How to…. write an internship report

As you are writing up the results for your research internship in the lab (usually anywhere between 5 to 9 months of work), take note of the following tips[1].
Please note, this is how I personally like to see it. Other groups and/or group leaders may disagree, so please check in time with your local supervisor and examiner!

The goal of the report

For a student it may feel as if the sole goal of the internship report is to reduce all of your hard work in the lab to a single. Final grade. While you will indeed be graded, there is definitely more to the report than that:

1. Writing the report is **a crucial part of your academic training**, because it forces you to think and write critically, in a logical and structured fashion, about the facts in front of you. During the writing of the report, you actively need to force yourself to take a step back and look at your data for what they are – not for what you want them to be. Question everything – especially yourself and your own experiments. This is one of the hardest things to do, but it is so, so important!
   As a minimal requirement, your written report needs to be technically sound and accurately reflect what you did and what you found. This alone requires that you write in clear and grammatically correct sentences with an appropriate logical structure.
   A good report also shows that the author can evaluate their own results in a broader conceptual context: how do your findings relate to other research in the lab as well as what is going on in the international research field?
   The best reports reads like a well written story from which it is clear that the author masters all of the material: it shows that the author can not only place they own findings in the appropriate scientific (and sometimes societal) context, but also offers recommendations for improvements and future directions of follow up work.
2. Your report is a **written record** of the progress that was made during your time in the lab. For your supervisor (usually a PhD student, postdoc or experienced technician), but also for the PI of the group, your report can be a crucial piece of information to fall back on. A well written report is part of the **scientific memory** of the lab. It will prevent your former colleagues from having to dig through all of your lab journals when they wonder “hmmm… how many times did we do this experiment again?” or “hmmm… did we also try this experiment in the other cell line?” A good report will not end up in a drawer. I frequently go back to well written reports from former students, sometimes long after they have left the lab.
   Together with a well organized RDM structure, this is the legacy you want to leave behind!

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[1] *I assume that you are familiar with the content of all the other “How to write” handouts on Nomenclature, Past and Present Tense, etc. as well. This hand out specifically focuses on the structure of the report itself.*

The length and structure of the report

It is increasingly common for students to have the option to write up their results "article style". This invariably means "brief". Although I certainly have enough reading to do and am not really looking for extra work, I prefer students to stick to the **longer, classical report format**. Start with an **introduction** that culminates in the **aim of the study**, describe the **materials and methods**, describe your **results** and end with a **discussion** (which can include a summarizing conclusion and which should include a future outlook/ideas for future experiments).

Why do I prefer this format?
The **first** reason is that, in reality, an article contains a small subset of all the experiments that the authors have performed – frequently over a period of many years. An article tells a story and the experiments in it are selected to support that story. But 99.9% of the time an internship (especially when it concerns basic research) will have loose ends. For instance, you may not have had time to reproduce your experiments (because it took you 4 months to get the conditions right, or because you had a hard time cloning your constructs). Or maybe there were technical issues with the final experiment you did during your last week in the lab (a bubble in your Western blot obscuring the band you were interested in and therefore not allowing you to draw a definitive conclusion). That's okay – it really is an inherent limitation of working in the lab for a limited time and every scientist knows this: the work is never finished and it really is a matter of chance whether you get to work on a project that is in the final stages of experimentation. Unfortunately, it is a lot harder to write up results when there is no 'obvious' story with a clear punchline to be told: you usually need more words to do it properly and critically. In my opinion, the short "article style" format is simply a mismatch for reporting results from an internship. The shorter format requires you to have a clear beginning, middle and end. But your internship data will rarely allow you to draw firm, definitive conclusions, or to come up with a very clear punch line.
The **second** reason why I prefer the longer format is perhaps more selfish, but it has to do with the second goal of the internship report: to leave a written record from the lab, allowing the lab to build on your experiments. This requires (for instance) a properly detailed materials and methods section. If you have ever tried to reproduce an experiment based on the scientific literature, you will often find that critical details are missing from the materials and methods. Again, this is frequently inherent to the short format (although journals are increasingly releasing the length restriction on this particular section for this very reason). Make sure that your report is sufficiently detailed and complete. Your former lab mates will thank you for it.

As far as I'm concerned, the goal of an internship is to learn how to acquire, analyze and then interpret lots of information – including variation between experiments. In your written report you can demonstrate that you are indeed capable of critically assessing and interpreting your data, to categorize different pieces of information and to form a logical and coherent argument.
Even without any length restrictions, you still have to be as **short** and **concise** as possible. At the same time however, you have to be **specific**, **precise** and **complete**. This poses a challenge, but it is not undoable.

Typical pitfalls

Don't tell me everything you know
You have read so many interesting articles that your head is just buzzing with knowledge and now you want to share that with everybody else. Wrong. When writing the introduction, you have to carefully **select** the background information and only include the parts that serve the overarching message of your report and aim of your project. Pick the right angle.
By the way, this doesn't mean that all of your reading has been in vain (it never is). You get to use all of your background knowledge again in the discussion. The more you read, the more you know and the more ammunition you have to critically assess your data and/or to propose future experiments.

Don't over interpret your data
Forget about the hard work that went into getting just this one Western blot to work after testing five different antibodies in three different cell lines. As we say in Dutch: *"één is geen"* (one is none). If you did not have time to reproduce your results that's just the way it is – but it does mean that you have to be cautious when interpreting your data and jumping to global conclusions. Show that you are aware of the limitations of your work. Tell the reader how many times something has been done. Are your results more or less conclusive or do they only suggest that something is the case?
If your *n* is large enough, use appropriate statistical tests. Even then, don't leave your common sense by the door and always keep asking yourself what the data really mean. You can always use the infamous "it is tempting to speculate…" if you think this is what's going on.

Don't suffer from tunnel vision
Of course, you did your experiments for a reason. You had a hypothesis. You set up the experiment in such a way that you could interpret the outcome. You had expectations about what was going to happen. This is also how you will write your results section: *"To test x, we did y"*. *"If a is true, then testing b would show c"*. Now look at your data for what they really are. Train yourself to look at your results "with fresh eyes". Imagine you had no prior assumptions or expectations: Does your protein really translocate to the nucleus or do you just want it to be there?
Looking at your experiments (not only during the writing, but also during data acquisition, actually) with fresh eyes is one of the hardest things to do. It is why a new student will sometimes spot something that the experts have missed: because they have no pre-conceived notion of what "should" be going on.

Don't write a labjournal
I just said that I want the report to be complete. This does NOT mean that you have to sum up every individual experiment. If that were the case, I might just as well read your lab journal. In the results section, you have to take a bird's eye view of your data. Combine individual experiments into a single message. You had a specific hypothesis. How do the individual experiments fit together? Were three of them individual steps in the optimization process? *("First, we tested if x…"*) Are the data in agreement or do different experiments tell a different story? *("In x out of y experiments, a clearly inhibited b")*. Distill a message, don't just list observations.
In other words: Now is the time to convert your lab journal into a scientific argument and a story.

Don't be vague
Even if your data are inconclusive, there is no reason for your writing to be vague. Do you have quantitative data? Then give me the numbers. Provide fold changes, averages and standard deviations (or confidence intervals) if you can. Be clear as to whether you are discussing technical or biological/experimental replicates. Know the difference. Did something obvious go wrong? Point out the limitation of the experiment. *("X suggests Y, but it is important to note that sample A ran out of the well during the loading of the gel.")*

Don't forget to interpret your data
Sometimes students find it hard to decide what goes into the results section and what goes into the discussion. My rule is as follows: Always interpret your data in the Results section. After describing your results (i.e. what you see), write at least one or two summarizing sentences that wrap up that individual section. This helps the reader (who may be lost after having seen five Western blots with slightly different results that are somehow connected) and it also helps **you** to connect the individual experiments in your report. Give just enough interpretation to maintain a logical structure and flow in your story. *("Together, these data suggest that X does Y". To test if this is indeed the case, we proceeded to…").*
Don't go into any in-depth discussions. Save that for… the discussion. Here, you get to critically assess how valid your findings are. Do you see variation between experiments? Then what could be the source (you switched machines, you switched kits, it was a full moon…)? How firmly can you conclude something and what data are lacking? What would you need to do next? Then zoom out a bit more to the conceptual level and discuss your work in the context of the broader literature. Would it make sense to follow up on what you did or would you go in a different direction?

Put all of that together into a scientific argument that flows logically, add a bit of style and you're done!