WRITING YOUR RESEARCH MANUSCRIPT: TIPS & TRICKS FOR GETTING STARTED

The writing of your research manuscript begins before you perform your first experiment. This may seem early or unnecessary, but writing your manuscript as you conduct your project offers many advantages. First, as you write, you can define the direction and scope of your project, allowing you to refine your thinking and understanding of your work. In addition, by writing as you go, you can document crucial details about your methods, experimental design, and data analysis. Without this documentation, it can be challenging to remember these details. Further, if you start your manuscript early and write as you go, you will quickly spot weaknesses in your results or experimental design and can address these weaknesses in the moment, thus improving the quality of your work. Finally, because you started your manuscript early, by the time you finish your experiments, you will have a full draft of your manuscript ready for editing and collaborator feedback. This will help you to publish your work quickly and ensure that your findings don't get scooped by another research team while you prepare to publish your work. Here, we provide you with tips & tricks to get started tackling your research manuscript.

BEFORE YOU BEGIN

Define Authorship

Collaborate with your supervisor to define authorship for the project. Understand where you fall in the order of authorship and your role in the project. This prevents conflicts of interest because each author's roles and responsibilities for the project are clearly defined.

Perform a Literature Review

As you begin a research project, you must develop a solid understanding of the gap in knowledge that your project will fill, the hypothesis that you will test, or the overarching goal of the project (i.e., developing a new method). To develop this understanding, perform an initial literature review. Keep track of vital papers that establish the foundation for your work (e.g., your gap in knowledge, your hypothesis, or your goal). Collaborating with a librarian can be helpful at this stage because they can help you navigate the various databases and pull high-quality resources. This review of literature will be ongoing. Thus, you must have a method to track your sources along the way.

Use a Reference Manager

Keeping track of research articles related to your study can be difficult. To make this easier, use a reference manager. With this software, you can keep track of important references. Further, this same software can be used to insert citations and format references in your manuscript. There are many reference managers to choose from, including EndNote, Mendeley, Papers, RefWorks, Zotero, and ReadCube. Some reference managers are free while others do require a paid subscription. RefWorks is available for free to anyone with a UAMS email. Visit the UAMS Library website for more information on the different reference managers.

Identify a Target Journal

Read broadly to identify journals where you might publish your study. Pick a few target journals where you would like to publish your work. Having a target journal and knowing the type of article that you aim to publish (e.g., a short report or a full-length article) will help determine the scope of your project. For instance, high-impact journals will likely want more rigorous, large-scale studies that ask novel questions of interest to a broad audience and use cutting-edge methods; in contrast, a journal specific to your field of study may be more interested in studies that answer fundamental questions in the field with proven methods. Once you've identified your target journal, you can write your manuscript according to author guidelines from the start, which is much simpler than trying to rework your document at the end.

Outline Experiments

Once you have solidified your gap in knowledge, your hypothesis, or your overarching goal, outline your experimental plan and determine how you will perform your experiments. For instance, what method will you use to test your hypothesis? What resources do you need to gather before you can begin? Do you need special approval for any aspect of your research? If so, you want to get approvals initiated so they don't delay your work. Your outlines should be detailed and should contain controls and a plan for statistical analyses.

Establish Your System for Managing Data

Establish a plan for storing and managing your data. Consider the following: (1) method for storing and backing up data, (2) method for laboratory notes (e.g., electronic notebook), (3) method for tracking data analysis, (4) method for storing code, and (5) method for making large datasets available.

Storing and organizing your data is critical because journals will ask for raw data in addition to finalized figures when you submit your manuscript. Thus, you must keep track of the raw data used to make your manuscript figures. Because your data are precious, you must store your data in multiple locations, and data should be backed up frequently. Use hard drives, approved cloud-based servers, and electronic notebooks to store your results. For statistical analyses, you likely will use analysis software (e.g., Python, MATLAB, SPSS). Determine which software (including version) you will use. If your study involves code, use a code-management system, such as GitHub, to protect your code. Finally, if you work with large datasets, you may be required to place the data in a public repository. Determine how and when this will occur.

WRITE AS YOU GO

Do not wait until you have completed your experiments to draft your research manuscript. Instead, write your manuscript as you conduct the work. Guidance on which sections of the manuscript to write when varies and often depends on personal preference. Some people prefer to write the Introduction as they perform their literature review and edit the Introduction once the project is complete. Others prefer to focus on Results and Discussion first and write the Introduction at the end. Here we provide one potential order for tackling subsections of your manuscript.

First write your **Methods**. When performing a new experiment, write the Methods subsection for that experiment. As you optimize your experiment, edit the subsection. Once you achieve your publication-quality result, be sure to finalize the Methods subsection. This way, when you compile the methods for the manuscript, you already have a draft of the methods used to collect the publication-quality data.

As you carry out your experiments, you will accumulate data. Thus, next draft your **Data Figures** and **Figure Legends**. Make manuscript figures as you collect data, even if the data are not publication quality. You can always replace the data later. By developing your figures as you go, you can consider how you will present and group your data into a narrative for readers.

Eventually, a narrative for your manuscript will emerge. Remember, data do not need to be presented in the order collected, and thus you can use your figures to help storyboard your narrative. Try printing out your data and grouping the data in different ways. What grouping makes the most sense? What order helps the reader follow your story? What order emphasizes the take-home message you hope to communicate with your work? You may not have all the pieces to the puzzle at this stage, but you can begin to envision the direction of your manuscript. And with this outline, you can begin to draft your **Results.** The figures and results will serve as the foundation of your manuscript. Understanding your target journal and the overarching narrative within the Results will help you gauge how much work remains before your story is complete.

Once you have a solid draft of Results, even if your data are not finalized, you can draft the **Discussion.** Here you will put your results into context. Because you've been completing an ongoing literature review, you can easily compare your data with other studies in your field. Then, you can frame your **Introduction** around the topics covered in Discussion. Remember, the take-home message of your Discussion should be the question you propose to answer in your Introduction.

Finally, you can write the remaining aspects, such as the **Title**, **Abstract**, and **Acknowledgments**. Throughout the writing process, you should incorporate **References** from your reference management software. You should also follow your target journal's guidelines to authors as you go, especially when it comes to number of figures permitted and word count restrictions.

If you write as you go, by the time you finalize your data, you will already have a full working draft of your manuscript, and you'll be ready to edit your work.

EDIT YOUR MANUSCRIPT

Approach the initial writing of your manuscript as your first attempt to get your ideas on the page. Once you have a full draft, you must refine your ideas and your text. First, read through the full draft of your manuscript and ask yourself the following: Is the question or goal of the study clearly stated in the Introduction? Do I provide all necessary details in Methods? Are my results clear and accurate? Have I misinterpreted any data? Are any further experiments required to illustrate my point? Do I clearly communicate the take-home message in my Discussion, and are there any other interpretations of data that I failed to discuss? Overall, is my language precise and concise?

Once you feel confident in your answers to each of these questions, you are ready to send your manuscripts to colleagues and collaborators for feedback. Each author of the manuscript should review and provide feedback on the manuscript. In addition, ask colleagues for feedback. Feedback from those who are not in your field is particularly helpful because they can often tell you if your main message is clear. They can also help identify any information that may be needed by readers that you've failed to include in your Introduction or Methods. This is also an excellent time to receive feedback from a scientific editor who can help refine the narrative and writing of your manuscript. Contact the Science Communication Group for help editing your manuscript.

Because you will gather feedback and potential changes from numerous people, perform the editing in an iterative fashion. This will allow you to incorporate feedback as you go. Don't make major changes to your document while others are reviewing the draft because this can complicate the revision process. Remember, time away from your document helps you to spot potential errors and further improve the text. Ultimately, editing is critical to the success of your manuscript, so ensure you leave enough time for this crucial step.

FINAL ADVICE

Writing is an iterative process, and your first, second, or third drafts will never be perfect, and that is okay. Remember that these initial drafts are all about getting your ideas on paper, nothing more. It may be helpful to imagine yourself as an artist, sketching a large canvas in pencil. You don't need refined details and intricate brush stokes; you simply need to transfer a general outline of the image in your head onto the canvas. Then, like an artist, you will go back again and again over months to add the necessary details to your piece.

Remember, by writing your manuscript as you go, you can organize ideas, identify gaps in your manuscript that remain, and maintain momentum as you carry out your work. Writing is a tool for discovery. As you write, you will refine your thinking and generate novel ideas that ultimately strengthen the science of your project. If you remember nothing else, remember this: Write early, write often, and leave time to revise.

ADDITIONAL RESOURCES

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