Stop procrastinating and get on with it: how to kick-start your first scientific paper

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Preparing your first manuscript is a daunting task. As a conscientious student, you will have spent many a day and late night reading articles on the latest cutting-edge work from top research labs around the world. You've been chipping away in the lab too, and now your supervisor suggests it's time to put together these first results into a manuscript of your own for publication. But by what extraordinary feat will this disheveled pile of scribbled notes and disorganized data files be transformed into 'one of those' - a neat and self-consistent story with elegant figures and perfect prose? Remind yourself: every brilliant paper starts out like this; you just need to get started, and here's how.

Tip: **Use the cracks of time between things.** This is a perfect example; I have just 20 minutes before I need to leave work and will aim to write this article aimed at new graduate students before I go. So let's get started…

Step 1: Start by working out the story. Pose a question, then answer it using your data (figures) in a logical sequence. To do this, start with a blank piece of paper and a pen. I mean a *real* piece of paper, not a word document, not an electronic sketch pad… a real piece. Write down at the top of the paper the *question* you are going to answer. It might not be the question your supervisor posed a year ago, or what you had in your head while you were working. But it is the *interesting question you are able to answer.* Now, sketch out how figures will be used to present your data, in a sequence which logically addresses the question. Below is an example of this from a recent paper written in my group; normally I sit down and do this together with students, but there's no reason (after reading this!) you shouldn't just do it yourself. The key here is think about the clearest way to represent the data so that each figure carries a message in itself. In between or alongside each figure mark out the key points you are making – the sequence of figures and statements tells the story.

Step 2: Figures and their captions. Once you have the pen-on-paper sketch of the figures, next comes the task of turning these into professional and clear figures with good summary captions. There are many things to look out for here: be sure to use a sufficiently large font for all text in figures (such as axis labels); choose good symbols and line styles so the figure can easily be understood in black and white (even if you also use colour); avoid 'white space' by using empty areas for insets, legends, or schematic diagrams.

With each figure comes a caption. A caption begins with a short description of what the figure shows, followed by more detailed information. For now, use this as a storage space for collecting together the technical nitty-gritty about the how the data were collected: what preparation procedures were used; what materials were used; what were the conditions of the measurement; how many repeat experiments were made; notes on error; what equation was used to fit the data; etc.

Tip: **pictures and schematics are powerful but dangerous; handle with care!** The casual reader might not look much further than a particularly nice schematic before deciding they've got your message, so you need to make sure it's the right one. A really good schematic is likely to be pasted into many a presentation over the coming years (and not only by you – it's always nice to see your work in the introduction of other talks at conferences) so take pride in making a good job of it. This absolutely doesn't mean fancy graphics and fiddly detail - quite the reverse - it means simplicity and clarity to promote (only) the message you intend.

Step 3: The bullet-point version. Now it's time to commit your ideas and interpretation to paper. Once you have the framework of figures and the question well stated this isn't so difficult. First you need to decide whether your manuscript is going to have sections (e.g. Introduction, Methods, Results, Discussion, Conclusion) – in which case enter these into your document before you start – or whether it will be *Letter*-style (without sections). Put your figures into the appropriate places, then you're ready to start. Write short statements telling the story of your work (no more than 2 lines) – I use bullet points. Don't worry about order to start with, just get the ideas down on paper. Then it's like threading buttons onto a lace; you just pick them in the right order. Imagine telling your story to a smart-but-unacquainted colleague. What will she really need to know before you can explain to her the crux of your new discovery?

How much detail to include? The *arc* of the story is important. Always keep your (busy) reader in mind; she needs to be able to start at the beginning and read linearly through to the end, picking up most of your message on first pass and without losing track. A paper which puts across a clear and useful message will be cited. So use a separate Methods section to tidy away all the boring-but-important detail, or (for a Letter) keep it brief by referring to other papers where the methods are described in more detail. It needs to be available for those

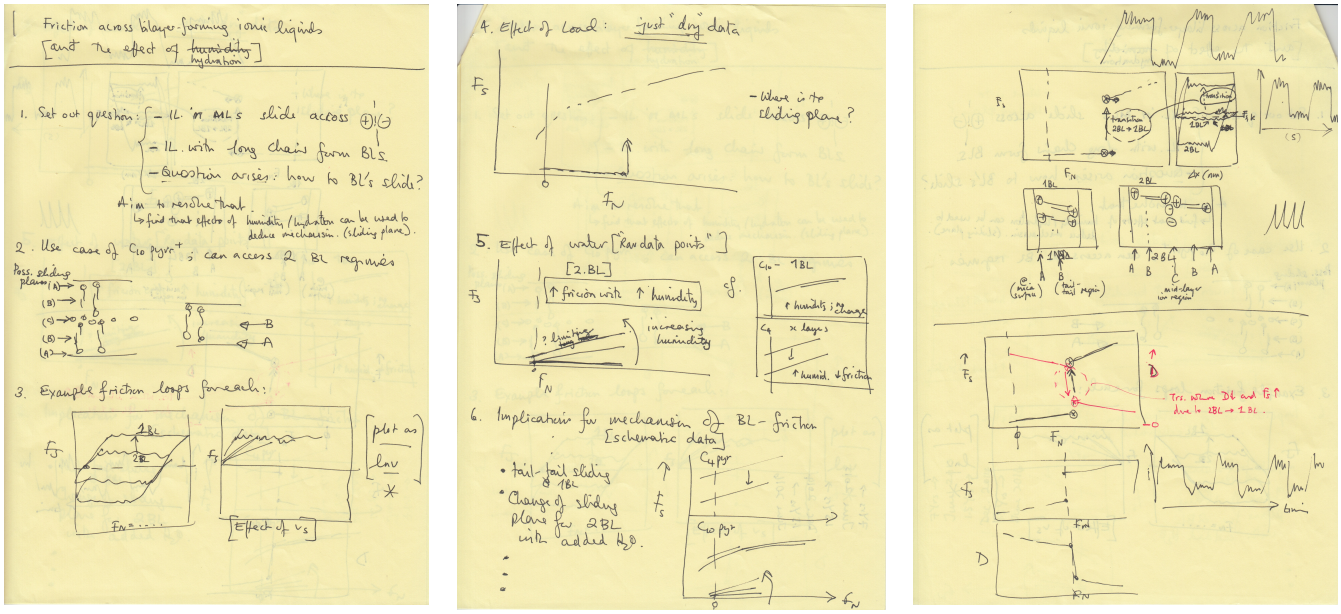

Figure 1: The story in outline form; first steps towards a manuscript. This one ended up as *Journal of Physical Chemistry Letters* (2014), **5**, 4032-4037.

readers who want it, but without obstructing the central message.

Tip: **You *can* start with the abstract!** We are often advised to leave writing the Introduction and Abstract until last – the though being that once you are sure what the paper contains it will be much easier to summarise and introduce. But if you're struggling with getting a handle on the structure or story, sometimes writing a short (max 150 word) abstract helps get your thoughts straight. Limit yourself to this word count and you won't be able to ramble on about this or that little interesting nugget, or such and such corollary: you cut to the chase. One or two sentences background, then a statement about what you've discovered and another sentence elaborating a little, and one final sentence about the generality or broader interest. That's it. Think about your abstract while you're in the lab, or on your journey home, in the shower… at some point the gold-dust will descend and you need to capture it. Once you have this your paper will begin to write itself: each sentence of the abstract corresponds roughly to a section of your paper. You'll probably return to polish (or even re-write) the abstract later, but it'll have done a valuable job already.

Step 4: Flesh it out. Each of your bullet-statements will become one or more full sentences. Paragraphs need to emerge with good structure: each paragraph starts with a sentence which reveals the content of the whole paragraph. Then sections emerge: even a paper without explicit section-headings still has structure. Introduction, Results & Discussion, Conclusion. If you choose to combine the Results and Discussion (I often do; it seems artificial to separate them entirely) make sure that you address each figure in turn by first describing the result(s) in that figure then, separately, discuss it afterwards. A reader who doesn't agree with your interpretation should nonetheless be able to clearly identify the unambiguous result. You'll need to add references at the appropriate points, ensuring that you are fair in attributing the first and most significant results in pertinent areas.

Tip: **Get your writing-fingers twitching**. Some days the words just don't come, however long you stare at the screen. Other days they flow fast and the fingers can hardly keep up. But there isn't time to just wait for one of those, so how to make sure you have a good-writing-day when you need one? My favoured method is to *get re-reading*. Think back to the absolutely best papers you've read – not the best science necessarily (although that will probably be good too), but the papers which had the best turns-of-phrase and scientific style you most admired. Put together a pile of them, and read, read, read. Digest. Sleep well. Then open the computer, start writing, and don't let anything distract you.

A note on integrity. As long as you do a good job of this, people all around the world are actually going to read your paper. Hundreds or perhaps thousands of them. When you're writing your first manuscript it's hard to imagine! But when the citations start to trickle in, or people seem to know your name at a conference, you'll know it's happening. So think now: what opinion do you want those colleagues to form of you? It goes without saying that you will be honest and fair in describing your data. But further, you need to be measured in they way you place your work amongst other work in the field; attribute others' findings and ideas appropriately; and be clear about error in your measurements. And gratuitous self-citation is ugly, don't indulge.

Finally, in case you're wondering, I didn't finish in 20 minutes. But I did get most of it drafted and so was able to finish it off with another slice of time in the evening. So: stop procrastinating, get started now, and good luck!