

Eight Steps to Developing an Effective Outline

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Preparing an outline is the most important step in the process of producing a manuscript for publication in a journal. The outline bears roughly the same relation to the final manuscript as an architectural blueprint does to a finished house.

Its purpose of an outline is to divide the writing of the entire paper into a number of smaller tasks.

A good outline will organize the various topics and arguments in logical form. By ordering the topics you will identify, before writing the manuscript, any gaps that might exist.

There is no single best way to prepare a scientific manuscript, except as determined by the individual writer and the circumstances. You should know your own style of writing best. Whatever you decide to do, you should follow at least these steps before beginning to write your manuscript.

Remember, at this stage, you are only constructing an outline. You are not writing; you just need to put down some notes to guide your thinking.

1. Develop a central message of the manuscript

Prepare a central message sentence (20-25 words). If you were asked to summarize your paper in one sentence, what would you say? Everything in the manuscript will be written to support this central message.

2. Define the materials and methods

Briefly state the **population** in which you worked, the **sampling method** you employed, the **materials** you used, and most importantly, the **methods** you used to carry out the study

3. Summarize the question(s) and problem(s)

What was known before you started the study? What answers were needed to address the problem(s)? List the key points pertaining to the question(s) and problem(s). What did you do to answer the question(s)?

4. Define the principal findings and results

Your central message sentence probably encapsulates the most important findings. There may be others that you feel ought to be included. List these in note form. Don't worry about the order or about how many you put down.

5. Describe the conclusions and implications

Make brief notes on each of the implications that arise from your study. What are the principal conclusions of your findings? What is new in your work and why does it matter? What are the limitations and the implications of your results? Are there any changes in practice, approaches or techniques that you would recommend?

6. Organize and group related ideas together

List each key point separately. Key points can be arranged chronologically, by order of importance or by some other pattern. The organizing scheme should be clear and well structured. You can use a cluster map, an issue tree, numbering, or some other organizational structure.

Identify the important details, describe the principal findings, and provide your analysis and conclusions that contribute to each key point.

7. Identify the references that pertain to each key point

8. Develop the introduction

Before beginning on the introduction, read through the notes you have made so far in your outline. Read them through and see whether there is a coherent and cohesive story and a unifying theme that runs through the outline.

Your introduction outline should start with the main message, describe what the purpose or objective of your study was, how you went about doing the study, what you found and what are the implications of what you found.

Ten Steps to Writing an Effective Abstract

<http://www.sffedit.net>

An abstract is a condensed version of the manuscript, which highlights the major points covered, concisely describes its content and scope, and reviews its material in abbreviated form. It is usually the first section read and sets the tone of the paper for the reviewer. It must be concise and easy to read and must cover the important points of the paper.

Many publications have a required style for abstracts; the "Guidelines for Authors" provided by the publisher will provide specific instructions. Stay within the publisher's guidelines, or your manuscript might be rejected.

Writing an abstract involves summarizing a whole manuscript and providing as much new information as possible. The best way to write an effective abstract is to start with a draft of the complete manuscript and follow these 10 steps:

1. Identify the major objectives and conclusions.
2. Identify phrases with keywords in the methods section.
3. Identify the major results from the discussion or results section.
4. Assemble the above information into a single paragraph.
5. State your hypothesis or method used in the first sentence.
6. Omit background information, literature review, and detailed description of methods.
7. Remove extra words and phrases.
8. Revise the paragraph so that the abstract conveys only the essential information.
9. Check to see if it meets the guidelines of the targeted journal.
10. Give the abstract to a colleague (preferably one who is not familiar with your work) and ask him/her whether it makes sense.

Writing an effective abstract will improve the chances of your manuscript being accepted, encourage people to read it, and increase its impact.

A number of studies have indicated that a badly written manuscript with poor use of English, even with good science, has less chance of being accepted and published.

Ten Steps to Writing an Effective Introduction

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The purpose of the Introduction is to stimulate the reader's interest and to provide pertinent background information necessary to understand the rest of the paper. You must summarize the problem to be addressed, give background on the subject, discuss previous research on the topic, and explain *exactly* what the paper will address, why, and how. Besides motivating a reader to read your manuscript and to care about your results, the Introduction is useful also to the journal's reviewers and editors in judging the importance of your manuscript.

An Introduction is usually 300 to 500 words, but may be more, depending on the journal and the topic. Therefore, the Introduction needs to be very concise, well structured, and inclusive of all the information needed to follow the development of your findings.

Some people recommend that the Introduction be the first section written when writing a manuscript. If you need help beginning, please read our article *Twelve Steps in Developing an Effective First Draft* at <http://www.sfcedit.net/newsletters.htm>.

Below are the steps in developing an effective Introduction. However, since every journal is different, it is important that you look at papers in your targeted journal to determine whether they use all of these steps. For example, some journals do not include conclusions in the Introduction.

1. Begin the Introduction by providing a concise *background* account of the problem studied.
2. State the *objective* of the investigation. Your research objective is the most important part of the introduction.
3. Establish the *significance* of your work: Why was there a need to conduct the study?
4. Introduce the reader to the pertinent *literature*. Do not give a full history of the topic. Only quote previous work having direct bearing on the present problem.
5. Clearly state your *hypothesis*, the variables investigated, and concisely summarize the methods used.

6. *Define* any abbreviations or specialized terms.
7. Provide a concise *discussion* of the results and findings of other studies so the reader understands the big picture.
8. Describe some of the major *findings* presented in your manuscript and explain how they contribute to the larger field of research.
9. State the principal *conclusions* derived from your results.
10. Identify any *questions* left unanswered and any new questions generated by your study.

Other points to consider when writing your Introduction:

1. Be aware of who will be reading your manuscript and make sure the Introduction is directed to that audience.
2. Move from general to specific: from the problem in the real world to the literature to your research.
3. Write in the present tense except for what you did or found, which should be in the past tense.
4. Be concise.

Twelve Steps to Writing an Effective Materials and Methods

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In the Materials and Methods section you explain *clearly* how you conducted your study in order to: (1) enable readers to evaluate the work performed and (2) permit others to replicate your study.

You must describe exactly what you did: what and how experiments were run, what, how much, how often, where, when, and why equipment and materials were used. The main consideration is to ensure that enough detail is provided to verify your findings and to enable the replication of the study.

You should maintain a balance between brevity (you cannot describe every technical issue) and completeness (you need to give adequate detail so that readers know what happened).

This should be the easiest section to write. If you need help beginning, please read our article *Twelve Steps in Developing an Effective First Draft* at <http://www.sffedit.net/newsletters.htm>.

Since each journal has different requirements, review the journal's guidelines before beginning to write this section. The steps listed here are a general compilation of these requirements.

1. Order your procedures chronologically or by type of procedure and then chronologically within type of procedure using sub-headings, where appropriate, to clarify what you did. It is up to you to decide what order of presentation will make the most sense to your reader.
2. Use the past tense and the third person to describe what you did. For example: "The sample was incubated at 37°C for 3 days." - NOT: "I incubate the sample at 37°C for 3 days."
3. Describe your experimental design clearly, including the hypotheses you tested, variables measured, how many replicates you had, controls, treatments, etc.
4. Explain why each procedure was done. Reference may be made to a published paper as an alternative to describing a lengthy procedure.

5. Identify the source of any specific type of equipment, a specific enzyme, organism, or a culture from a particular supplier, which is critical to the success of the experiment.
6. Describe in detail any modifications to equipment or equipment constructed specifically for the study and, if pertinent, provide illustrations of the modifications.
7. Precisely quantify measurements (all metric) and include errors of measurement.
8. Describe the dates and the site where your field study was conducted including physical and biological characteristics of the site, if pertinent to the study's objectives.
9. Identify treatments using the variable or treatment name, rather than an ambiguous, generic name or number (e.g., use "healthy donors" rather than "group 1").
10. If required by the journal, mention the approval for the study by the relevant ethics committee(s) and the informed consent of the subjects.
11. Describe statistical tests and the comparisons made; ordinary statistical methods should be used without comment; advanced or unusual methods may require a literature citation.
12. Show your Materials and Methods section to a colleague and ask whether they would have difficulty in repeating your study.

Other points to consider when writing the Materials and Methods:

1. Don't mix results with procedures.
2. Omit all explanatory information and background - save it for the discussion.
3. Don't include information that is irrelevant to the reader, such as what color ice bucket you used, or which individual logged in the data.

Focusing on your Central Message

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This is one of the most important parts of writing your paper, and one that is often overlooked. Think carefully about what it is that you want your readers to understand about your work. Remember, we are all busy and we need to absorb your message quickly and clearly. Try these exercises:

1. Write down the three central points of your paper.
2. Summarize your paper in one sentence.
3. Describe your work to a colleague in one minute.

These might sound easy, but try them and you'll find out they aren't!

Don't rush this part of your planning. It is worth spending time getting it right. Once you have mastered these exercises you will feel more confident about the whole writing process that follows.

A common problem with summarizing your work is that there are usually several major findings. This exercise is meant to focus your thinking on the central issues. It is not going to form the published abstract. So, if you really can't squeeze your key message into one sentence don't worry. Try to do it in two. If you can't do that then you need to take a careful look at the reasons. Remember, this is a very important part of the process for writing papers so work at it. Talk to your colleagues and see if between you it is possible to highlight the central message of your work.

A number of studies have indicated that a badly written manuscript with poor use of English, even with good science, has less chance of being accepted and published.

Fourteen Steps to Writing an Effective Discussion Section

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The purpose of the Discussion is to state your interpretations and opinions, explain the implications of your findings, and make suggestions for future research. Its main function is to answer the questions posed in the Introduction, explain how the results support the answers and, how the answers fit in with existing knowledge on the topic. The Discussion is considered the heart of the paper and usually requires several writing attempts.

The organization of the Discussion is important. Before beginning you should try to develop an outline to organize your thoughts in a logical form. You can use a cluster map, an issue tree, numbering, or some other organizational structure. The steps listed below are intended to help you organize your thoughts. If you need additional help see our articles *Eight Steps to Developing an Effective Manuscript Outline* and *Twelve Steps to Developing an Effective First Draft of your Manuscript* at www.sffedit.net/newsletters.htm.

To make your message clear, the discussion should be kept as short as possible while clearly and fully stating, supporting, explaining, and defending your answers and discussing other important and directly relevant issues. Care must be taken to provide a commentary and not a reiteration of the results. Side issues should not be included, as these tend to obscure the message. No paper is perfect; the key is to help the reader determine what can be positively learned and what is more speculative.

1. Organize the Discussion from the specific to the general: your findings to the literature, to theory, to practice.
2. Use the same key terms, the same verb tense (present tense), and the same point of view that you used when posing the questions in the Introduction.
3. Begin by re-stating the hypothesis you were testing and answering the questions posed in the introduction.
4. Support the answers with the results. Explain how your results relate to expectations and to the literature, clearly stating why they are acceptable and how they are consistent or fit in with previously published knowledge on the topic.

5. Address all the results relating to the questions, regardless of whether or not the findings were statistically significant.
6. Describe the patterns, principles, and relationships shown by each major finding/result and put them in perspective. The sequencing of providing this information is important; first state the answer, then the relevant results, then cite the work of others. If necessary, point the reader to a figure or table to enhance the “story”.
7. Defend your answers, if necessary, by explaining both why your answer is satisfactory and why others are not. Only by giving both sides to the argument can you make your explanation convincing.
8. Discuss and evaluate conflicting explanations of the results. This is the sign of a good discussion.
9. Discuss any unexpected findings. When discussing an unexpected finding, begin the paragraph with the finding and then describe it.
10. Identify potential limitations and weaknesses and comment on the relative importance of these to your interpretation of the results and how they may affect the validity of the findings. When identifying limitations and weaknesses, avoid using an apologetic tone.
11. Summarize concisely the principal implications of the findings, regardless of statistical significance.
12. Provide recommendations (no more than two) for further research. Do not offer suggestions which could have been easily addressed within the study, as this shows there has been inadequate examination and interpretation of the data.
13. Explain how the results and conclusions of this study are important and how they influence our knowledge or understanding of the problem being examined.
14. In your writing of the Discussion, discuss everything, but be concise, brief, and specific.

Twelve Steps to Developing an Effective First Draft of your Manuscript

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You should now have detailed notes you can use to write your draft paper. If you don't have one already, it may help to prepare an outline for each section which includes a number of major headings, sub-headings and paragraphs covering different points. If you need help in preparing an outline see our article *Eight Steps to Developing an Effective Manuscript Outline* at www.sffedit.net/newsletters.htm. At this point you will need to convert your notes and outline into narrative form.

Some people recommend that you begin with the Introduction and continue in order through each section of the paper to help ensure flow. Others suggest that you begin with the easiest sections, which are usually the Methods and Results, followed by the Discussion, Conclusion, Introduction, References and Title, leaving the Abstract until the end. The main thing is to begin writing and begin filling up the blank screen or piece of paper.

- 1. Consolidate all the information.** Ensure you have everything you need to write efficiently, i.e., all data, references, drafts of tables and figures, etc.
- 2. Target a journal.** Determine the journal to which you plan to submit your manuscript and write your manuscript according to the focus of the targeted journal. The focus may be clearly stated within the journal or may be determined by examining several recent issues of the targeted journal.
- 3. Start writing.** When writing the first draft, the goal is to put something down on paper, so it does not matter if sentences are incomplete and the grammar incorrect, provided that the main points and ideas have been captured. Write when your energy is high, not when you are tired. Try to find a time and place where you can think and write without distractions.
- 4. Write quickly.** Don't worry about words, spelling or punctuation at all at this stage, just ideas. Keep going. Leave gaps if necessary. Try to write quickly, to keep the flow going. Use abbreviations and leave space for words that do not come to mind immediately.
- 5. Write in your own voice.** Expressing yourself in your own way will help you to say what you mean more precisely. It will be easier for your reader if they can "hear" your voice.

6. Write without editing. Don't try to get it right the first time. Resist the temptation to edit as you go. Otherwise, you will tend to get stuck and waste time. If you try to write and edit at the same time, you will do neither well.

7. Keep to the plan of your outline. Use the headings from your outline to focus what you want to say. If you find yourself wandering from the point, stop and move on to the next topic in the outline.

8. Write the paper in parts. Don't attempt to write the whole manuscript at once, instead, treat each section as a mini essay. Look at your notes, think about the goal of that particular section and what you want to accomplish and say.

9. Put the first draft aside. Put aside your first draft for at least one day. The idea of waiting a day or more is to allow you to "be" another person. It is difficult to proofread and edit your own work; a day or more between creation and critique helps.

10. Revise it. Revise it and be prepared to do this several times until you feel it is not possible to improve it further. The objective is to look at your work not as its author, but as a respectful but stern critic. Does each sentence make sense? In your longer sentences, can you keep track of the subject at hand? Do your longer paragraphs follow a single idea, or can they be broken into smaller paragraphs? These are some of the questions you should ask yourself.

11. Revise for clarity and brevity. Revise sentences and paragraphs with special attention to clearness. For maximum readability, most sentences should be about 15-20 words. For a scientific article, paragraphs of about 150 words in length are considered optimal. Avoid using unnecessary words.

12. Be consistent. Often a manuscript has more than one author and therefore the writing may be shared. However, the style needs to be consistent throughout. The first author must go through the entire manuscript and make any necessary editorial changes before submitting the manuscript to the journal.

Twelve Steps to Writing an Effective Results Section

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The purpose of a Results section is to present the *key* results of your research without interpreting their meaning. It cannot be combined with the Discussion section unless the journal combines the Results and Discussion into one section. The results should be presented in an orderly sequence, using an outline as a guide for writing and following the sequence of the Methods section upon which the results are based. For every result there must be a method in the Methods section. It is important to carefully plan the tables and figures to ensure that their sequencing tells a story. If you need help in preparing an outline see our article *Eight Steps to Developing an Effective Manuscript Outline* at <http://www.sffedit.net/newsletters.htm>.

1. Determine which results to present by deciding which are relevant to the question(s) presented in the Introduction irrespective of whether or not the results support the hypothesis(es). The Results section does not need to include every result you obtained or observed.
2. Organize the data in the Results section in either chronological order according to the Methods or in order of most to least important. Within each paragraph, the order of most to least important results should be followed.
3. Determine whether the data are best presented in the form of text, figures, graphs, or tables.
4. Summarize your findings and point the reader to the relevant data in the text, figures and/or tables. The text should complement the figures or tables, not repeat the same information.
5. Describe the results and data of the controls and include observations not presented in a formal figure or table, if appropriate.
6. Provide a clear description of the magnitude of a response or difference. If appropriate, use percentage of change rather than exact data.
7. Make sure that the data are accurate and consistent throughout the manuscript.
8. Summarize the statistical analysis and report actual P values for all primary analyses.

9. Use the past tense when you refer to your results.
10. Number figures and tables consecutively in the same sequence they are first mentioned in the text. Depending on the journal, they should be in order at the end of the report after the References, or located appropriately within the text of your results section.
11. Provide a heading for each figure and table. Depending on the journal the table titles and figure legends should be listed separately or located above the table or below the figure. Each figure and table must be sufficiently complete that it could stand on its own, separate from the text.
12. Write with accuracy, brevity and clarity.

Twelve Steps to Developing Effective Tables and Figures

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The purpose of tables and figures is to report data too numerous or complicated to be described adequately in the text and/or to reveal trends or patterns in the data. Tables and figures are critical. If readers go beyond the abstract, they are likely to examine the tables and figures next.

Before writing the first draft of your manuscript, it is important to organize the data you plan to present in the manuscript. By preparing the tables and figures, their titles and legends, and appropriate statistical analyses, you will be certain of your results before you need to interpret them. At this time you will also be able to determine if you have all the data you need. Before writing the first draft, it is important to plan which results answer the questions you posed in your research and which data can be left out.

If you need help beginning, please read our article *Twelve Steps in Developing an Effective First Draft* at <http://www.sfcedit.net/newsletters.htm>.

1. Decide which results to present, paying attention to whether data are best presented within the text or as tables or figures.
2. Limit the number of tables and figures to those that provide essential information that could not adequately be presented in the text.
3. Include only results which are relevant to the question(s) posed in the introduction, irrespective of whether or not the results support the hypothesis(es).
4. Design each table and figure to be understandable on its own, without reference to the text.
5. Number each figure and table in the order in which they are referred to in the text (figures and tables are numbered separately).
6. Organize the tables and figures in such an order that they tell a story.
7. Check with the targeted journal, but typically tables and figures are located on separate pages that follow the Reference section.

8. Make sure there is no page break in the middle of a table or figure, if the journal wants the tables and figures integrated into the text. Do not wrap text around tables and figures.
9. Be sure all figures and tables are referenced in the text of the article.
10. Obtain permission from the copyright holder (usually the publisher) and acknowledge the source, if you are including a table or figure that has already been published.
11. Write the table titles and figure legends in the past tense.
12. Provide information regarding what is presented in the table or figure in the table titles and figure legends, but not a summary or interpretation of the results.

Tables

Tables are used to make an article more readable by removing numeric data from the text. Tables can also be used to synthesize existing literature, to explain variables, or to present the wording of survey questions.

1. Create tables with the table function (pull down menu) in Microsoft Word. Do not use tabs.
2. Use column headings and table notes accurately to simplify and clarify the table. In most cases, the meaning of each column should be apparent without reference to the text.
3. Check with the journal, but most journals want the table title and table on the same page, with each table on a separate page in numerical order.

Figures

Figures provide visual impact and therefore they are often the best way to communicate the primary finding. Figures are traditionally used to display trends and group results but can also be used effectively to communicate processes or to display detailed data simply.

1. Label each axis including units of measurement and clearly identify the data you are displaying (e.g. label each line in a graph).
2. Check with the journal, but most want the figure legends listed in numerical order on a separate page and each figure on a separate page in numerical order.

3. Figures should be of high image quality, with minimal pixelization. Check with the journal on which image file type they prefer.
4. Figures are usually in black and white. Color is extremely expensive to publish, and should only be used when it provides unique information.
5. Do not include experimental details in the legend; these details should be included in the methods section.
6. Photographs of subjects should be used only if written, informed consent was obtained prior to the taking of the photograph.
7. Choose the correct figure format: 1) if independent and dependent variables are numeric, line diagrams or scattergrams, 2) if only the dependent variable is numeric, bar graphs, 3) for proportions, bar graphs or pie charts.