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 you, the student, it may feel as if the sole goal of the internship report is to reduce all of your hard work to yet another 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!
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.

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 don't want my students to care too much about the word count. I always tell them 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 am I so firmly against the article style 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

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

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 article style 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.

Let me be clear on two points:

1. Writing an article is an art in and by itself. It requires you to strip away layers of noise until you are left with a clear and concise message. See for yourself: open up any scientific journal and read an article. Do you ever find evidence of the struggles you encountered? The failed experiments? The troubleshooting? My guess would be no. That is because the format demands that you leave all of that information out. You only present the final message (maybe 10% of the work) to the world. But the goal of an internship is NOT to polish your work and to strip away all of that extra information. The goal of an internship is to learn how to make sense of all of that information. In your internship report you get to show that you are indeed capable of critically assessing and interpreting your data. The very goal of the exercise is to learn how you have to wade through all of those experiments you did and how to deal with the variation between them. Forcing data that are all over the place into a short format where you are going to have to cut corners is not the way to do it.
2. 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. And it is, in fact, what you signed up for.

Typical pitfalls

Don't tell me everything you know
You have read so many articles that your head is just buzzing with knowledge and now you want the world to know. 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 in interpreting your data and that you have to show that you are aware of the limitations. 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.

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: do you really observe an increase in activity? 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 data fit into that little piece of science? 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.

Don't be vague

Even if your data are inconclusive, there is no reason to be vague. Do you have quantitative data? Then give me the numbers. Provide averages and standard deviations. Be clear as to whether you are discussing technical or experimental replicates. 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 showing your results, 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. *("Together, these data suggest that X does Y". To test if this is indeed the case, we proceeded to…")* Put yourself in the reader's position: Are there any obvious glaring issues that they need to know (e.g. a sample is obviously missing from the gel because you forgot to transfect it)? Then briefly mention them here. However, 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. Put all of that together into a scientific argument that flows logically and you're done!