the printers, if you can, try and **put some money aside for printing and binding**. It cost me €250 to print mine, money I didn't have aside as a student, so saving for this rainy day will give you some extra cash for partying that night!

Reading papers for your PhD thesis

During a lot of PhDs, reading papers doesn't get the amount of attention it deserves. When it comes to writing your thesis, you not only need to know your subject area inside out, but you also need to be an expert on the scientific history of your chosen topic. Besides a lengthy introduction you will also need three introductory sections to each of your chapters. This can result in a lot of reading and a lot of references, sometimes over two hundred.

Take a break from thesis writing

After reading ten papers or more finding a good starting point or a good opening line to a chapter can be tiresome. **Allowing the data from the papers to settle in your head** will allow you to formulate some ideas or hypothesis regarding the subject.

Writing your PhD thesis

When you discuss writing up with some of your colleagues, some will say all they have to do is “format their figures and write up”. However, collating and formatting figures can be one of the most time-consuming parts of writing up. With blots to scan, crop and label, histograms to prepare and legends to write, composing figures can be a mammoth task. **Preparing your data in advance**, will also show you where you are lacking data, where you need a nicer image or where you need some more N numbers. Reviewing data in the short term will hopefully help with paper preparation once you have submitted.

Obviously the most mundane part of the thesis is writing the materials and methods. Made up from notes from your lab book, your materials and methods can result in you trawling through your lab books to find concentrations, numbers of cells or what antibody you used. If you can, write down a concise version of your materials and methods. More than likely you will have to edit this come thesis time, but you will save time in sifting through notes.

Adjusting your writing style will save you time in the long run. Identifying how your PI likes to phrase sentences and structure paragraph will reduce the amount of corrections you have to do and ease the relationship with your PI when writing up. Some PhDs theses will contain over 200 references. **Structure your referencing** with Mendeley or some other referencing programme will save you time.

Review your thesis/dissertation before submission

Read through sections you have written to look for spelling mistakes, syntax and grammatical errors and bad scientific phrasing. Reviewing your work will also help you to generate ideas for the next sections or chapters and determine what you need to write about next. Going for easy wins (i.e. content you already have a good depth or reading) will help you generate content faster and remove some of the procrastination associated with writing. Finally, depending on how busy your PI is or how long they take to read your chapters, the review process can add weeks to how long it takes. Submit your chapters regularly for correction and critique.

Mistakes you should avoid when writing your PhD thesis

- **Fill your Bibliography with references to blogs, webpages and Textbooks** - Using information in your PhD thesis that is not from a primary researched published source is not acceptable practice for writing your PhD thesis. This can also be said for textbooks and blogs which might discuss or provide knowledge that is in-depth and correct, however, it is not the primary source of published information and therefore may be subject to opinion or misinterpretation. When writing your PhD thesis it is essential that you **use primary published information**, hopefully from a reputable journal which supports your work or your argument. Using information from Joe Bloggs will not look good in front of your examiner and will result in you having to rewrite and resubmit your thesis.
- **Have numerous spelling mistakes** - Spelling mistakes in your PhD thesis should be kept to an absolute minimum. Remember you are submitting a gold-standard piece of literature, therefore the language used should be perfect. I understand that for many non-natives speakers this may be a problem. Even though you may have grasped speaking English, your writing might not be 100%. Using programs like spell check should circumvent this problem, even for native English speakers this is essential as our brain doesn't always tell our fingers what to correctly write. If you can spell check your PhD thesis as often as possible, or even submit to a group of colleagues.
- **Submit a poorly formatted Bibliography** - When reading through your PhD thesis your examiner will review your thesis to find interesting publications or check to see if you have referenced their papers properly. If your bibliography is not correctly formatted, numbered or alphabetized this will lead to frustration in correction. If possible use the bibliography formatting program Mendeley.com to avoid sloppy mistakes, (more about Mendeley.com later).

Tips for writing your thesis statement

Writing a thesis statement for your undergraduate degree, master's degree or PhD can be one of the most frustrating parts of writing. Unfortunately, not many lecturers or teachers give good examples of what a good thesis statement should look like and what are the key elements involved. After writing so much for your thesis and collecting all your thoughts together, expressing them in about 500-700 words for your thesis statement can be difficult.

When I was writing up my PhD thesis, the statement was the last section I put together and even though it was only 700 words it was one of the most corrected sections of my PhD thesis. The main reason for this is that your thesis statement is where your examiner will get the first impression of what your thesis is about. Because writing your thesis statement can be somewhat stressful I thought I would give an example of sections that are involved:

- **A strong opening line:**

First impressions are important and this will definitely be the case with your statement. The first line of

your statement should be give an overview of the relevance of the research area. Here are some examples from scientific papers:

"During the effector CD8+ T-cell response, transcriptional differentiation programs are engaged that promote effector T cells with varying memory potential." (taken from Kurtulus S et al 2014).

"Mammalian forkhead-box family members belonging to 'O' category (FoxO) manipulate a plethora of genes modulating a wide array of cellular functions including cell cycle regulation, apoptosis, DNA damage repair and energy metabolism." (taken from Shukla S et al 2014).

Irrespective of your scientific background, these opening lines provide the reader with an overview of the relevance of the research area. In the examples above these opening lines prepare the reader for what is about to come and give them a reference point for why they have carried out this research and wrote this thesis.

- **Historical perspective**

The next few lines in a thesis statement provide a historical overview of the area of research and discuss what previous results have shown. Some key phrases used in this section are:

"Previous research has shown" "It has been reported that"

This section is the build up for what you are about to discuss. Mentioning key findings here gives you the leverage to argue your points.

- **Our data has shown**

The next section of your thesis statement will give the reader an overview of the data or findings of your thesis. Some common opening lines in this section are:

"Here, we have investigated" "Here we report" "Our data has shown that"

In this section you will give an overview of key findings that show the power of your results. An example might be:

"Here we have shown that eating an apple everyday reduces cholesterol levels, improves gut microflora and increases serotonin levels. Furthermore we demonstrate that eating an apple in the morning improves dietary choices for all subsequent meals and reduces anxiety"

To increase the power of your research findings you can discuss some of the instrumentation or methods that you use to collect your results. This might look like:

"Using data from 300 questionnaires carried out by a random population we found that"

• **Supporting your data**

If possible, using supporting data is a nice way of carrying out a convincing argument in your thesis statement. Even though this may be secondary data, it can illustrate why the research was important, relevant or supporting to your argument. The concluding lines of your thesis statement will wrap all your thoughts into one nice package, discuss how your results were relevant to the field and gives your closing argument. Some key phrases in a conclusion might look like this:

"Here we conclude that running five miles a day improves muscle mass, reduces weight when combined with a nutritional diet and increases lifespan."

"Collectively these results show"

When writing your thesis statement, try to keep it within 500 - 800 words long, check for spelling errors and grammatical mistakes and always make sure that your facts are correct and not just taken from Wikipedia. If required you can always put references in your statement, however, some formats may not allow this depending on where you are submitting.

3 Key points:

1. *Set deadline for each chapter*
2. *Do a detailed spell check*
3. *Use the correct style of referencing*

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TIPS FOR USING MENDELEY.COM REFERENCING

As an experimental biochemist embedded in a largely computational research group I was lucky enough to be exposed to some clever software tools that simplify everyday tasks such as primer design, DNA sequencing, homology modelling, and viewing protein structures. However, I noticed my peers were still performing many tedious tasks by hand, or using antiquated software. The best example of this was reference management, although there are programs to collate and present your references some can be troublesome.

Mendeley is a free reference management tool that integrates seamlessly with MS Word and Open Office. The developers of Mendeley have an excellent website with easy to follow tutorials on the main features, see <http://www.mendeley.com/videotutorials/> but nothing beats the experiences of someone who uses it on a daily basis.

Essentially, Mendeley is iTunes for your research papers. It allows for easy uploading, storage, and retrieval of your papers from multiple computers, in multiple formats. In addition, it automatically generates a copy of all your documents on a cloud, thanks to the free 500Mb of storage space they provide for every user. After using this software for over two years, the main features I think people will be interested in are;

- **Creating your Mendeley Library**

Creating your library is straightforward. I found the best way was to simply select the “Watch Folder” option from the add files menu in the main toolbar, and browse to the folder which contains your documents of interest. They can be Pdf or Word documents. Mendeley will now proceed to add each document to the library, scanning each for useful details such the title, the authors, the journal it was published in. In addition, any documents subsequently added to the folder will now automatically be visible in Mendeley.

The documents do not need to be labelled logically for Mendeley to populate the metadata for each article. This is akin to letting iTunes fetch the details of a particular track for you, so that you have the correct album art, singer, album name etc. However, Mendeley does not always get this right, so some manual manipulation may be required to clean up the data. I consider this a small price to pay considering the benefits granted by the rest of the functions.

Once your documents are imported I suggest using the synchronization functionality, this uploads everything to the cloud storage they provide, allowing you to access it from any computer with an internet connection.

Once you have imported your documents the first thing you'll notice is that double clicking on any one of the articles brings you to a full version of the document. This is fully searchable via the toolbar on the top right. It might not seem like a major feature, but when you're trying to remember where you came across the evidence for that statement in your thesis it's an extremely valuable and time saving feature.

- **Your whole library is searchable**

You can search for authors names, or journal name, or just individual terms you are interested in. It's happened to me before that I couldn't remember the author, but I could remember a particular term used with the article, a few keystrokes quickly narrow down the list of possible suspects. It's worth noting, the more effort you put into having the correct details for each article the better the results of any search will be. If you're slightly OCD like me, you'll actually get enjoyment out of making sure everything is correct and welcome the distraction from writing your thesis.

- **Sending/Receiving Articles through Mendeley**

How much you use this feature depends on how collaborative your research group is, and how many other people you can convince to use Mendeley. Essentially it allows you to select any number of journal articles from your library and send them to any other Mendeley user that you have invited to join Mendeley. It's actually much quicker than email, and the document is automatically integrated to your existing library, including any notes, and annotation made by the previous "owner". The recipient does not have to have a subscription to the online publisher of that article, so it's an excellent way to share papers among less privileged colleagues.

- **Access to the original URL from Mendeley**

This is perhaps one of my favourite features. Frequently, I will be reading an article which cites some other articles I'd like to read. Tracking down references can be extremely time-consuming depending on the way the references are cited. However, by far the easiest way is to go to the URL of the article you are currently reading, and hope that there are hyperlinks to the articles referenced in that paper. This still means entering the details of the current paper in Google Scholar, or PubMed, and getting to the right location. Mendeley bypasses all of that by providing the URL of the source article you are reading. You simply click on the link and you are on the correct webpage for that article, from there you can go straight to the reference section of the look for hyperlinks. It's a very fast and effective way to navigate from source to source with no typing involved.

- **Digital Annotation and Highlighting in Mendeley**

A relatively minor, but useful feature of Mendeley is that individual documents can be have “sticky notes”, essentially a collapsible text box which you can place anywhere. Generally useful for making quick notes of questions, or thoughts as you read the paper. It’s also possible to make more detailed notes in the toolbar on the right-hand side, this is a better option in my opinion, since these notes are searchable, so you can actually pick out a paper based on the contents of the notes you made as you were reading it.

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14 AWESOME TIPS TO HELP YOU WRITE YOUR PHD THESIS OR DISSERTATION QUICKER

1. The Laptop trick

This is a fairly easy and motivating tip for writing your PhD thesis or dissertation. So, what you do is place your charger as far away from you as possible (but not too far!!!) and start writing without your laptop cord plugged in. It's now a race of time to see how much you can write before your laptop goes dead, but remember to save regularly!

2. Write now, Edit your thesis later

Putting words on paper will be the biggest challenge during your dissertation with editing coming later. Therefore getting as much down as possible and letting those scientific juices flow will allow you to write a lot of your PhD fast. Next step is to take a break and reflect. Later you can return and edit what you have written. Remember, editing is as important as writing as your PI/Professor will soon get tired if you aren't presenting a well written piece of work.

3. Talk your thesis out on Evernote

Sometimes it's easier to talk than it is to write. Using Evernote to type your speech might save you a lot of time and get your thoughts on to paper a lot more clearly. You may occasionally need to return to your Evernote recording as it will not correctly translate scientific words such as phosphorylation or ubiquitination. Try using keywords in these instances to save time.

4. Place writing blocks in your calendar for writing your thesis/dissertation

If you haven't got a calendar, get one! Set up your week in advance and block book where you are going to spend time writing and relaxing. Remember, it's a marathon not a sprint so 12 hour shifts will get you nowhere fast.

5. Talk with Professors/Post-Docs about your thesis

By now you will have probably spent the past 4-5 years working on your PhD and will have just spoken about it to a handful of people. Talking about your project to other Professors or Post-Docs in your department will help you articulate what your project is about before you put pen to paper. It will also allow you to think logically about your project and how you need to tell the story during your PhD thesis.

6. Place figures in your dissertation

Sometimes it's just damn difficult trying to convey what your project was about, how a protein complex formed or how signalling elements looped to create feedback. Creating diagrams/pathways of these complexes and signalling cascades will help you convey your message and give your examiner an easier time to understand certain concepts.

7. Stay on top of scientific publications

Just like the news you will need to keep up with scientific publications doing your thesis writing. Sometimes publications can add to your theories and overcome vagueness in the field. Also, when it comes to viva/defence time knowing your field in depth will only get you through to the PhD finish line, so read read read!

8. Use Google Docs for feedback

Placing your thesis in Google Docs will allow you to maintain a single version of your PhD and prevent you from saving your thesis everywhere. It will also allow your Professor to access the copy, make edits and hopefully hasten the process, especially if your Professor travels a lot.

9. Cite your sources religiously

Everyone reads then writes, but might forget where they got the data from or a certain quote, make sure to update your references as you write.

10. Look at old posters or presentations for thesis content

During your PhD you will have probably attended a few meetings and presented a few posters. Using the figure legends and abstracts might save time in putting together figures for your PhD thesis.

11. Write about what you know

Sometimes it's easy to get caught up about your lack of knowledge or an area you are finding it difficult to decipher. Go for the low hanging fruit and write about content you already know something about. By the time it comes to writing about the hard stuff you'll have the confidence to sail through it.

12. Don't count words

As long as your PhD is full of correct information and your arguments support your data it doesn't really matter how long your PhD thesis is. If you can, strive for 150 pages, this should give you enough space to tell your story and get your message across.

13. Accept help in writing your PhD thesis

Although your name will be on the front of the thesis countless friends and family will have helped you along the way. When writing up don't be afraid to ask people for help, they'll understand and it will definitely remove some of the stress of running small errands.

14. Enjoy the day you submit your thesis

The day you submit should be one of the greatest days in your life. You will have spent a lot of time preparing your PhD thesis so why not put some effort into celebrating your achievement. You'll only do it once so make it epic!

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HOW LONG IS A PHD THESIS?

One question I asked myself before I started to write up was "How Long is a PhD thesis?". If, like me, you did your PhD under the supervision of a new PI, you will not have thesis examples from previous PhD students. Perusing old PhD theses and chatting to ex-PhD students can give you a wealth of information about how to structure your thesis, how long it may take, if you are likely to publish, potential external examiners/collaborators or competitors etc etc. Because I was one of the first students to leave the lab it left me with a lot of questions about the PhD thesis:

- How long is a PhD thesis introduction chapter?
- How do I write a materials and methods section?
- How do I write a PhD thesis conclusion?

Because I found out the hard way about many of the questions above I thought I would give some responses and hopefully answer some of your questions about the PhD thesis.

How do I write a materials & methods section?

You are correct, this is not the first chapter! However, I would definitely recommend beginning with the materials and methods section. The materials and methods section is the engine of your thesis and can be anywhere from 10 to 50 pages depending on the amount of protocols you carried out during your research.

As writing goes, the materials & methods section will be the easiest to write. If you have documented your experiments and know the source of the protocols and experiments, it should be relatively easy to write the materials & methods section of your thesis.

Personally, it took me 3 to 4 days and most of the time was spent on formatting and ensuring consistency.

3 Tips when Writing your Material and Methods:

1. Focus on your main experiments first that were highly used throughout your PhD, you more than likely will be able to write them from memory.
2. Ensure decimals, symbols and measurements are correct and are consistent throughout i.e. 2ml vs 2mL vs 2 mL.
3. Write your materials and methods section chronologically, if you look at my thesis you should see that I start with experiments that I use in the first results chapter and finish with experiments I carried out in the third results chapter.

How do I write a PhD thesis introduction?

Depending on what type of thesis you are submitting, how long a PhD thesis introduction is can vary. For instance, in some European countries students submit 3 journal style papers for their PhD thesis so only require relatively short introductions. However, if you are writing an Irish/British or Northern American style thesis you might have a longer 30-page introduction. The idea of the introduction should be to give the reader all the knowledge required to read the rest of your thesis and come to a conclusion. Therefore, the introduction should cover a brief history of your research area, an overview of the disease model or research model studied and pathways involved.

For instance my PhD was on a signalling pathway in mitosis, so I broke my introduction down into a few sections:

- The disease model my research was based on, treatment & drugs available
- Signalling pathways that result in this disease
- An overview of signalling pathways that were directly related to my research

The whole idea of the introduction section is to give your examiner a taste of things to come, then when you get to your results chapter you can give a detailed insight into signalling pathways involved in your research.

How do I write a PhD thesis conclusion?

At this stage you are probably really tired of writing your thesis and trying to meet the deadline so writing a conclusion can be challenging. What I tried to do with my PhD thesis conclusion was to give a brief overview of what I had discussed in the previous chapters and then give my own personal input into the area and what I thought was important. At the end of the day a PhD thesis is your body of work and thoughts, so explaining your points, giving new hypotheses based on your research and giving a direction for further research should be the aim of the conclusion.



WRITING YOUR PHD THESIS/GRANT/PAPER ON THE GO

Finding time to write your paper, grant or PhD thesis can also be a bit of a problem if you have other commitments such as lab work, administrative or supervisory work. Before you know it, you will be going to bed without putting pen to paper or fingers to a keyboard. In many cases you will be writing a paper while at the same time trying to finish lab work.

Your phone is your laptop

You might use your phone for a thousand other things, but using your phone to write your grant or PhD thesis might not seem like such a crazy idea and will be a great way to increase the amount of words you write a day. I understand that a phone isn't the most ideal way of writing. You might find it hard to edit, format or add images but what it will allow you to do is get your ideas on paper. Using Gmail on my phone I wrote one of my papers and the start of my thesis while I was finishing up in the lab.

What you have to remember is that it won't be perfect, you will have to edit but what it will do is get you writing which is the most important part. Creating a good habit of writing a paragraph or two while on the train or at the bench will dramatically reduce the amount of time you will have to spend on your laptop. Just think of it as a huge text message, I am sure you write enough of them.

Record your thoughts

Most of my greatest ideas come to me on the go, but I rarely take time to write them down. This can definitely be the case in grant or thesis writing, as you walk down the street you will perfectly formulate an idea in your head, repeat it in your head and assure yourself you'll remember it. Keeping hold of these ideas no matter how good or bad could be a time saver further down the line. Again, you can use your phone, open and press record. Soon you'll have all your thoughts, even some lectures you attend or

conversations you have on tape, providing you with a tonne of content for your thesis or grant.

Use your time on the bus/train wisely

Work out how long a week you spend travelling to and from the lab/office. It can often add up to almost 10 hours a week sitting staring into traffic or on public transport. This is a considerable amount of time you could spend reading, writing or recording what you need to get done for your project. What I would recommend is dedicating a week to writing or reading project related content on your transit. Email it all to yourself and put it in a word document. At the end of the week, do a word count and shock yourself at how productive you have been during the week!

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A FINAL NOTE

Having read this e-Book I hope that not only have I offered you some valuable advice on maximising your productivity, writing up your PhD and dealing with the stresses associated with a PhD but also have you assured that you are not alone. Completing a PhD is one of the hardest, most challenging things you'll ever have to do, but there is a light at the end of tunnel – believe me, I've been in your shoes.

If you enjoyed this e-Book visit our webpage www.elisagenie.com or www.assaygenie.com for more articles like this.

Before it was the best of times, it was the worst of times" - Charles Dickens

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Advice presented in this e-book is only to be taken as suggestive advice and not literally. We are not personally responsible for actions based on reading this ebook nor are we liable for future actions the reader may take. We hope this book will give the reader some food for thought on what options lie ahead of them on academia and how they can improve their careers and work efficiency.

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