

How to Read a Scientific Paper

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This document explains the different sections of a scientific paper. We have laid out the sections like a ‘mock’ paper to explain a bit about what is typically included in each section. Journals provide authors with instructions about which sections are required in different types of scientific papers. For example, a ‘commentary’ paper might have slightly different sections than an ‘original research’ paper. A commentary paper shares authors’ thoughts on a topic but not research they have done that are backed up by existing resources and research while an original research paper shares research the authors have designed and carried out. This example covers sections that are usually in a scientific paper that reports on original research and guidance for reading these.

Title

The title of the paper should explain what the paper is about and contain some keywords relevant to the topic.

AUTHORS AND AFFILIATIONS: NAME OF FIRST AUTHOR^{1,2}, NAME OF SECOND AUTHOR^{3,4}, NAME OF THIRD AUTHOR^{5,6,7}, NAME OF CORRESPONDING AUTHOR^{1,2}

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The order of the authors list varies depending on the scientific field. Generally, the first person listed drafted the paper. In some fields, the last author is the most senior person on the team who is responsible for the research overall, but in other fields that author is listed next to the first author. The order of authors between first and last usually represents how much each person contributed to the paper. Those who contributed more to the paper are closer to the first author, and those who contributed less to the paper are further down the author list.

If authors work for an institution or a company, these “affiliations” are listed. Although patient partners may not have formal affiliations, more and more often they are being listed as “Patient Author” for their affiliation. Formally identifying patient authors helps with the science of authorship and in understanding how many patients are contributing to writing scientific papers. Any patients identified as patient authors should be asked to provide their permission to do so.

When you read author affiliations, some academic institutions are better known and respected than others (rightly or wrongly). If you’re not sure about an institution or organization, you might want to do a search on it to learn more about it and how it is funded.

Scientists and clinicians who work in certain industries or who collaborate with some industries also author papers, which may cause skepticism for some readers. It may be important as a reader to review the authors’ conflicts of interests (this will be at the end of the paper, we call this section ‘Competing Interests’) and decide for yourself if you feel these conflicts may cause any biases. If you’re interested in reading more about what is called publication bias, this is a good article for [you](#).

Usually, one author is identified as the ‘corresponding author.’ The corresponding author is the person you can contact by email if you have questions about the paper. This is often the first author or the most senior author. Don’t be afraid to email the corresponding author to ask questions or to ask for a copy of the paper if you need to pay to access it (a paper that you need to pay to access is behind a ‘paywall,’ whereas a paper that you don’t need to pay for is called ‘open access’). Many people are happy to hear directly from people that are interested in their work.

If you’re interested in reading more about the requirements for authorship on a scientific paper, the International Committee of Medical Journal Editors has this guidance [here](#). This guidance has also been adapted for authorship teams that include patient [partners](#).

Abstract

The abstract can be thought of as a very condensed summary of what the paper is about. Often abstracts have a maximum wordcount in the range of 250 to 300 words. Some journals require a structured abstract, which means it has headings like: Introduction, Materials and Methods, Results, etc. If you skim the abstract, you should have a good idea what the paper is about and if you want to invest the time in reading the whole paper. Other people prefer to read the ‘Introduction’ before they make that decision. There’s no ‘right’ approach to what information you look at to help you decide whether or not you wish to read the entire paper.

Plain Language Summary

A plain language summary is not always required by the journal. If there is a plain language summary, it often has a word count maximum of about 250-300 words. It should be written at a language level that the general population can understand. Its contents should not be identical to the Abstract, but it should provide an easy-to-read snapshot of the paper.

Introduction or Background

This section helps set the context for the content of the paper. It covers a bit about the field of research and how the specific project (or group of projects) fits in to that field. For example, it should help the reader understand the field generally, including any gaps or the need for this work. It should also share how the work fills any gaps in the field or the reasons for doing the research. It may also set what readers can expect in the paper.

Materials and Methods

Sometimes this section may just be called Methods, depending on research that's being reported. This section describes exactly what materials were used and how the research was done and should provide enough information so that another research team could replicate the work.

For experimental research that is done in a lab, this section will describe any chemicals, instruments, readings that were taken, and other experimental details. For other types of work, it may describe, for example, how a survey was developed, launched, and responses collected and analyzed or how focus groups were carried out. It will also describe how the research was designed to minimize bias in the results of the research. If animals were used in the study or if human participants or samples were involved, special approvals may be needed to do the research. Those approvals will be noted in this section.

Results

The Results section describes the findings of the research. It often has text along with charts or graphics (sometimes called figures) and tables that present the data from the research. This section simply presents the results rather than putting them in to context within the field of study which comes in the Discussion section.

The Results section may include information about numbers and statistics. For example, it may include how many people participated in the study or the number of analyzed samples. The number may be important in terms of what the results say. Specific words such as significant or nonsignificant have a statistical definition which is important to keep in mind. This glossary from Statistics Canada might be helpful about [statistics](#) terms and this Statistics Cheat Sheet offers some basics about [statistics](#).

This section should include all results – not just the expected or easy to interpret ones. Sometimes researchers find things they didn't expect, and those should also be reported here.

Sometimes the Results and Discussion sections are combined in a paper, depending what the journal requires.

Discussion

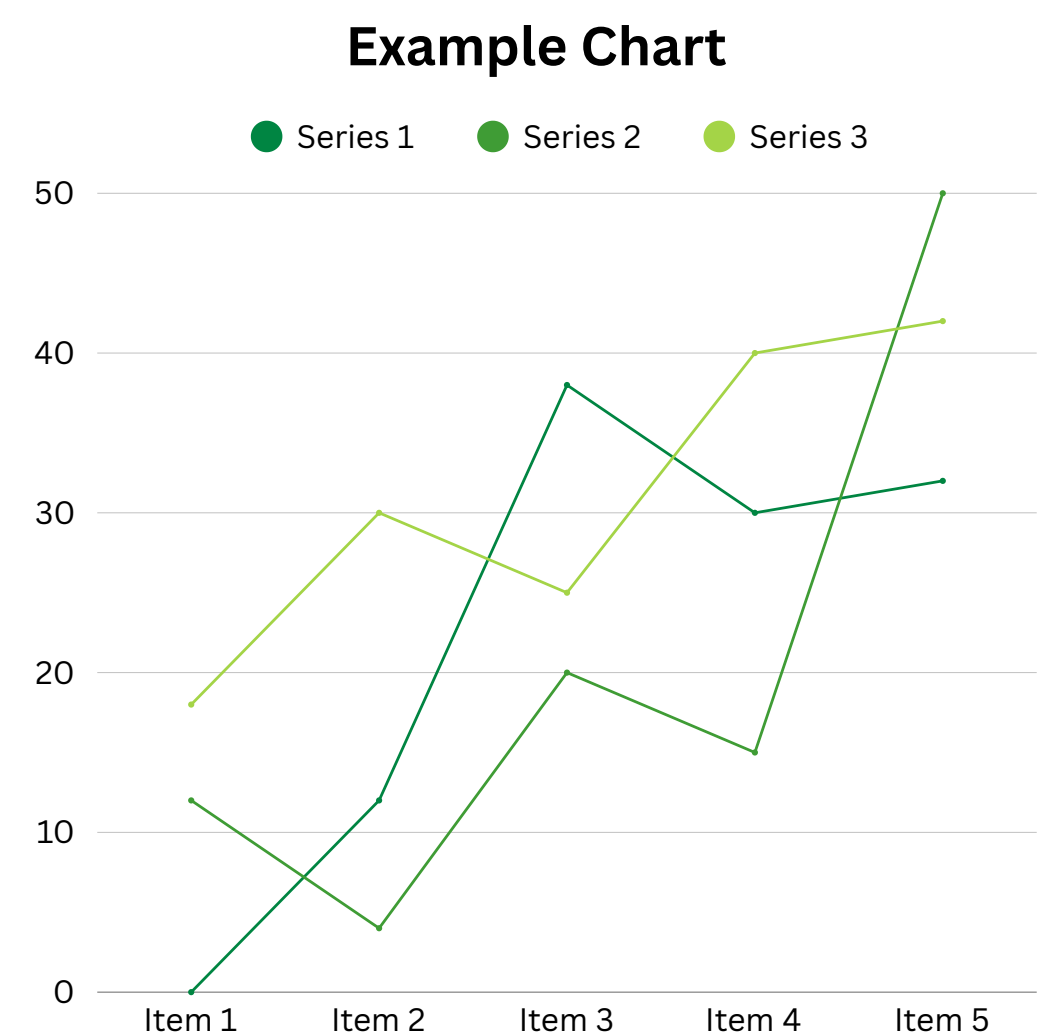
The Discussion section is an opportunity to put the results of the work in to the larger context of other work in the field, and to make interpretations of the results according to what is known in the field already. Here results are generally compared and contrasted to other work that is published on the same topic. Concrete ideas about why results are similar to or different from other results in the field should be presented.

Any unanticipated or hard to explain results should be discussed here. The researchers may explain their thoughts around these results, and may comment that these results offer an opportunity for future research and research directions.

Depending on your relationship to or knowledge about the area of research, you may even interpret the results differently from the authorship team. Sometimes the results of research can be very context or perspective dependent.

This section should also describe any limitations that the authors have identified in the research. This is like describing the boundaries of, or related to, the research. For example, if the people who responded to the survey were from a specific demographic only, results are only relevant to that demographic. For example, if participants were adult, upper middle class women, it would be a stretch to generalize these results to adolescents from a different socioeconomic class. In this case, the authors should note that more research should be done to include other demographics so that the results can be representative of other demographics or more broadly applicable across demographics. Another limitation might be that, due to budget, only 10 people could be included in a focus group. The authors should identify this and include how this might affect the results or the generalizability of the results.

This section might also include the authors' thoughts on what future work should be done that would further contribute to these findings, broaden them, make them more generalizable, or build on them.



Conclusion

The Conclusion does not need to be a long section. It helps reinforce the main finding(s) of the research, and how the authors filled an identified need or gap that was clearly stated in the Introduction of the paper. In many cases this presents the ‘take home’ message for readers and potential next steps.

After these main sections of a scientific paper, there can be a number of additional sections that tell you more about the research. Depending on the journal, these sections may be a bit different, but here are some of the main ones that are often seen.

Availability of data and materials

This section tells other researchers if they are able to access the data and materials generated by or used by the authors for their own work. Open science is a movement in research to make data and materials more readily available to others in a field. This type of approach is helpful to move research forward by sharing results and materials in a transparent manner that leads to less ‘research waste’ overall. There may be valid reasons that data and materials are not made available for others, and these should be stated if that’s the [case](#).

Abbreviations

Sometimes a list of abbreviations or acronyms used in the paper along with what they stand for is provided at the end of the paper.

References

This is a list of all of the scientific papers and maybe websites or other resources that the authors have referenced in writing the paper. This can be a good place to ‘dig’ if you’re interested in exploring and learning more about topics related to the article.

Some examples of how references are listed are here:

1. Smith, John et al. Year. Article title. Journal, volume (issue), pages
2. Institute of Musculoskeletal Health and Arthritis. Year. Article title. Journal, volume (issue), pages

Acknowledgements

This is a section that lists individuals who contributed to the research and maybe even the paper, but who did not meet the requirements to be listed as an author.

Funding

This section discloses which organization(s) or funding body(ies) provided funding support for the research. This might include a health funding agency, a health charity or patient organization, a philanthropic organization, industry, or other organizations. The funding source may be important to you in terms of deciding about the objectivity or the motivations behind the research. For example, if research is funded by industry, you may have concerns about potential bias or conflict of interest, or that the results that are shared are ‘positive’ results only.

Author Information

Generally, this section includes author affiliations and explains each author’s contribution to the work (for example, if they designed the research, carried it out, how they contributed to the manuscript, etc.). Sometimes authors are just listed here by their initials.

Ethics Declarations

While ethics approval is usually also cited in the main body of the paper, information will also be listed here about whether or not it was required for the work. Generally, research that involves human participants requires research ethics review. If ethics approval was not needed for the work, or if a ‘waiver’ was received from a research ethics board, this is noted in this section. A waiver is a document provided by an ethics board and means the research team was permitted to do the research without receiving informed consent from participants. There may be a few instances where consent is not formally required, for example, if the ethics board deems the research to be of minimal risk to participants, or if obtaining informed consent is not practical for a variety of reasons.

Consent for publication

This goes along with the ethics declaration. Generally, when data from human participants is part of research, those participants are consented for the research results to be used in a research publication. There are some instances where people may not be consented and a waiver from a research ethics board is obtained for ethics. This would be noted here and in the ethics declaration.

Competing Interests

Any potential conflicts of interest are listed in this section – these may be perceived or real competing interests, and which have the potential to create bias. For example, if an author has accepted funding from industry for the work presented or for other work they’ve done, this would be declared in this section. All authors, including patient authors, need to declare any competing interests.

Supplementary Information

This section may include files or data that is available for download or on request by readers of the paper. Supplementary Information includes items or documents that might be useful for others to use or help inform them, but that is not included in the main body of the paper. For example, while some of the data from the research may be shared in the main body of the paper as a table, a complete set of data or other tables that were simply too much information for the main body may be included in this section. Another example of a file found here might be the entire wording of a survey whose results are summarized in the paper.
