How to Successfully Write the 5 Sections of a Manuscript

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Outline

Title

Abstract

Introduction

Materials and methods

Results

Discussion and conclusions

References

The Five Sections

Why five sections?

The Humanities vs. the Sciences

Paiva, et al., 2012

Title

Capture reviewers' and readers' attention

Informative yet concise

Knight and Ingersoll (1996) suggest that 16 words should be the maximum length of a title

Paiva, et al., 2012

Title: Descriptive Phrase

For many journals, the title does not need to be a complete sentence, and no verb is necessary:

Complications in warfarin use

Title: Capitalization

Always check the journal's style guide:

Complications in warfarin use
Complications in Warfarin Use

Complications in warfarin use: A study
Complications in warfarin use: a study

Title: Complete Sentence

Use the simple present tense

Describe a conclusion that your paper supports

Title: Complete Sentence

Gene X is required for intestinal cell differentiation

Frameshift mutations in gene X cause abnormal notochord development in zebrafish

Paiva, et al., 2012

Title: Reader Expectations

The title should answer the question, “What does this research contribute to the field?”

Reviewers will expect the paper’s content to match the title.

Title: Word Choice

Make the words easy to search.

How will readers search for your paper?

If no one can find it, no one will cite it.

Title: What to Include

Key terms: Species names, geographical regions, method used

The most common name used for genes, methods, etc.

An answer

Title: What to Avoid

Abbreviations (unless the journal or field allows, e.g., ENSO in climatology)

CFR alleviates PCD in hazardous environments: An EFSA approach to GRB developments

Title: What to Avoid

Filler terms such as “Effect of,” “Comparison of,” “A Study of,” or “Observations on”

A study of the effect of X on abnormal brain development

Musings on recent explorations of the central Amazon basin

Title: What to Avoid

Using “Novel” or “First time” unless absolutely certain (overselling)

A novel approach to improved beef marbling in Brazilian cattle

Method X improves beef marbling in Brazilian cattle

Title: What to Avoid

Questions undermine your authority:

What is the best approach to the removal of micro- and nanoplastics from the ocean?

Can X method effectively assess credit risk?

Title: What to Avoid

If you include too little information, no one will read further.

An effective cancer biomarker
Alternatives to Portland cement

These phrases are too broad to describe one study.
Provide enough information to make your study unique.

Abstract: Before You Write

- Although the Abstract comes at the beginning of the text, it is often written last because it summarizes the entire article.

- Word count limit (150-250 words)

Abstract: Structure

Determine what the journal requires before writing your abstract:

- Unstructured abstract
- Structured abstract (headings)
- Plain-language summary (additional)

Abstract: Substance

Your abstract may be all that some people read.

- Convince readers to read the entire paper.
- Make it easy to understand.
- Make sure each piece of information is crucial to your topic and relates to your main conclusions.

Abstract: Style

- Use strong verbs ("analyze" vs. phrases "*perform an analysis*").

- Avoid filler phrases ("It is currently known that…" "We found that…").

Abstract: What to Include

- Importance of the research
- Critical background
- Clear hypothesis
- Methods summary
- Key results
- Succinct conclusion

Abstract: What to Avoid

- Excessive abbreviation use
- Citations (references and manufacturers)
- References to the text/figures
- Statistics
- Topics that your research does not address

Introduction

- **Assume no one has read your abstract**
- Provide an overview of the entire paper
- State the importance of the research
- Provide a background of the topic and current understanding
- Define acronyms (PCR, DNA)

Introduction: Answering Questions

- What is known about this topic? What is not yet known?
- How does this paper add to the literature?
- What is the purpose or hypothesis of the study?

Introduction: The Three Main Parts

- Start with the widest possible angle. Write a broad statement on the entire field:

- “Infectious diseases cause millions of deaths each year.”

Introduction: The Three Main Parts

- Next, provide a sentence that narrows down the scope of the manuscript:

- "Some of the most common infectious diseases are caused by bacteria such as *Mycobacterium tuberculosis*."

Introduction: The Three Main Parts

- Then, move on to provide specific results from previous literature that pertains to your study
  - Most relevant (< 5 years old)
  - Primary literature
  - Balanced

Introduction: Filling in Gaps

- When noting research gaps in the literature, include some information about why anyone should need to find the answer:

- "Understanding how the P127 oncogene contributes to the transformation of epithelial cells could lead to the discovery of novel anticancer therapeutics."

Introduction: Filling in Gaps

- If others have noted the same open question in previous articles, cite them.
- Focus on well-defined gaps. Mentioning that there is no cure for cancer is too broad of a gap.
- Emphasize how your paper will address any gaps.

Introduction: Transition from the Gaps

- Explain the problems your research addresses in the context of recent advances in the area.

- Present the reader with some basic information about what led you to complete your study in particular.

Introduction: Wrapping Up

- State your hypothesis.

- Describe your study's results in one or two sentences. One sentence may offer a brief description of the methods used, and the second a brief summary of one or two key findings.

Materials and Methods

- What did you use?
- How did you use it?

Materials and Methods

- This section provides critical details that allow reviewers to determine the validity of the results and conclusions.

- Include enough detail for other researchers to reproduce your results without taking up precious space.

Materials and Methods

- **Reproducibility**: This section provides an excellent reference for other researchers who want to reproduce certain experiments or techniques.

- **Credibility:** A clear and detailed Methods section also allows for the importance of the results and conclusions to be interpreted by reviewers.

Materials and Methods

- A well-written Methods section can ultimately increase your chance of acceptance.

- “One of the more common reasons for rejection of a manuscript is that the reviewers cannot fully understand how the study was conducted” Pronvenzale (2007).

Materials and Methods: Organization

- Write as you perform your experiments.
- Start with basic characteristics of the entire study and then move into details of specific experiments.
- Match the order of the methods with the order in which results are described.

Materials and Methods: Organization

- Study subjects or samples
- Interventions
- Experimental details
- Data analysis and statistics

Materials and Methods: Subjects and Samples

- Human subjects: (CONSORT guidelines, IRB approval); provide relevant demographic data
- Animal studies: (ARRIVE guidelines, IACUC approval); provide relevant attributes
- Cover the control and experimental groups

Materials and Methods: Subjects and Samples

- Provide the source of reagents
- Make sure you have included appropriate controls—this is a common cause of rejection

Materials and Methods: Interventions

- This subsection mostly applies to clinical trials, in which a very specific treatment or drug regimen was administered to the experimental group but not the control group.

- Include the source of any drugs or other compounds, the dosage, and the method of administration.

Materials and Methods: Experimental Details

- Describe how each experiment was performed.
- Report the methods in the same order as the results generated by those methods.
- Describe all the methods used to produce your results, even if you only need one sentence.

Materials and Methods: Experimental Details

- When using methods described in a previous paper, always include the proper citation: “Toxicity assays were performed as described previously” (Silva, et al. 2009).

- If you have modified previous methods, include the citation for the original method and fully describe the changes you made

Materials and Methods: Data Analysis and Statistics

- Describe any statistical tests fully. Saying that a t-test was used is not enough; there are several types of t-tests.

- If multiple statistical tests were used, be sure to clearly indicate which test was used to analyze each set of data and how you decided which test to use.

Materials and Methods: Data Analysis and Statistics

"Competition indices with a normal distribution, as determined by the Kolmogorov-Smirnov test, were tested for differences by Student's t-test. Data sets without a normal distribution were tested for differences using the Mann-Whitney U test."

Materials and Methods: Data Analysis and Statistics

Always define the threshold for statistical significance (e.g., “p-values < 0.05 were considered significant.”)

Materials and Methods: How Much Detail?

The Materials and Methods section “should strike a balance between providing sufficient detail so that readers can repeat the experiments themselves, but is not expected to be a laboratory manual” Cetin and Hackam (2005).

Materials and Methods: Details to Include

- Appropriate sequence data or accession numbers
- Citations to methods used previously
- Any and all modifications made to a past procedure
- The source of plasmids, strains, etc.
- Description of statistical tests

Materials and Methods: Details to Omit

- A lengthy discussion of the pros and cons of a particular technique (save for the Discussion)
- Results of any kind (save for the Results)

Materials and Methods: Details to Omit

- Repeated descriptions of a single method. If the same method was used in two situations, just describe what was different the second time:

- “Cells were grown and treated as described above and then fixed for microscopy.”

Materials and Methods: Pro Tips

- Have the co-authors write about the methods that they used for their contribution to the results

- Do not cut and paste an old methods section, even from one of your own papers. iThenticate (http://www.ithenticate.com/) and other programs will flag this as plagiarism, jeopardizing your submission

Results

- The Results section is meant only to report findings. It is about evidence, not interpretation.

- Always consult the journal guidelines. Find out whether the journal wants a combined Results and Discussion section. If you can combine the two sections, then you can present your data and discuss their importance at the same time.

Results: Organization

- Always present data in a way that makes the most sense, even if it does not exactly follow the order in which you carried out the experiments.

- Matching the order of Results to the order of the Materials and Methods used to produce them is advisable.

Results: Organization

- Results should follow the most logical order.
- Wherever possible, link your results together to explain the connection or rationale:
- “Having shown that salamanders prefer cool water over warm water, we next determined whether water was preferred to other liquids.”

Results: What to Avoid

- Speculation about the reason that you observed certain results (Discussion)
- Results found in previous studies (Discussion, Introduction (literature review))

Results: What to Avoid

- Lengthy descriptions of how data were analyzed (Materials and Methods)

- Comparisons of the results of two experiments or two methods for measuring the same phenomenon (Discussion)

Results: What to Avoid

- Make sure your results are always the subject of the sentence.

- Avoid statements like “ANOVA was used to demonstrate differences in branch length”.
- Instead, write “Branches were shortest in the group receiving the lowest concentration of phytohormones ($p < 0.005$ by ANOVA).”

Results: What to Include

- Results that support your study goal.
- Any statistics that support your results.
- Tables, figures, and graphs that help show your work

Discussion

- The place to show the creative side of science.
  - connect your work to the field
  - discuss the possible reasons behind the results you found
  - discuss the limitations of your study
  - propose future research directions based on your results

Discussion: Interpretation

- The Results involves dispassionate reporting, but the Discussion involves interpretation.

- This section is your chance to take the reader or reviewer from a neutral feeling about your paper to a positive one.

Discussion: Organization

- Often, there is no set structure.
- However, check the journal guidelines—the Discussion may be combined with the Conclusion.

Discussion: Organization

- Most begin with a paragraph that describes the key conclusions that you can draw from your results.

- Subsequent paragraphs place the results within the context of the field of study and offer explanations for unexpected results.

Discussion: What to Include

- If you reported an observation earlier, speculate why it occurred.

- If you obtained different results from others, explain why. Note any differences in study methods, materials, or conditions.

Discussion: What to Include

- The significance and implications of your results
- How your results refute or support your original hypothesis
- The implications of your results for future experiments, theories, or policies

Discussion: What to Include

- How your data support your hypothesis but not alternative hypotheses

- Most data can be explained multiple ways. How do your results (and prior references) lend evidence for your specific proposal? How do they rule out alternative explanations?

Discussion: What to Include

- Speculation about unexpected results
  - Most results will follow roughly in line with your hypothesis or be predictable given the parameters of the experiments. Some results, however, are completely unanticipated. Any such results should receive multiple sentences of explanations (there may be more than one viable reason).

Discussion: Limitations

- Far from weakening your paper, mentioning a few limitations will prove to the reviewers that you have seriously considered your study with a critical mind.

- Balance the discussion of limitations with some strengths, so that the reader is left with an overall positive impression.

Discussion: The Final Three Points

- Start a paragraph by summarizing your strengths
- State the limitations
- End the paragraph with future implications

Conclusion

- This section should specifically answer the major question that you raised in your Introduction.

- Taking the time to provide a brief summary will help the reader understand the most important points that your data support and the broader picture.

Conclusion: What to Avoid

- Do not discuss specific results, only the conclusions that they support.

- Additionally, do not feel that you need to provide data or citations for these statements; you should already have included the relevant information in the Introduction or Discussion.

Conclusion

- Finally, a concluding paragraph highlights the importance of the study and summarizes your take-away points.

- People tend to remember what they read first and last, so start strong and finish strong.

References

- This is where you show you know what is current in the field and whose work is most relevant to your study.

- It is crucial that the reference list be complete and accurate.

References

- Readers will use to verify some assertions that you make (or to discover new papers).

- Reviewers will check to see that you are citing appropriate sources to support your conclusions.

References: Formatting

- Always follow the journal's guidelines for citing references.
- Proper formatting makes it easier for the journal to assess a manuscript
- Paying attention to the journal's instructions also communicates that you are thoughtful and dedicated to submitting to that journal.

References: Formatting

- In-text references may by parenthetical citations or annotations that link to endnotes or footnotes.
- Some journals require active references.
- Some journals require a References page, endnotes, or footnotes.

References: Formatting

- There are programs that can help you manage and format references within a document.
  - EndNote (works well with Microsoft Word)
  - Zotero
  - Mendeley

References: What to Include

- Every source mentioned in the paper
- Any appropriate reference, focusing on the most recent literature
- Primary literature whenever possible, instead of review articles

References: What to Avoid

- References that are not cited in the text
- Citing an abstract without reading the full manuscript
- Citing conference abstracts

References: Final Note

- References formatting changes according to the journal.

- Always keep the complete citation; you may need to reformat the references; e.g., “et al.” is not always acceptable.

How to Successfully Write the 5 Sections of a Manuscript (Preparing Your Manuscript II)

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