

## Overview and Principles of Scientific Writing

### Abstract

Scientific writing in English started in the 14<sup>th</sup> century. Human beings have been able to communicate for thousands of years. Yet scientific communication as it is today is relatively new. It was only 300 years ago that the first journals were published. Writing is the most vital means for communicating scientific work. It helps document and communicate ideas, activities and findings to others. Good writing can be beneficial to scientists in a number of ways. In this article we have discussed the basic overview and principles of scientific writing.

**Keywords:** *Academic writing, research article writing, scientific writing*

### History of Scientific Writing

Scientific writing in English started in the 14<sup>th</sup> century.<sup>[1]</sup> Almost four centuries ago, Sir Francis Bacon said that science should be written “in the simplest and least abstruse language.” Human beings have been able to communicate for thousands of years, yet scientific communication as it is today is relatively new. It was only 300 years ago that the first journals were published. The first scientific journals appeared in 1665 when coincidentally two different journals commenced publication, the *Journal des Sçavans* in France and the *Philosophical Transactions of the Royal Society of London* in England. Since that time, journals have served as the primary means of communication in the sciences. The Royal Society established good practice for scientific writing. Its founder member Thomas Sprat wrote on the importance of plain and accurate description rather than rhetorical flourishes in his history of the Royal Society of London.<sup>[2]</sup> Robert Boyle emphasized the importance of not boring the reader with a dull, flat style.<sup>[2]</sup>

### Why is Writing Important in Science?

Writing is the most vital means of communicating scientific work. It helps document and communicate ideas, activities, and findings to others. Scientific writing can take several forms from a

laboratory notebook to a project report, an article in an academic journal or scientific magazine. Good writing can be beneficial to scientists in a number of ways – it can lead to improved collaboration and an easier access to cross-disciplinary knowledge. It would also help communicate better with other researchers and also the public, who fund research projects.

### What Makes Good Writing?

#### Clear and effective

First, an idea needs to be communicated clearly and effectively. This is even more important in scientific writing. The whole point of scientific writing is to get one's results across to other scientists, to policymakers, and sometimes even to the lay public. It is all about getting your idea across clearly and effectively. Most people are generally worried about sounding smarter or more elegant through their writing. By focusing on trying to sound in a certain way, they forget about just trying to get their ideas across clearly and effectively. Another factor that determines the quality of writing is clear writing. And for this, one has to have logical and clear thinking.

#### Simple

The language used must be direct, avoiding vague or complicated sentences. Technical terms and jargon are usually avoided and used only when necessary for accuracy.

#### Objectiveness

Being objective suggests that you are stating facts and are not influenced by

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personal feelings or biases. Objectivity in science makes your work more professional and also credible. One must consider both sides of an argument without the use of words such as “appalling” or “wonderful.”

**Brief**

As short as possible, unnecessary words or sentences should be avoided (repetition and redundancy).

**Hedging**

In academic writing, you have to make decisions about your stance on a particular subject, or the strength of the claims you are making. Be careful not to make strong claims such as “This proves.” Instead, use phrases such as “It could be suggested that...”

**Precision**

Effective scientific writing assumes the abundant use of specific dates and figures. Vague and ambiguous language such as about, approximately, and almost must be avoided. Word combinations such as “a lot of people” or “someone said” are not considered good academic writing expressions [Figure 1].

**When to Write**

The final version of a research article follows a repetitive process of thinking and writing rough ideas. Once this has converged to something coherent, you are ready to write the version which is intended for public view. Only after you have the full structure in your head will you know the most effective manner (e.g., the best order) to write the entire research article.

**Types of Scientific Publications**

Most published scientific manuscripts come under the ambit of the following [Figure 2]:

**Full articles or original articles**

These represent completed research work and further the knowledge in a particular field. It starts with a research

question and describes the methodology followed in conducting the study. It also includes details on the results obtained using specific statistical methods and the interpretation of these results. An original article is an extensive study conducted to explore a research hypothesis.

**Case reports**

This is usually a rare or unusual clinical condition, a previously unreported or unrecognized disease, unusual side effects to therapy or response to treatment, and unique use of imaging modalities or diagnostic tests to assist diagnosis of a disease.<sup>[3]</sup> Generally, a case report should be short and focused, with its main components being the abstract, introduction, case description, and discussion.<sup>[3]</sup>

**Letter to editor**

A letter to the editor provides a means of communication between the author of an article and the reader of a journal, allowing continued dialog about journal content to take place.<sup>[4]</sup> Writing letters to the editor can be an effective way of sharing your opinion and inspiring others to take action. Letters to the editor are usually a type of short communication that can be written on any topic that attracts the attention of the readers.<sup>[5]</sup> One of the most important aspects of a letter to the editor is that it must be short. It is known that a letter is more easily accessible to readers when the message is short and brief.<sup>[5]</sup> A letter must have a purpose, and it should convey its message in a short and definitive fashion.

**Meeting abstracts/rapid communications/short communications**

These are usually published for the quick and early communication of significant and original advances. They are much shorter than original articles and often are the precursor of full-length original research articles.

**Review articles**

These summarize and/or provide a critical analysis of recent developments on a specific hot topic, highlighting

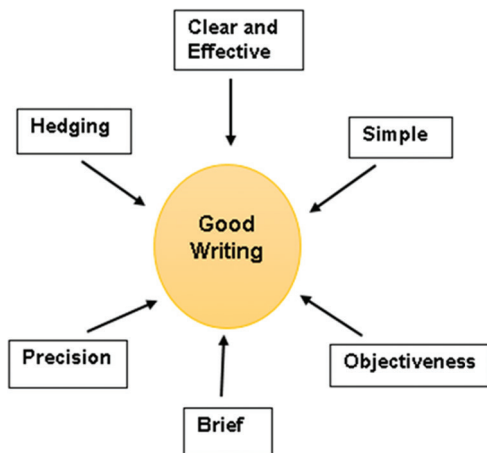


Figure 1: Characteristics of good scientific writing

		Types of Scientific Writing	
		Public	Not public
Peer-reviewed	Peer-reviewed	<ul style="list-style-type: none"> <li>•Original research papers</li> <li>•Reviews</li> <li>•Meeting abstracts</li> <li>•Conference reports</li> </ul>	<ul style="list-style-type: none"> <li>•Grant Applications</li> <li>•Fellowship proposals</li> </ul>
	Not peer-reviewed	<ul style="list-style-type: none"> <li>•Books, chapters</li> <li>•Book reviews</li> <li>•Teaching materials</li> <li>•Theses/dissertations</li> <li>•Editorial comments</li> <li>•Letters to the editor</li> <li>•Research reports (sometimes)</li> <li>•Web pages</li> </ul>	<ul style="list-style-type: none"> <li>•Correspondence</li> <li>•Confidential reports</li> </ul>

Figure 2: Various types of scientific publications

important points that have previously been reported. They do not, however, introduce new information.

### Grant/fellowship proposals

These documents determine funding. Often, proposals are never made public (at least, until a decision is made).

Typically, most of the publicly available scientific publications are peer reviewed. Peer-reviewed publications are reports that have been evaluated and validated for scientific accuracy or thoroughness by experts working in the same field. Peer review is strenuously applied today by most scientific publishers and often, the greater the rigor of the journal, the greater the quality of the articles published and their consequent impact.

### Developing an Original Hypothesis

There are a number of key questions that need to be answered before beginning a research project:

- Is the research idea new and interesting?
- Will it be able to address unanswered questions in the field?
- Is the work challenging?
- Is the research idea directly related to a current hot topic?

If the answers to the above questions are “yes,” then there is a high chance that the results will be published and contribute to furthering knowledge in the field.

### Conducting a Systematic Literature Review

A thorough systematic literature review helps answers the questions above. Citation indexing tools such as PubMed can help identify the previous research work completed on a specific idea, the major scientific groups currently working on the idea, funding obtained previously on the topic, etc., It is vitally necessary to understand if a certain hypothesis merits working on. If a literature review proves that the idea has been explored and has not yielded promising results, it may not be wise to invest time and resources on the same.

### Writing the First Draft

The first draft is a rough sketch of your future final piece of writing. The first draft of a research article is not expected to be perfect, it is important to understand this. The scientist’s goal must be to “write” and not “write well.” Once you have read a significant portion of the sources that you have come across, it is time to begin writing the first draft of your scientific article. To avoid writer’s block, it is often a good idea to begin writing before you feel that you are prepared to write. The most common mistake is editing or revising a draft in the process of writing. Another common mistake while writing the first draft is paying too much attention to secondary arguments, factual material, and other

minor peculiarities. The main goal of the first draft is to sketch out your main ideas; the details can be filled in later.

### The different parts of a research paper

In scientific writing, Introduction, Methods, Results, and Discussion (IMRAD)<sup>[6]</sup> is the common organizational structure (a document format). IMRAD is the most prominent norm for the structure of a scientific journal article of the original research type<sup>[7]</sup> [Figure 3].

Since its origin in 1665, the scientific article has been through many changes. Although during the first two centuries its form and style were not standardized, the letter form and the experimental report coexisted. In the early 20<sup>th</sup> century, contemporary norms began to be standardized with a decreasing use of the literary style. Gradually, in the course of the 20<sup>th</sup> century, the formal established IMRAD structure was adopted.<sup>[8]</sup>

An original research article usually follows a specific structure. This is called the IMRAD structure which is elaborated below:

- Introduction: The introduction provides background information and explains what your study is about and the purpose behind it
- Methods: The methods section gives a detailed explanation of how you conducted your research and the materials you used. This is done so that other researchers can replicate your research and reproduce the findings
- Results: This section presents your research findings in detail along with all the data
- Discussion: This section interprets the findings and discusses the impact that your research may have on the field of study.

Make sure you cite all the references you have used in your article. In the end, provide a detailed reference list of all the sources you have used.



Figure 3: IMRAD structure of a research paper

## Importance of Revision

Revision is a very important factor in scientific writing. Most scientists try to get it perfect on the first draft and do not give enough weight to revision. It is important to get the first draft quickly on article, and then put a lot of emphasis on revision. The elegance part happens on revision, not on the first draft. Most people will readily agree that more revision would bring about an improvement in their writing. However, despite this widespread recognition of the importance of revision, several writers simply do not make revision an essential part of their writing process. One reason for this resistance is that many writers believe their own first drafts to be unambiguously flawed; in alternative words, they believe that the weakness of the first draft is due to their lack of writing skill rather than from the intrinsic weakness of any first draft. As a result, they have little faith in their ability to mend the problems with their writing.

A shift in perspective is suggested: instead of worrying that your writing requires an exceptional amount of Revised, try thinking that all writing requires a great deal of Revised. A first draft must be evaluated as meticulously as we can; however, there is no need to apply those harsh standards to ourselves as writers. This caution is very important because only a few people excel at writing first drafts; the tendency toward self-criticism means that the initial draft becomes a source of frustration instead of a valuable starting point. Accepting that the writing process is tedious makes it easier to understand that writing will seldom be suitable for a reader without extensive Revised.

The overview and basic principles have been covered here; however, the actual details on how to go about writing the different types of scientific articles such as original articles and case reports shall be covered in the subsequent issues of this journal. These articles shall include extensive details on how to write each section of a research paper, right from the hypothesis, writing abstracts, till the discussion and conclusion of the article.

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## Conflicts of interest

There are no conflicts of interest.

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