Weitzlab Guide to Good Paper Writing

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All scientific papers should be well written; this will make the reader want to read the paper, and will increase the likelihood that the reader will actually pay attention to what you are trying to say. You may have been taught to write lab reports, and hence papers, as following the order of introduction, summary of previous results, experiment, results and discussion. However, in almost all cases, if you write a paper with this structure, it will be just like a lab report: Boring!

These are suggestions for writing better scientific papers. However, please remember that, like all cases with the English language, these are not rules, but are guidelines, and there will certainly be times that they do not apply or that they should be changed. Nevertheless, do this only with care and foreknowledge.

Conclusion:
- Start with the conclusion first. This does not mean the conclusion section, but the conclusion you have arrived at. Make it one sentence, two at most. Have a single, key point you are trying to make. These are the most important sentences that you will write, as this will determine exactly what the paper is about. If you write this first, then you can write the rest of the paper to just make this point.
- Ideally, you know exactly what the main conclusion is before you write the paper. These are the easiest papers to write. However, there are times when the actual writing of the paper will help refine what it is about. Thus never be afraid to change these sentences if you learn more upon writing the paper. This can mean rewriting parts of the paper, but this will invariably lead to a better paper, so make sure to do this.

Main point of the paper:
- *A short paper* (Science, Nature, PRL or other letters journal) can only make one main point, and perhaps half of a second point.
- *A longer paper* can make an additional point. However, rarely can a single paper make more than a couple of points. There should always be a central point for each paper.

Introduction:
- The introduction is the most important part of the paper. It is what will make the reader want to read more of the paper. It is often also the main paragraph that determines whether or not a paper is accepted.
- Write the introduction *after* you have written the two sentence summary.
- Typically, you will write the introduction when you first begin the paper. You will then completely rewrite it when you have finished the paper, and you really understand what the main point of the paper is.
- Follow this general order to write an effective introduction:
  - Have a general, introductory sentence about the topic.

- o In the first few sentences, establish that the topic of the paper, as summarized in your one-sentence conclusion, is interesting and important, preferably both scientifically and technologically.
- o A lot may already be known, so review the literature, but very concisely.
- o Conclude from this review that there is one key thing that is still unknown, without which we can not progress.
- o This key thing is exactly what your conclusion sentence is about; this means that you have introduced exactly what your paper is about.
- o Finish the introductory paragraph with a statement about how if we understood or knew the information about the topic of the paper it would be very important.
- o Then start a new paragraph which very concisely describes what you have done and what you have learned. This should be a short paragraph, and should essentially summarize the point made in the conclusion sentence you have prepared.

Figures:
- Choose the figures, and write captions before you write the main text of the paper. These should be chosen to make the point that is your conclusion. Having the figures chosen first will make writing easier.
- Discuss the figures in the text. Guide the reader through the figures in the text of the paper. The reader should not have to stop and read the caption to understand what is in the figure and why it is important. Note that this is not a universal rule: both Science and Nature prefer to have a very detailed caption, with very little discussion of the figure in the text.
- When describing a figure, it is important that the reader know what to look for before looking at the figure. Therefore, it is always best to describe what you are plotting or showing, and the key point that you want the reader to come away with, before you have the reader look at the figure. The reader should look at the figure when you write 'in Fig. x.' The reader's eyes will go the figure then, breaking the flow of the text, so you should have described the figure before you say this. Thus, it is always more readable to put a phrase 'as shown in Fig. x' at the end of a sentence after the main point of the figure is described rather than starting a sentence with 'In Fig. x, we show.'
- The discussion of a figure should appear where it is natural. For example, if there are several pieces of data that are compared in the figure, each set can be discussed in separate places in the paper.

Outline:
- You are trying to make the point of the conclusion, and you are trying to provide the most convincing case to the reader. This will often mean presenting things in an order that is different than the way you discovered the conclusion; don't be historical, be as clear as possible.
- It is usually best to write an outline after writing the summary sentence and choosing the figures. This will make writing the paper easier, and will ensure that the whole paper is structured to make the point in the summary sentences.

Readability:
- *All papers* should tell a story and should be interesting for the reader to read; this will help ensure that they are read, understood, and therefore people pay attention to them, which is the purpose of writing a paper.
- *Long papers* can sometimes follow the traditional format of Introduction, Experiment, Results, Discussion and Conclusion. However, they often will be clearer by not following this format. The format chosen should match the best way to make the point of the conclusion.
- *Short papers* (Science, Nature, PRL or other letters journal) should tell a story. They will rarely follow the traditional format above. Instead, they will present the results in a way that most clearly makes the point.
- *Story*: Here is a trick when presenting data. See if there are two parts of the data that help make the point. Use the first part to establish the point, but leave some aspect of the point as a hypothesis that needs to be tested. Then use the second part of the story as a proof of the hypothesis. This often can be used, but not always.

Grammar:
- Generally use the present tense. It makes the paper more immediate. You can also use the past tense for things that you did in the past in order to set up your experiment or measurements. However, this has to be done carefully. It is simpler to use the present tense for everything.
- Do not use parentheses in text; if something is not important enough to put in the text, it does not need to be there – there is no reason to put it in parentheses.
- Do not use 'i.e.'; this is generally lazy writing.
- Don't be afraid to use parallelism for emphasis. Thus, for example, you can use two sentences with identical structure to make a point when you are comparing or contrasting two things. This can sound repetitive, but is actually a powerful way of making a point.

Wording:
- Avoid jargon in the paper.
- After you write the paper, do a search and replace to look for all instances of 'in order to' and replace it with 'to.' You almost never need to say 'In order to.'
- Never use 'on the other hand.' This can be used only when you first use 'on the one hand,' and it is very rare that you will actually use this construction.
- If you find yourself frequently beginning your sentences with 'this', then your writing is not clean. It should not be necessary to refer so abstractly to something you previously mentioned.
- If you use 'one ...', it should be followed at some point with 'a second …' or 'another …'. If you mean to use 'one' simply to give a single example that is not the only example that exists, but is the only one you'll talk about, you should instead use 'a …'
    - Bad: "One method for sorting droplets is to use an electric field. Sorting is a powerful technique."

- Good: "A method for sorting droplets is to use an electric field. Sorting is a powerful technique."
  - Good: "One method for sorting droplets is to use an electric field. A second method is to use a pressurized air valve. Sorting is a powerful technique."
- Don't say 'As a rule of thumb'; this is a colloquialism. Instead, say 'In general'.
- Don't say 'It is instructive to' do something, just do it.
  - Bad: "It is instructive to examine ways in which droplets may be manipulated. Droplets can be split, merged, and sorted."
  - Good: "Droplets can be manipulated in many ways, including splitting, merging, and sorting."
- Heaping on multiple adjectives is generally a bad idea.
  - Bad: "Kilohertz manipulation and measurement speeds …"
    Three modifiers ("kilohertz", "manipulation", "measurement") is too much for a single noun ("speeds") to handle!
  - Good: "Manipulation and measurement at kilohertz speeds …"
- The only personal names you should include in the text of a paper (not counting article references or citations) are names of people who are dead.
  - Good: "Purcell has shown that a low Reynolds number scallop would be no good."
  - Bad: "Weitz has shown that semicolons are useful."

Order:
- Pay close attention to the order of your structure. Put things in the most logical order. For example, when you are describing your experiment, keep logical portions together. It is usually not a good idea to mix the description of the experiment with the results, although in a short paper, this is often not the case – there, you may not have a separate experiment section, and thus may want to introduce new experimental techniques as they are needed.

Segues:
- Segues are the sentences that join one concept to the next. They are the sentences that start a new paragraph and introduce a new concept. They are very important for the readability of the paper. Never use trite segues like:
  - "We now describe such and such." This is very commonly done. However, a line like this is totally redundant, and simply reflects lazy writing. You don't need to say what you are going to do; just do it. Find a more appropriate segue.
  - "Such and such has been of interest over the past few years." This, or variants like this, are frequently used as starting sentences for a paper. Again, this is totally redundant, and is lazy writing. Of course the topic is interesting! Otherwise, why would you be writing the paper, and why would the reader be reading it? Find a better introductory sentence.
  - Never say "as discussed below". If you find yourself needing to say that, then it means you are not correctly directing the flow of your paper.

Abstract
- The abstract should be written last, after the rest of the paper is complete.
- It should consist roughly, not literally, of
    - 2 sentences from the Introduction
    - 2 sentences from the Conclusion
    - 1 sentence about the importance of the paper