

An Investigation of Writing in Biology

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Abstract

Although not a common association, a significant portion of a biological laboratory researcher's career is comprised of writing. With the goal of providing prospective biology researchers information about the role of writing in their future career, I will explore the different types of writing that are most prevalent in the careers of biology-focused scientific lab researchers. Additionally, I will search for common practices students can adopt to thrive when writing in biology. To obtain this information, I will conduct interviews with UC Davis professors who specialize in the field of biology and analyze various biology writing guides. The results of this study suggest that there are various types of writings in biology that fall into the following four categories: pre-study writings, laboratory writings, post-study writings, and emails. However, the three main types of writing in biology are research proposals, research papers, and emails. I have also discovered many different practices that students can adopt to succeed when writing in biology, such as participating in the peer review process and setting daily time aside to practice writing skills. Through this study, I hope the inherent connection between writing and the sciences becomes more evident in the minds of future biology students.

Introduction

At a young age I decided that my dream was to become a biological scientist. When I thought about my future, I would picture myself in a white lab coat, latex gloves, and goggles. I would always be in the laboratory, exploring different specimens and looking at organisms under

a microscope. What I did not imagine was sitting in front of a computer, pondering how to word a research proposal to get funding for my studies. From this research study, however, I have discovered that writing is an extremely common practice for a biological scientist.

Due to the many types of writing within the field of biology, it is logical to split the kinds of writing a biological laboratory researcher encounters into categories. Writing in biology can be split into four main categories: pre-study writings, laboratory writings, post-study writings, and emails. Pre-study writings include writings that occur before a study is put into motion, such as research proposals. Writings done in laboratory notebooks and progress reports that occur throughout a study are laboratory writings. Post-study writings encompass the majority of the types of writing a biological lab researcher participates in. These writings include laboratory reports, research articles, and creating written aspects for presentations and posters. Lastly, the writing done in emails, to those within and outside the laboratory of employment, make up the final category of biological writings.

I performed this study with the hopes of giving those interested in the field of biology an introduction to the types of writing that are commonly encountered in the main four categories listed above. With the goal of helping those interested in becoming biological laboratory researchers succeed in their biological writings, I have also included tips on how to become a stronger biological writer in these categories.

Methods

To gather information to answer my question, I conducted both primary research and secondary research. I conducted primary research in the form of interviews. I interviewed two professors who work in the College of Biological Sciences at the University of California, Davis.

The first interviewee, Siobhan Brady, has a doctorate in Developmental Biology from the University of Toronto and studies in the Department of Plant Biology and Genome Center at UC Davis. The second interviewee is Jonathan Eisen who has a doctorate in Biological Sciences from Stanford University and studies in the Genome Center, Department of Evolution and Ecology, and the Department of Medical Microbiology and Immunology at UC Davis. Additionally, I performed secondary research by analyzing various biological writing guides that were either released by universities or published by experts in the field. When analyzing these sources, I looked for patterns in tips on writing and looked for the most heavily emphasized types of writings in biology.

Findings

Through this study, the three main types of writing that have made themselves most distinct are research proposals, research papers, and emails. These types of writings will be discussed thoroughly; however, the purpose of the other types of writing in biology will also be discussed in the category they reside in: pre-study writings, laboratory writings, post-study writings, or emails. Additionally, examples of each type of writing will be listed in an appendix at the end of this research paper.

The main type of pre-study writing is a research proposal, also known as a grant proposal. The goal of a research proposal is to convince an individual or organization to fund the research you wish to conduct (Roldan & Pardue, 2016). Research proposals play a vital role in the career of a biological laboratory researcher, as without access to the necessary funds to conduct an experiment, a researcher cannot discuss or present findings to the general public or to fellow scientists. In the interviews conducted with Dr. Brady and Dr. Eisen, research proposals were in the top three types of writings a laboratory biologist participates in. In addition, when

asked which type of writing in their career they find most challenging, both interviewees listed research proposals. Dr. Brady explained that one of the reasons she finds writing research proposals difficult is because of the challenge they presents when communicating scientific ideas effectively. Dr. Eisen notes that in some grant programs, “ten percent of the grant proposals get funded,” meaning that when writing a grant proposal, you are trying to convince the funders that you are better than ninety percent of the other proposals. Dr. Eisen also states that he writes roughly ten grant proposals each year and, on average, it takes more than forty hours to complete one. This opens the question of how you can effectively write a research proposal.

Research proposals do not have one standard format,;however, there are specific sections within a proposal that should be addressed. According to *Writing Papers in the Biological Sciences*, research proposals are similar to research papers, with a lack of results and the analysis of those results (McMillan, Arnold, & Priore, 2017). Every grant proposal should contain an informative title and begin with an abstract and an introduction to the topic being investigated (Hofmann, 2016; McMillan, Arnold, & Priore, 2017). The aims of the study and planned methods to conduct the experiment are also vital, as these inform potential funders of what the overall goal of the experiment is and prove that you have planned out how data will be collected and what instruments will be necessary to collect that data. Depending on what the guidelines of the research proposal are, you may also be asked to provide a budget. This section should have specifics on the cost of labor and instruments needed to conduct the experiment of interest (McMillan, Arnold, & Priore, 2017). A research proposal should end with a statement about the impact the results of the study will have in the scientific community. It is important to keep in mind that some grant programs will provide detailed instructions on the format of the research proposal. Those instructions should always be carefully followed in order to maximize your

chance of getting an accepted proposal (Hofmann, 2016). After a research proposal has been accepted, the approved experiment may be conducted.

During a study, there are two main types of writings that occur, writing in progress reports and writing in laboratory notebooks. Building on the idea of research proposals, funders occasionally like to know the status of an experiment they funded. Progress reports are sent to funders to showcase the current progress and possible difficulties and changes to the original planned experiment. Writing in a laboratory notebook is also a type of writing that occurs throughout a study. A laboratory notebook provides observations and data collected during the study. This notebook stays within the lab and its contents are written while the data is being collected, not before or after the experiment (Roldan & Pardue, 2016). The completion of a study leads to the largest category of biological writings, post-study writings.

Post-study writings include laboratory reports, research articles, and written sections for presentations and posters. These writings discuss the results and conclusions from the performed study. Laboratory reports and research articles are fairly similar; however, they have different targeted audiences. Laboratory reports target those in the author's laboratory or those who have followed or collaborated with the author throughout the study. Research articles, on the other hand, target scientists who do not know the specifics of the study, but may be interested in the results of the experiment. According to *Writing in Biology: A Brief Guide*, research articles typically discuss "several experimental approaches that together give a clear answer to the question under the study" and are usually a result of a "collaboration of several scientists over a significant period of time" (Roldan & Pardue, 2016). These different approaches should result from original research done by the author. Laboratory reports, however, are often written after a single experiment that has not been repeated for accuracy. Both of these forms of writing have a

structured order referred to as “IMRaD” which stands for the following sections: introduction, methods, results, and discussion (Roldan & Pardue, 2016). Interestingly, in both Dr. Brady and Dr. Eisen's interviews, research articles were in the top three types of writings a biological laboratory scientist participates in. When asked how many research articles he writes in a given year, Dr. Eisen notes that he writes between ten to twenty papers and that the amount of time it takes to complete one paper varies greatly, but can take dozens of hours to complete.

In addition to IMRaD, research articles and laboratory reports have an abstract as an additional section. Abstracts summarize the research article and are meant to be concise. They should contain a brief introduction, discussion of methods, results of the study, and discussion of the findings. The next section of research articles and laboratory reports should be an introduction. Introductions should begin with a big picture and slowly narrow to the specifics of what is being investigated. Following the introduction is the methods section. This section describes how the experiment was carried out and must be detailed. The detail provided should allow another scientist who reads the section to replicate the experiment. After the research methods are discussed the author should have a results section that contains the data collected and importance of that data to the study. The last letter in IMRaD stands for a discussion of the findings. This section is meant to interpret the results of the study. In addition to interpreting the data, authors should also compare their study to other similar studies and explain the overall significance of their experiment (Roldan & Pardue, 2016). Although not explicitly included in IMRaD, references are also typically a portion of the research article and laboratory report. Additionally, acknowledgements is a section of a research article that is not typically in a laboratory report. This section tells the readers who funded or assisted with the study (Hofmann,

2016). These two types of reports, however, are not a scientist's sole method of portraying the results of a study.

Presentations and posters are also common methods biologists utilize to communicate their findings to other scientists or with the general public. Both scientific posters and presentations have written aspects to them, and for these forms of communication, being mindful of the audience the presentation or poster is intended to serve is vital. Types of presentations include those given inside the employed laboratory, such as to coworkers, and outside the employed laboratory, such as to possible collaborators or interested companies. A presentation to either audience should contain IMRaD; however, the presentation itself should not explicitly state IMRaD in the heading of each slide. It is more effective to create slides with minimal text that lead the audience through IMRaD in a story form. Posters are another common way biologists share information about their studies to others. In general, scientific posters should be about forty percent illustrations, forty percent white space, and twenty percent full of text. Like in presentations, scientific posters should also contain IMRaD and occasionally an abstract, depending on the guidelines of the poster session. IMRaD sections should be titled, clearly separated, and overall, bullet points are preferred over lengthy text (Roldan & Pardue, 2016). While post-study writings seem daunting, they are an important category of writing that give scientists an opportunity to share their findings with others.

The last category of writing in biology is writing done in emails. This is a finding that arose during the interviews with Dr. Brady and Dr. Eisen. Both interviewees emphasized emails in the top types of writing they encounter in their career. When asked whether these emails are to those within or outside of her lab, Dr. Brady notes that most of the emails she sends are to international collaborators. Further showcasing the time a biologist spends writing emails, Dr.

Eisen mentions that he would prefer to work on more grant proposals and papers, but states that those desired types of writing are not as frequent because of the urgency of other matters discussed in emails. This category serves as a reminder that science is collaborative. Often research is conducted with other labs, whether international or intranational, which allows for different perspectives and experiences to come together and effectively solve an issue with science.

Adoptable Practices

The second portion of my research question explored the various practices students can adopt to successfully write in biology. Through the interviews with Dr. Brady and Dr. Eisen, I received tips on how to do so. Dr. Brady mentions that daily writing practice is vital. Dr. Brady follows this practice herself, spending about thirty minutes a day writing research papers or proposals. For grant proposals specifically, Dr. Eisen states that reading and reviewing other grants is helpful. Dr. Eisen justifies this practice by explaining that by reviewing grants “you get put in the position of the reviewer” and “realize how hard it is to choose among grant proposals.” In regards to scientific papers, Dr. Eisen expresses that practice is the key to success. He then goes on to mention that writer’s block is common when writing papers and that his general approach to push through writer’s block is to encourage those affected by it to dive right in and get an idea on the paper. This idea can then be circled back to and revised before the final product is formed. These are simply a few practices that can be adopted to be successful in the main types of writing in biology.

References

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- Jonathan Eisen. (2018). Bio. <https://phylogenomics.me/jonathan-eisen/jonathan-eisen-bio-2/>
- McMillan, V. E., Arnold, R., & Priore, C. F. (2017). *Writing papers in the biological sciences*. Boston: Bedford/St. Martins.
- Roldan, L. A., & Pardue, M.-L. (2016). *Writing in biology: A brief guide*. New York: Oxford University Press.
- Siobhan Brady. (n.d.). <https://biology.ucdavis.edu/people/siobhan-brady>

Appendix

Pre-Study Writings:

- [Grant/Research Proposals](#)

Laboratory Writings:

- [Progress Report](#)
- [Laboratory Notebook](#)

Post-Study Writings:

- [Laboratory Report](#)
- [Research Article](#)
- [Presentation](#)
- [Poster](#)