First of all, congratulations on making it this far! Regardless of whether you are an undergraduate student working on your first research project or a postdoctoral researcher applying for a faculty position, you are somewhere along a gradient from **passive learner** to **independent thinker**. This document is intended as a reference to help you make this transition, by laying out expectations and best practices. It is based on my own experience as well as discussions with colleagues. Therefore, most of the examples are therefore biased towards a career as a professional scientist. However, this document is above all a guide to working and thinking like a **professional**. As such, I have consciously tried to keep the lessons general so that the tips, recommendations, and rules of thumb will apply to a broad range of professional activities and career paths that you may choose to follow.

This document was inspired by the works of other, particularly [Steve Stearns](http://stearnslab.yale.edu/some-modest-advice-graduate-students) and [Ray Huey’s response](file:///C:\Users\rob_c\Dropbox\Synced\TEACHING\MANIFESTO\References\Huey_Reply.pdf), [John Thompson](file:///C:\Users\rob_c\Dropbox\Synced\TEACHING\MANIFESTO\Reference\Thompson_Advice.pdf), Anurag Agrawal, Gina Baucom…

My role is to provide you with the environment, training and resources you need to flourish as a professional researcher. My choice of the terms **mentor** and **advisor** rather than **supervisor** is a deliberate attempt to stress that the quality of your thesis work is ultimately up to you, but I am here to offer guidance. As a **mentor**, I try to share my experience and expertise to help you to build on your strengths and overcome your weaknesses, to produce research that is read, understood, and respected by the world’s top scientists. To make this possible, my time and energy are devoted to a number of duties:

1. **Teaching** – developing and modifying course content to teach and to challenge students.
2. **Service** – contributing time and energy to meetings and committees that are necessary for a well-functioning Biology Department, University, and Community.
3. **Resource management** – writing grant applications (financial resources), attracting top-notch people like you (human resources), and allocating the most productive people to the most promising projects.
4. **QA/QC** – making sure that the quality of the science done in the lab is world-class. This includes establishing and constantly revising best-practices in the lab and the field, in data analysis, and in writing. I try to act as as a filter to help you avoid getting eaten alive in the shark-infested waters of the peer review process.
5. **Direction** – identifying avenues of research that are most promising given our current resources and expertise.
6. **Dissemination** – helping other scientists and the general public to learn about the work we are doing, and why it is important.

Technically, you may be considered a student, but it is important to understand that you are now on a career-orientd trajectory with different expectations and higher standards of performance. Your early undergraduate education has provided you with a general knowledge base, but it is now up to you build your expertise to become a competitor in the difficult job climate. Most of your learning at this point will occur outside of the classroom. For these reasons, I prefer to think of you as a mentee – a professional who is trying to move to the next level – rather than a student.

**Reading(!)** – The most successful mentees read often and read widely to get a deep understanding of their specific field of research while maintaining a general perspective. It is a good thing to read (and re-read) papers in your own research area to develop a deep understanding of the state-of-the art in methods and analysis, and the big open questions. Here are a few specific tips

* **Schedule** large blocks of time to devote to reading. If you have a heavy workload you may have to limit this to 3 or 4 hours a week, otherwise you should spend 2-3 hours per day.
* **Subscribe** to email alerts for the best journals. Scan the titles quickly to identify relevant papers and save a link to the paper for your scheduled reading times.
* **Take notes** and summarize what you read in an organized document. Use an electronic format (e.g. OneNote, EverNote, or R-Markdown) so that they are easily searchable. A good strategy is to write notes by hand and then later organize and type them up. This is a good way to reinforce your learning and retention. These electronic notes also become valuable for sharing with your collaborators, including volunteers helping with your project who would like to learn more.
* **Identify** the top scientists in your area. Pay attention to names that come up repeatedly in papers and figure out which names are pirncipal investigators, rather than graduate students or postdocs. Ask your peers (including me!) what they think of the quality of the science. Pay close attention to their research methods.

**Project management** – As the project manager, you are ultimately responsible for developing your project plans and implementing them. As noted above, my role is to provide feedback, maintain quality, and help you get the resources you need to successfully implement your project. If you are early in your career (e.g. 537 Thesis project), your goals will be more clearly defined than if you are a senior graduate student or postdoc. However, regardless of the stage you are at, you areresponsible for planning and implementing your experimental design and data collection.

**Skill development** – Success requires development of a number of important and skills. Many of these come with experience, but there are also a number of excellent books you can read to help you avoid making critical errors. These specific skills are discussed in more detail elsewhere, so here is a very brief introduction:

* **Problem solving** – hopefully you have lots of experience with this now. Continue to nurse your instincts to break down complex problems into simpler, testable components.
* **Experimental design** – a lot has been written on this; you should also pay close attention to the methods used by the leaders in your field of research.
* **Data collection** – careful bookkeeping is absolutely crucial. Learn to think like a computer and take good notes. Record everything electronically as soon as possible and make multiple copies in multiple places (computer + external hard drive + ‘the cloud’)
* **Analysis** – the details of a particular analysis (e.g. linear model in R) can be technical and straight-forward, but exploring your data and identifying the best tools to use can be more of an art form. Here again, paying attention to the analyses used by the leaders in youur field will provide a good starting point.
* **Communication** – whether **oral** or **written**, there are a lot of great resources for learning about effective communication. Good science communicators spend most of their time planning and editing, rather than writing or laying out slides.

As you progress in your professional development, academic grades become less relevant. Instead, you are judged by your contributions and by the assessment of your peers. This can be tricky because you no longer get the kind of feedback that you get from a test score. Therefore, it is important to understand how you will be assessed and stay mindful of this in everything you do. As a general rule of thumb: aim for excellence and try at all times to think and act in a professional manner.

To really understand what it means to be a professional – and why it takes so much energy – it is helpful to think about your reference letter. For example, look carefully at the Ontario Graduate Scholarship form recreated below (emphasis added):

**Part 1: Ratings**

1. Any **awards or funding** received
2. **Mentoring & leadership** experience
3. Outstanding **technical abilities** in the lab, field and/or analysis
4. **Mentoring & project management** experience
5. Planning and *time management* (e.g. staying on schedule or even ahead of schedule)
6. **Challenges** overcome (e.g. working through a difficult protocol or personal issues)
7. Outstanding **service** (e.g. graduate student representative)

This section would also include words and phrases like ‘friendly’, ‘enthusiastic’, ‘gets along with everyone’.

## Higher standards

The first thing you should note is that grading has changed from an absolute scale (e.g A–>F) to a relative scale. Most graduate students will successfully defend an thesis and achieve an A in all of their courses, but only 1 in 50 will be in the top 2%. To obtain fellowships you will need to be at least in the top 10% in each category, and the top 2% or 5% in most of them. Being average (top 50%) is not likely to be competitive.

These are high standards, and you will only achieve them if you are really passionate about your work and if you embrace the discomfort that comes from acknowledging your weaknesses and always pushing yourself to the next level.

# Transferrable Skills

There is currently a lot of discussion about the job market facing modern graduate students and the need for transferrable skills. It is helpful to keep these in mind when working through your thesis and applying for jobs, both within and outside of academia. The skills most valuable both inside and outside of academia include:

1. **Scientific communication** – Tends to focus on quantitative results and careful consideration of alternative hypotheses (.g. peer-reviewed publication)
2. **Public communication** – Requires simplifying complicated data, analyses and concepts. Analogies or specific examples are often helpful. Also requires careful consideration of the audience and why they should care about your research (e.g. press release for your paper).
3. **Writing** – A good understanding of language and grammar is just the beginning. Understanding how to organize your thoughts into a coherent argument with a logical flow and effectively communicate those ideas concisely.
4. **Presentation** – How to present results and ideas in a way that is visually compelling. e.g. figures in a paper or powerpoint presentation.
5. **Oral communication** – When presenting at public lectures or presentations at scientific conferences, understand the interests and expertise of your audience and simplify complex results and concepts as needed.
6. **Leadership and mentoring** – Are students helping with your project(s)? If so, you can treat them as basic labourers or you can use the opportunity to build mentoring skills to be an inspiring mentor.
7. **Experimental design** – Design an experiment that effectively tests an important question or hypothesis, while incorporating or controlling for other confouding factors.

Create a new document to keep track of your skills.

* Move ‘standards’ section to the top

If you spend some time reading the top scientific journals, you will see that all good scientific studies are alike; they are each the result of excellence in each of a number of areas, including:

**Data Analysis** — This step can often be the most challenging for students, particularly undergraduate and Masters thesis students who may have little experience in data analysis outside of a perscribed classroom setting. Additionally, the Reproducibility and Open Science standards, adopted by the Colautti Lab, require that all data manipulation and analyses are ‘hard-coded’, for example as custom scripts in the R programming language. Fortunately, there are many tools to help you, including the R-crash-course available on the Colautti Lab website. A much more difficult problem is figuring out the best way to analyze your data. In the process, you will realize that good data analysis is as much art (picking the methods and graphing the data) as it is science (correctly applying the chosen analyses). Working through methods in recent papers from top journals that analyze data similar to yours is a crucial first step.

Time management

Family, friends, and personal health (mental and physical) are important. Time taken for family, friends and personal health can help to increase your energy levels and focus. In some cases, one or more of these may require you to take time off from your thesis or to drop it altogether. Don’t feel bad about doing this. Science is great but there is more to life.