HOW TO WRITE A GOOD SCIENTIFIC PAPER: A STEP-BY-STEP GUIDE

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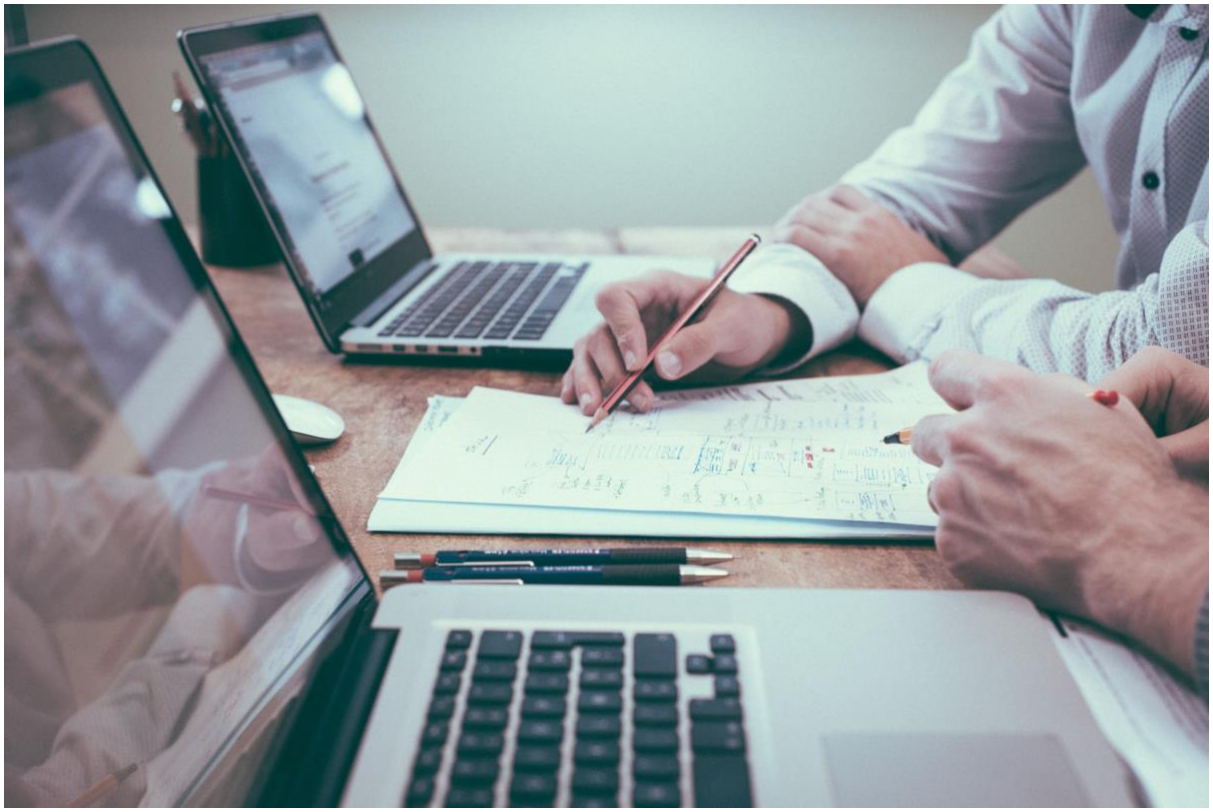

Who wouldn't like to see their scientific paper published in a good journal? Yet, putting together a manuscript for the first time might feel like a complex, challenging process. So here we break this task into simple, doable steps and share a few tips on making your writing process smooth and quick.

1. Decide on a storyline and a key message for your scientific paper

Before you jump into writing a paper, you need to think about its key message. What have you discovered? What would be the main takeaway for your paper's audience? You should be crystal clear on this, so spend some time thinking about it.

Try to formulate your key message in one sentence. For example, "we found that X marks progenitor cells in the developing mouse brain". Or, "we want to suggest a molecular structure of nucleic acids"… well, you can't pull this one off again, but you get the drill.

When you have decided on the key message, think of a storyline that will convey this message. How can you arrange your results so that they will deliver a convincing story? At this stage, it might be helpful to choose a preliminary title and write a brief outline of your research paper.

2. Understand your audience

When writing a scientific paper, you're trying to explain your key findings to a particular audience interested in your research topic. For your paper to resonate with this audience, you need to understand who your readers are.

When outlining the key message and storyline of your paper, think about scientists who might read it: *What are their scientific backgrounds and their research topics? What is their rationale for reading my paper?*
If your research is interdisciplinary (eg, biophysics), ask yourself: *Will all potential readers understand my message? How can I adjust the storyline so that it resonates with scientists from different fields?*

3. Prepare figures and tables

Once you have defined your key message and storyline, perhaps even drafted an outline, you can start preparing figures and tables. Many scientists will only read the abstract and then skip to figures and tables without reading the main text. Therefore, these visual items should look top-notch and convey your message to the audience.

How to decide if you should present your data as tables or figures? Tables work well for displaying a large amount of data that can't be easily plotted onto a graph. Figures are ideal for presenting images, data plots, maps, or schematics and are often used to compare experimental results between different samples or against calculated/theoretical values.

When designing a figure or table, ensure that they communicate your results and look visually appealing. Both figures and tables should have a clear and concise legend or caption. Also, figures and tables must be self-explanatory and not repeat the data shared elsewhere in your paper.

4. Start with the Methods section

Once you're finished with figures and tables, you can start writing (finally!). Although the abstract and introduction are the first sections of your manuscript, many sources, including scientific journals such as Elsevier, recommend writing them last.

We suggest you using the following writing process:
Methods -> Results -> Discussion -> Conclusion -> Introduction ->Abstract

The Methods is the most straightforward section of your manuscript, where you explain how you investigated your research question and describe the protocols and methods you used. Here you need to include enough details so an interested reader can reproduce your experiment. However, if you're using an established technique, a reference to a paper describing this method would suffice, so you don't need to duplicate the details.

Quick tip on references: Start collecting your bibliography in advance and use reference software, such as Mendeley or Zotero.

5. Write the Results section

In the Results section, you should only include representative results essential to prove your message. You can place any other supporting data in the Supplementary materials. As this section presents your results, you are usually not expected to cite any references here.

6. Compose the Discussion

In the Discussion section, explain the importance of your results for your research field. You should not simply repeat your Results section here but rather discuss what it meant. Don't hesitate to make strong statements if your results back them up, but avoid any statements not supported by your results.

Here you are also expected to compare your findings with other published studies in your field. If they are not consistent, suggest possible reasons explaining the difference. Also, the Discussion section should mention any inconclusive results and limitations of the study.

7. Write the Conclusion

The Conclusion can be either a separate section or the last paragraph of the Discussion, depending on the journal. Here you highlight the most important outcomes of your work and explain how they advance the field. Avoid repeating the main points of the Discussion; instead, interpret your results at a higher level of abstraction.

8. Now it's time for the Introduction

The Introduction section justifies the motivation for your work. In this section, you state your research question/problem, review any existing knowledge in the field, and provide readers with the background information needed to understand your study.

Ensure that you cite current and relevant research papers, including studies with contradicting results. A general recommendation is to use articles no older than ten years unless it's the first discovery in the field. You should also introduce your study aim at the end of this section.

9. Finish off with the Abstract

Now it's time to write the abstract, which summarizes the content of your paper, allowing a reader to decide if they want to read further. Many scientists will only skim the Abstract, so it must be valuable and engaging to encourage them to read the entire paper. Typically, journals don't allow more than 250 words for this section, so you'll have to keep it brief.

10. Once you've got the first draft, keep on editing

To speed up your writing process, try to get your thoughts down the paper as quickly as possible. Don't worry too much about spelling, grammar, style, or the exact words. You can edit or even re-write the whole section afterward. However, once you drafted the entire section (eg, Methods or Results), you need to ensure that your writing is clear, concise, and easy to read. Here are a few pointers on how to keep your style clean and easy to follow.

Check that your sentences follow a cohesive, logical flow

To connect sentences, you can use transition words, such as *therefore, however,* and *also*, but be careful not to overuse them. If two sentences are related, you can also connect them with punctuation marks, such as colons or semicolons. Importantly, ensure your sentences and paragraphs are connected in a logical order: from a general overview to specific details, from introducing a model to describing the results, etc.

Keep your writing clear and straightforward rather than stylish or fancy

The main goal of writing a scientific paper is to be understood (and accepted, published, cited!), so clarity is the key. Avoid using metaphors or similes unless you're sure that your readers won't misinterpret them.

Keep your sentences short and to the point

Always check your sentences for redundant words. If a word doesn't play any role in the sentence, cut it out.

Example: The core PRC2 complex consists of a histone methyltransferase subunit EZH2, which *depends on association with* SUZ12 and EED and *the additional association* of the histone-binding proteins RBBP.
Revised: The core PRC2 complex consists of a histone methyltransferase subunit EZH2, *which works together with* SUZ12, EED, and the histone-binding proteins RBBP.

Write with nouns and verbs – use adverbs and adjectives sparingly

"When you catch an adjective, kill it. No, I don't mean utterly, but kill most of them."
Mark Twain

Write in plain English

Use language that is clear for everyone, including non-native English speakers, by avoiding jargon words. Even if English is your first language, keep in mind that it's not the case for many scientists. Remember that you want your paper to be understood and cited by as many scientists as possible.

Also, minimize the number of abbreviations you use, especially avoid those not typical for the field, as they will make your text hard to follow.

Use active voice whenever possible

Feel free to write the Methods in the passive voice because this section focuses on the steps taken rather than on who did it. However, we recommend using active voice in all other sections whenever you can. Writing most of your sentences in the active voice makes the text easy to read and understand.

Example: CUT&RUN typically uses fresh, unfixed samples as starting material, but *there have been adjustments to the protocol that allow* the use of samples cryopreserved in 10% DMSO.
Revised: CUT&RUN typically uses fresh, unfixed samples as starting material, but *protocol adjustments can allow* the use of samples cryopreserved in 10% DMSO.

Avoid '**zombie nouns**' (ie, nominalizations).

You can easily recognize them by an ending, such as *-tion, -ment, -ency (implementation, agreement, tendency, etc)*. Zombi nouns make sentences wordy, so when you see it – replace it with an active verb.

Our findings *are in agreement* with the previous studies. -> Our findings *agree* with previous studies.

We *made an assessment of*… -> We *assessed*…
Our study *took* many factors *into consideration.* -> Our study *considered* many factors.

Keep the subject and verb close together

Sentences are easy to read if the verb follows the subject because the readers immediately understand what is happening in the sentence. In contrast, separating the subject and verb by a lot of text might confuse the readers and force them to re-read the sentence to understand the meaning.

Example: ***The discovery*** that PRC2 loss does not lead to the global loss of H2AK119ub1 h***as complicated and expanded our model.***
Revised: We found that PRC2 loss does not lead to the global loss of H2AK119ub1, and ***this discovery has complicated and expanded our model***.

Wrapping it up

It's a good practice to get regular feedback from your supervisor, other authors, and collaborators. Once you got a section draft in good shape, send it around to 1-2 colleagues. While you'll be writing the next section, they will be providing you with valuable feedback on the previous one – win-win!

If you've already decided about the target journal for submission, you can always check the journal guidelines for authors (eg, for Nature, PNAS). Also, you can check out the style of other articles from the target journals you're planning to submit.

Finally, be prepared that getting your research paper ready for submission won't be a fast process. You will go through several rounds of editing and get many frustrating comments (pro-tip: don't reply to those immediately), but it will be all worth it when you finally see your paper in print or pre-print! Then, don't forget to tweet about your first publication. Time to celebrate and get cited!

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