

Types of Science Writing

The purpose of science writing is to communicate scientific research to various audiences. Like much writing, it includes both description and analysis: surveys of previous research and descriptions of current methodologies and results; and analysis related to the trends, importance, and implications of research findings. Although science writers present facts and careful reasoning based on evidence, they must also use techniques of good communication to shape their presentation of findings in an engaging and persuasive way. Therefore, most types of science writing follow a format that frames the information presented with a sense of context.

Engaging and informing the reader: the opening

An opening section introduces the topic and emphasizes its importance. This section also provides an overview of past and current research to show how the proposed or completed study addresses a gap in the body of knowledge. Finally, the introduction establishes the purpose of the literature review, research proposal, or lab report/research paper.

Making sense of it all: discussion and conclusions

After a survey of research trends, proposed methodology/expected results, or results of a study, the concluding section (including the discussion) provides analysis. In this section the science writer emphasizes matters of significance for the reader: demonstrates the importance of the proposed research, explains results, accounts for unexpected results, proposes changes in methodology, and/or discusses the implications or applications of the research.

The types of science writing outlined here – **the review article, the research proposal, and the lab report/research paper** – tend to follow conventional formats, but there are variations within these formats according to the purposes of the writers and the expectations of their audiences.

The Review Article or Literature Review

Purpose: to summarize and synthesize research that has been done on a particular topic. A review emphasizes important findings in a field and may identify gaps or shortcomings in the research. As it describes and evaluates the studies of others, its primary focus is on what the research has demonstrated through the methodologies and results of study and experimentation.

Audience: usually a science journal's broadest readership because a review is more general in its focus than a research article.

Format:

1) Introduction – introduces the topic and its significance and provides a brief preview of the sub-topics or major trends to be covered in the paper

2) Body – presents a survey of the stages or significant trends in the research

Studies are discussed in **groups or clusters** often identified with subheadings. To develop the body, the writer must determine **criteria for grouping**: will studies be clustered according to major advances in the research (chronological development) or areas of consensus or lack of consensus in the field? Will the body highlight similarities and differences in the findings in terms of methods, results, and/or the focus of research studies?

Tips:* the body should contain both **generalizations about the set of studies under review (written in the present tense) and **citations of specific studies** (past tense) to identify and verify observed trends.

Topic and concluding sentences of paragraphs and/or sections should synthesize research findings and may show differences and similarities or points of agreement/disagreement.

3) Conclusion – provides a final general overview of what is known and what is left to explore in the field This section may discuss practical implications or suggest directions for future research.

Distinguishing Elements:

The review article is **largely descriptive** in that it identifies trends or patterns in an area of research across studies. However, analysis is required as the writer offers an **interpretation** of the state of knowledge in the field, perhaps calling attention to an issue in the field, proposing a theory or model to resolve it, or suggesting directions for future research. As well, unlike research papers that feature functional headings related to the IMRAD format, the review article uses **topical or content headings** to indicate the sections of the review.

The Research Proposal

Purpose: to convince a scientific audience that a proposed problem for investigation is worth exploring and that the proposed research approach will be effective. The proposal should present a specific, interesting research question and demonstrate the following: the question's significance, the merit of the proposed research methods, the ways in which results will contribute to the solution to the problem, and the degree to which the research will advance the state of the science in this area.

Audience: academic departments that grant approval for dissertation projects and funding agencies. Research proposals are often read by a broader range of readers than a journal article.

Format:

1) Introduction – presents the specific objectives and scientific significance of the proposed research and also previews the rest of the paper. Because the audience may be more general than for the research article, the introduction provides a more comprehensive orientation to the topic and to the purpose of and need for the proposed research.

2) Background – provides a thorough, detailed discussion of the primary literature and requires synthesis and evaluation of that body of knowledge. **The Background demonstrates the researcher's breadth of knowledge** and shows both how far the previous research has gone and where it needs to go. Although the major sections of the proposal are identified with functional headings – Introduction, Background, Methods – the headings within the background section are topical, according to trends in the research. This section ends with a summary of what is known and not known about the topic and a clear description of the specific research question(s) or hypothesis(es) that will be investigated.

3) Methods or Proposed Research – shows how the proposed research question follows logically from the research that has gone before. This section is similar to a Materials and Methods section of a research article but is written in the future tense. It provides a detailed, heavily documented description of proposed methods, with citations that demonstrate the validity of the methodological approach. This section outlines specific aspects of methodology: sample sizes, number of replicates, sites, and how the data will be analyzed. It also provides plans to address possible problems in the research.

Distinguishing Elements:

The research proposal is a **persuasive piece of writing** that needs to account for audience to a greater degree than the other types of science writing. It should show an alignment of the proposed research with a granting agency's goals and priorities. In this type of writing, **the persona of the researcher** is more important than in other types, so the proposal demonstrates the researcher's experience and expertise. Finally, in keeping with the persuasive nature of the proposal, the Methods section contains fewer details than in an article but more explanation for the **rationale** behind the methodological approach.

The Lab or Research Paper

Purpose: to present either the results of primary research accomplished through study/experimentation or theoretical developments in a particular field. In both the lab report and research article, the writing is both descriptive/factual and analytical/persuasive. It accurately reports the details of the research but also attempts to convince readers of the importance of the research in terms of its contribution to the advancing knowledge in the field.

Audience: for the student writer, most often a professor or teaching assistant; for the report writer, a wider audience – a journal editor, peer reviewers, a community of specialists in a discipline, the general scientific community.

Format: follows the dominant format of articles in science journals – Introduction, Methods, Results, and Discussion (IMRAD).*

Section	Purpose	Answers These Questions
Introduction	Introduces topic of investigation and its importance States central question or hypothesis Cites any relevant literature May identify gap in the research States objective or purpose	Why is this topic significant or interesting? Why did you undertake this investigation?
Materials and Methods	Describes the research design Details the experimental procedure step by step	How could someone else replicate your study or experiment?
Results	Reports in detail the findings of the investigation Provides figures and tables to support the text	What actually happened? How can you report all relevant results most efficiently?

Discussion	Summarizes results and draws tentative conclusions Comments on results related to research question or hypothesis Examines other supporting or contradicting evidence Suggests refinements or applications of research Offers possibilities for further study	Why did you obtain these results? Did you obtain the expected results? Why or why not? How do your conclusions relate to other research on the topic? How might your study or experiment be improved or used? What next?
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**Note:* If the focus of a paper is theoretical or historical rather than experimental, the IMRAD format will not be suitable. A more variable structure, with topical rather than functional headings, may be needed to propose new theories, models, formulations of hypotheses, or interpretations of previously observed phenomena.

Distinguishing Elements:

Although they use the same format, lab reports and research papers differ in terms of scope and the complexity of their analyses.

Description (subject, scope, style):

Lab reports focus on only one experiment or repeated experiment and report results in a spare, concise way. Research papers may report on a sequence of experiments or other wider subjects. Because the focus of the research paper is broader, it may address matters that don't relate directly to experimentation – such as definitions, new research methods, or reinterpretations of data – and thus its style is more expansive.

Analysis (context, interpretation, and conclusions):

While a **lab report** provides a relatively **short introduction and review of the literature**, the **research paper** presents a **thorough introduction of the topic** and the importance of the research in the context of other work in the field. It provides a **comprehensive review of all relevant literature**.

A **lab report** interprets only **specific aspects of the data related to the study/** experiment at hand. It may not present any general conclusions aside from possibly recommending avenues for further research. A **research paper**, however, offers an **extensive interpretation of results** and may include both definite and tentative conclusions, alternate ways of interpreting results, and/or other kinds of speculation, in addition to possible applications and research directions.

Abstract

The **abstract is a short summary of the main points of a research report, proposal, or review article**. It is usually 150-250 words and a single paragraph, though it may be longer; proposal abstracts are often one page or 200-300 words. The purpose is to provide the reader with a complete, accurate synopsis of the larger text and will reflect the structure of that text. **The abstract for a research paper will follow the IMRAD format** used in the report and contain these elements: topic (a sentence or two, written in present tense);

background/rationale for or purpose of the study (several sentences, with no references to previous research); methods and results (written in past tense); and conclusions and implications (present tense).

Abstracts not following the IMRAD format will be structured differently; for example, they may reflect the line of reasoning in an article. The proposal abstract is structured according to the content of the proposal itself; it summarizes the research problem, goals, and proposed methods. Depending on the discipline or field, some abstracts are structured more formally, with the following headings: Objectives, Design, Setting, Participants, Intervention, Measurements, Results, Conclusions. **In many formats, abstracts often conclude with a brief list of keywords.**

References

There is no standard style of documentation in the sciences; styles tend to be journal-specific. Two common styles are the **name-and-year system** and the **citation-order/citation-sequence system**.

The **name-and-year system** includes a list of references at the end of the report **that are arranged alphabetically**. This system uses in-text citations in the body of the report to indicate information that comes from sources, for example (Anderson and Wyatt, 2010). **In both the citations and the References section, the year of publication appears directly after the authors' names.**

Hargrave, C. W., K.D. Hambright, and J. W. Weider. 2011. Variation in resource consumption across a gradient of increasing intra- and interspecific richness. *Ecology* 92: 1226-1235.

A reference from an internet source would appear this way:

Anderson I, Wyatt D. 2004. False positives for the defibrillator: the effects of stress on cardio-pulmonary distress in emergency room patients. *Emergent Care* [Internet]. [cited 2005 May 31]; 24(330): 343-352. Available from: <http://> (full URL).

The **citation-order system** also includes a **list of references at the end of the report**, but they are arranged in **the order in which they appear in the text**, rather than alphabetically. Each reference is given a number, and only one number, no matter how often it appears in the body of the report. **When the reference is referred to in the text, only the number is given [6]**. The full publication information for the source will appear in the References section.

[6] E.M. Iancu, D.E. Speiser, N. Rufer, Assessing ageing of individual T lymphocytes: mission impossible? *Mech. Ageing Dev.* 129 (2008) 67-78.

In the citation-order system, the year appears later in the reference than it does in the name-and-year system. Because there are many variations within and between systems, science writers must be aware of specific requirements of journals and follow those guidelines closely.

Acknowledgement:

Penrose, Ann M. and Katz, Steven B. (2010). *Writing in the Sciences: Exploring Conventions of Scientific Discourse* (third edition). New York: Longman.

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