How to write scientific text

Disclaimer

The guidelines below are just meant to serve as a general idea of how to structure a manuscript. There is no claim of comprehensiveness, completeness, or even of correctness. By the end of the day, a written piece of work should optimally transfer knowledge from the writer to the reader, and there are obviously many different ways to accomplish this. However, before you develop your personal style, it might be worthwhile thinking about some general concepts.

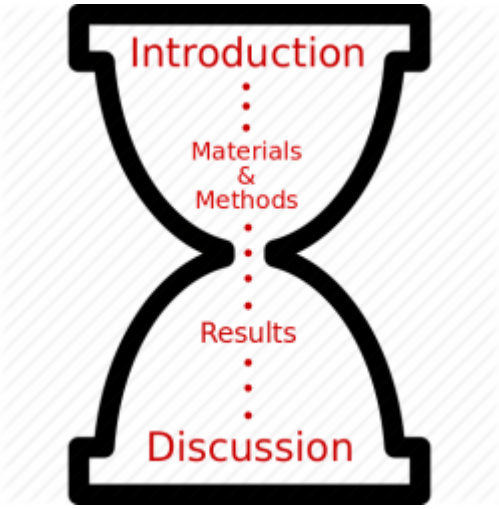
Writing style

It is sad but probably true, most people do not read your text while enjoying themselves. Instead they scan it to extract the relevant information as quickly as possible. One of the main tasks when writing scientific text is therefore to

- structure it as clearly as possible
- keep a clearly recognizable golden thread through your text
- make important information stand out
- use a linear structure. Talk about topic A, then about topic A', and then about topic B. Unless you are a very experienced writer, avoid by all means a nested structure, such A, B, A'.
- write short sentences, and make sure that one sentence contains only a single information
- back up each statement with a reference, unless it can be safely considered undisputed common knowledge
- include figures where they are helpful for transferring your information. Sometimes, one figure can replace pages of written text
- make use of tables, when you no longer can place the information into the main text. If you decided on a table, then don't repeat its content in the main text.

The standard structure of a manuscript

It is a good idea to imagine the structure of a manuscript in the form of an hourglass. You start your introduction with a general overview of the research field and then subsequently narrow the focus to the particular problem you are interested in, and that you will tackle in the course of your work. Materials and Methods, as well as the results that you generate are focussed on your problem. This is the part of your work that represents the constriction in the hourglass. In the course of the discussion, you will broaden your focus again to link back your findings to the research field your problem is embedded into. However, of course you need to stay reasonable…



Abstract

Objective

The abstract should draw your reader's attention to your work. It should either prompt him or her to continue reading, or to take home at least your name with your main findings and conclusions.

What to consider

Writing an abstract is probably the most tricky part, and you should write it only once you have a full overview of your project. If your abstract is boring or incomprehensible, most people will not read the remainder of your text. Moreover, many readers will, because of time constraints, only read your abstract. To nonetheless reach these people, you abstract should briefly inform about the background, your research question, your main findings and your main conclusions.

For papers, this section is typically about 250-300 words in length. For theses, the summary is typically longer and can extend to several pages. The structure, however, remains the same.

1. Background and basic introduction (1-2 sentences)
2. Problem (1 sentence)
3. Our research question (1 sentence)
4. Results (2-3 sentences)
5. Main conclusion (2-3 sentences)

The Nature journal provides a nice example of how to structure an abstract

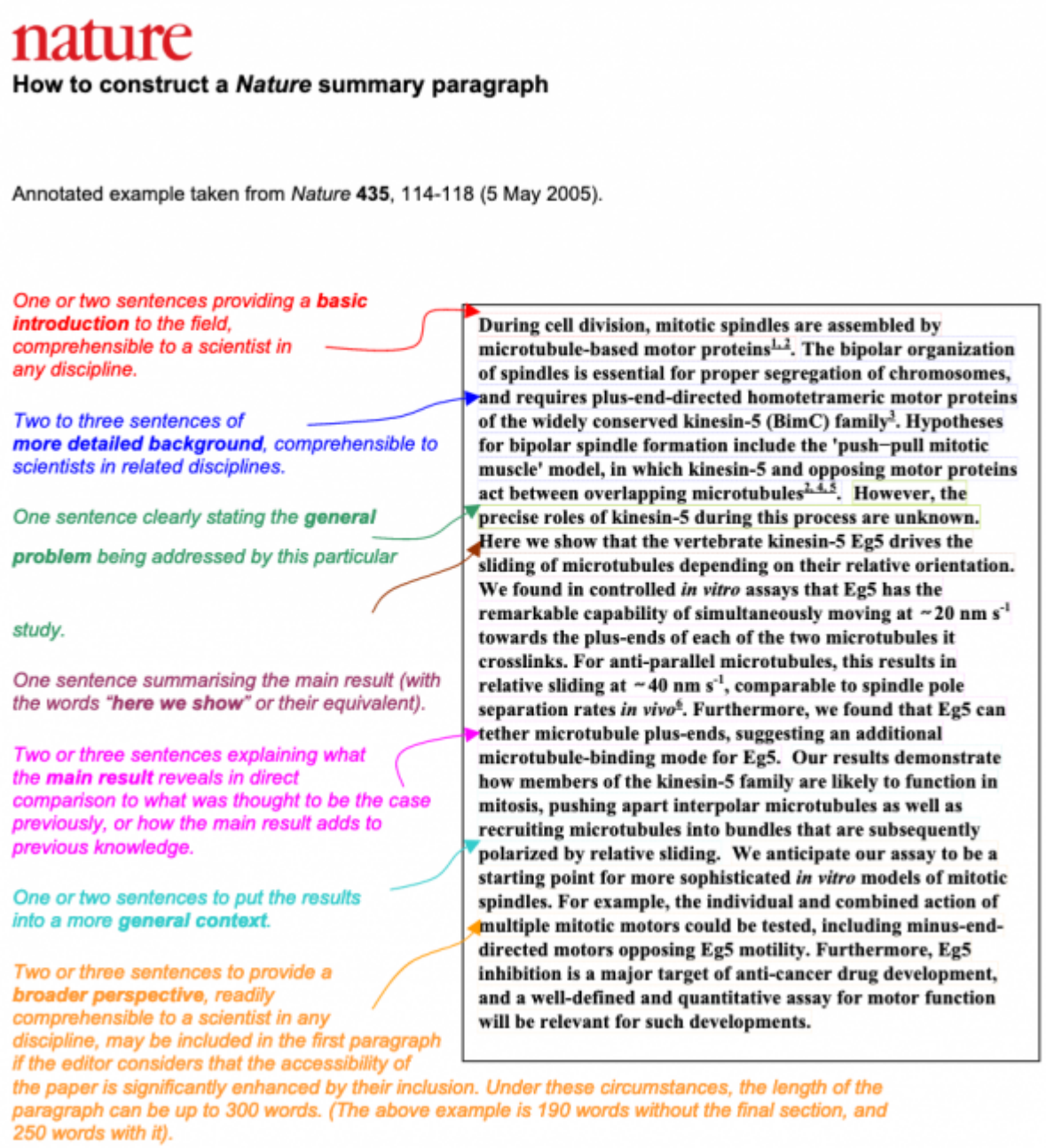


Figure 1: Nature's guideline of how to write an abstract

Introduction

Objective

The introduction sets the stage for our research project.

What to consider

An introduction must serve the following needs

- introduce the general research field, but keep the scope reasonable
- provide an overview of the state of the art in the research field. This requires knowledge of the relevant literature

- lead over to pending questions and problems in the field
- clarify your motivation for your research project
- clearly specify your research questions and/or your working hypothesis.

Towards the end of the introduction the reader needs to understand what you are going to do, why you want to do it, and why you think that it leads to an advance in the field.

Materials & Methods

Objective

The Materials & Methods section must provide all information that is required for reproducing your analysis.

Materials

Consider *Materials* as original resources[1)]. You exploit these resources in the course of your analysis. Make sure to have the following information included

- all data that you used in the course of your analysis
  - genome assemblies → make sure that you provide the data source together with the accession number
  - gene sets[2)] → make sure that you provide the data source together with the accession number

    If you use data that is already locally available in the ApplBio system, you still have to provide the original data source

  - species lists[3)], including full species names, NCBI Taxonomy Id, and if it deems appropriate, the common name. Add further information ad libitum
  - data bases, which you used
  - computer hardware
  - programming languages that you used
  - ...

Methods

Provide in this section all methods that you used in the course of analyzing your data. Methods are, for example

- Programs and software Make sure to always add the version of the software, if available, together with the source from where you downloaded the software, and the reference where it was published.
  - If you used the software always with a standard set of parameters, you can specify them

here
    - group software under one summarizing heading, if applicable. For example, you may group software for genome assembly, assembly quality assessment, repeat recognition, gene prediction, and genome browser in one section named **Genome assembly and annotation**
- Biological experiments, which have been performed in the course of your project
- …

Results

Objective

In this section, you describe which analyses you did–not necessarily in a chronological order but rather in an order that fits best the way of how you tell your story–and what ever came out from these analyses. Describe in the first place what you saw, and not what you did not see, i.e. write in a positive manner. The reconciliation between your observation and your expectation should be kept for the discussion. There is one exception: In the case that an unexpected outcome triggered the next analysis, then you can use this as a motivation for the next section.

Planning and writing the results section

When writing this section, it is advisable to think first about a hierarchical order of research questions or research hypotheses[4)]. A Results section is written best, when the result of the initial analysis triggers a question/hypothesis, which you then address with the following analysis. If you succeed to generate this order, the flow through your manuscript becomes kind of 'natural'. It is, thus, advisable to outline the Results section first by specifying the individual questions, and once the scaffold exists, start filling it with content.

Figures

The Results section is where most of your figures and tables will end up in. Keep the following in mind

- Think about the final size of your image in the text **before** creating it. This will save you a lot of hassle … Typically, the width of the figure should be no more than 80 mm for a single column figure, or no more than 160 mm for a double column figure. The height of the figure should be no more than 220 mm when it is printed on A4 paper.
- figures should be sized such that they are neither exceedingly large nor small to an extent that your reader has to hurt his or her eyes to extract information from them
- make sure that the font size of any text within the figure is still large enough for reading, once you have scaled your figure to the final size
- please avoid figures in landscape format whenever possible
- when using colors in your figure, it is advisable to use a color palette suitable also for color blind people
- make sure that the weight of any line in your figure is still appropriate after scaling your figure to the finale size
- Each figure

- has a number, and you have to refer to the figure in the text. Keep in mind, you have to number the figures in the order that they are mentioned in the text.
- has a concise and informative title
- has a concise and informative description, which does not repeat the title. Make sure to explain all relevant things the reader should see in the figure. In essence, the reader should get the information from the figure, even when not reading the main text

Tables

Everything what was said about figures applies also to tables. In addition, you may consider the following

- try avoiding tables that span more than one page. If you really have to show them, then it is probably a good idea to move them to the appendix
- please use only horizontal lines in tables
- label columns and rows in an informative manner. If you have to use abbreviations, explain them in the table footer
- avoid, whenever possible, redundancies in the table
- tables are always hard to read, make them as appealing as possible

Discussion

Objective

In the discussion, you have to link your results to your main research questions/hypotheses that triggered this project. You will interpret your findings, you will discuss to what extent your findings may depend on *ad hoc* decisions on, e.g. choice of particular programs and of program parameters, and eventually you will embed your work into the research field. Towards the end of the discussion, your reader needs to understand the scientific advance that was made by your project.

Conclusion & outlook

Here, you wrap everything up.

In addition, we can explain if we had more time what we could still do and what we could achieve.

References

The purpose and use of references

When to add a citation? is a question that it particularly hard to answer, especially for beginners. However, the answer is not particularly difficult to find, once you consider what citations are good for.

Scientific text is about providing facts, and to provide chains of arguments that result in the

generation of new knowledge. It is for this reason that there is a simple yet very strict rule: Every statement that you make in a scientific text needs to be backed up with supporting information. There are two ways of providing this information

- you cite a trustworthy source from which you have adopted the statement. Such sources are either peer-reviewed journals or textbooks (also peer reviewed). You will probably understand that sources of information, which you then add as a citation, need to be static. Highly dynamic resources, such as Wikipedia are therefore not suitable.[5)]
- you provide the data that supports the statement yourself

There are very few cases where you don't have to back up a statement. You can omit a reference if

- you talk about something that can safely be considered as common knowledge. For example, you don't have to cite somebody when you make the claim that living human beings are in possession of a head.
- you clearly point out that you are speculating

For your next text, simply ask yourself: Do I make a statement in the text, and if so, do I have to back it up with a reference or with data.

How to cite

There is no fix, and all embracing rule of how your citations should be formated in the text and in the bibliography. Depending on the journal you submit your manuscript to, you will have to adjust the format. For the theses, which are written in the ApplBio group, please make sure to have the *in text* citations formated as following:

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It was found that parts of the AMPK-TOR pathway can be traced back to the
last common ancestor of pro- and eukaryotes (Jain et al. 2018)
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In the case that you want to embed the reference into the sentence, please choose the following format

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Jain et al. (2018) stated that parts of the AMPK-TOR pathway can be traced
back to the common ancestor of pro- and eukaryotes.
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Having the in text references formatted like this makes them easy to interpret if you are halfway familiar with the literature in your research area. Typically, I suggest using the reference style of MBE.

Irrespective of your format choice, make sure that the way of how you cite is consistent throughout the text. Best is to use a citation manager, such as BibDesk in the case of LaTex, or Endnote in the case you use Microsoft word or Mendeley.

Acknowledgement

Almost nobody manages to complete a project alone, and you are often relying on help or input from other people that are not on the author list. It is, therefore, a nice gesture if you acknowledge this help and support. Make sure to acknowledge funding sources in a proper way

Appendix

The appendix or the online supplementary material is the place where you can provide accessory information that is important for your study, but which you decide not to place into the main text. Reasons for this decision could be, for example

- data size. Large trees or long taxon lists are probably better suitable for the Appendix
- the information does not contribute to the main message of the manuscript, but supports only a subordinate side project, where you, for example, assess the effect of parameter variation on the outcome of a particular analysis

Keep in mind that it is considerably easy to move blocks of information between the main text and the appendix. Thus, you can adapt the structure of your manuscript also in the last minute, if you think that it increases the readability

Read More

- So, you're writing a paper - Editorial from Nature Methods: PDF
- Writing Scientific English by Tim Skern: WebLink

Enjoy your writing time :)

1) Do not include meta-data here, i.e. data that you generated while analysing the original data

2) sometimes referred to as 'proteomes'

3) This is only necessary if you are dealing with more species than you can explicitly name in the text. It does not make sense to provide a species list if you are working only with human and mouse. However, you need to provide one if you are working with 20 or so species, which you later refer to as *Mammals*, for example

4) Note, a question makes however typically a poor section heading…

5) The argumentation is simple: if you look up a particular reference in 20 years, it has to provide the very same information as it did at the timepoint of adding this reference