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# How to Write a Good Scientific Paper: Review Articles

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## How to Write a Good Scientific Paper: Review Articles

For a regular contribution to a peer-reviewed scientific journal, a paper must meet four criteria before it is publishable:<sup>1</sup>

- The content of the paper must match the scope of the journal
- The quality of the paper (method and execution of the research, as well as the writing) must be sufficiently high
- It must present novel results (with the exception of review papers and the like)
- The results must be significant enough to be worth reading about (and thus worth publishing)

An exception is made for the third requirement, novelty, for an important category of papers: the review article. Review articles, as the name implies, provide a critical evaluation of prior published work on a specific topic. Reviews tend to be quite popular with readers since they pack a lot of information in a little space, giving readers a great return on their invested time. They are a gift. Most readers don't have the time or inclination to thoroughly research the full literature on a specific topic, and so greatly appreciate it when an author reports on the results of their thorough review of the topic. Mini-reviews are becoming increasingly popular as well (more on that below).

What a review paper is *not* is a list of papers on a specific topic with a short summary of the important ones. Every review paper should have a story to tell, a theme, and a point of view. It should be idea-driven, not literature-driven or author-centric. Here are some of the most common themes found in the best review papers:

- A controversy: two or more camps with competing theories or explanations of a phenomenon, with evidence for each
- Progress towards the development of a major new tool, process, method, or theory
- Historical development leading to a major discovery or concept and its implications for today and the future
- Comparison of different approaches toward the measurement/design/fabrication/modeling of a specific thing of importance, and their advantages and disadvantages

- The use of a specific tool/process/method across disciplines or for different applications
- A novel insight gained from a wider view of recent progress on a topic, or the recognition of a critical new problem or issue previously unnoticed
- A call to action: why the community should devote considerable resources to a certain topic

The major goal of every review should be to achieve an organization and synthesis of past work around the chosen theme in order to accelerate the accumulation and assimilation of recent knowledge into the existing body of knowledge. A review provides order to what otherwise might appear to be a chaotic blast of recent research results. Thus, while a review paper may not present novel results, it almost always presents a novel meta-analysis of results leading to a novel organization and synthesis.

### 1 The Structure of a Review Article

Once a theme is chosen, the real work of writing a review paper begins with a comprehensive literature review. In some sense, the citations found in the review are the point of the article since they tell the reader what work is being synthesized. One can only organize and synthesize the work one is aware of, and nothing exposes the flaws of a review like missing references. Keep in mind that a review topic that is too broad is often less valuable than a review topic that is too narrow.<sup>2</sup> Focus is essential to success in a review article.

The introduction of a review article is not too dissimilar to the introduction to a research article.<sup>3</sup> It begins with a description of the background topic and why that topic is significant. It states the gap in the knowledge of that topic that has recently been filled with the work that is about to be reviewed. It then outlines the theme of the current review (the controversy, progress, historical development, etc.) and how it fits into that topic and its knowledge gap. It is important that the introduction clearly defines the scope of the review so that the reader knows what is included and what is excluded from consideration.

The structure of the middle sections of a review paper is designed for the story being told, and thus depends greatly on the theme chosen for the review. A good writer will let the story guide the flow of the review, always keeping in mind the goals of organization and synthesis. Presenting results in historical sequence is only appropriate if the theme of the review is one of historical development.

Like the introduction, the concluding section of a review paper is similar to that of a research paper. Conclusions generalize, looking for the bigger lessons that can be taught. After a very brief summary of the review and its primary message, one should highlight the implications of the reviewed work and point out the gaps still found in our current knowledge. Generally, the reader then expects a description of future work needed and future questions to be answered. It is good to end with some speculation, so long as it is labeled as such.

### 2 What Makes a Review “Good”?

Like a research article, the goal of the review article is to teach: “Good writing is good teaching.”<sup>4</sup> Good science writing always strives for accuracy and clarity, and that is certainly

true for review articles as well. Remember that the audience for a review article is wider than the audience for any of the articles that you cite in your review. Thus, try to make sense of the literature that you cite to this wider audience.

Reviews should be critical but even-handed and not just accepting of all previously published conclusions. But don't get personal: when criticizing, always criticize the work, not the authors. And remember that science progresses slowly and unevenly, in fits and starts. Be sympathetic to the many wrong turns that litter the final path to understanding.<sup>5</sup>

Generally, the author(s) will include their own work as a part of the review. After all, the authors are generally experts in the field being reviewed because they have contributed to that field. To mitigate this perceived conflict of interest, a difficult and careful balance must be achieved when fitting the author's own work into the overall literature of the field. An objective analysis of one's own work is very hard to pull off, so admitting as much is a good first step.

Writing a review article tends to be a lot of work. They are typically twice as long as most regular journal articles, with hundreds of references. Many experienced authors have one or more review papers hidden away within them, but there is often too little time to get them out. This is where the mini-review comes in. Mini-reviews tend to focus on a recent "hot topic" that has only a limited amount of accumulated literature. They tend to be about half the length and number of citations as full reviews due to their narrower scope. Still, they can be very valuable to readers if they accomplish the twin goals of organization and synthesis.

In summary, if you want to write a review paper the first step is to decide on the theme (story) of the paper. This helps to define the scope of the review, which then drives the literature search that must begin any such effort. The unique (even novel) contribution that the author of a review paper can make is the organization and synthesis of the knowledge found in the literature. Thus, deciding upon this organization and executing on the synthesis of the past work is where the authors truly add value with their review. The authors of a good review paper deserve a huge thanks from the many readers who benefit from their efforts — we need more of such efforts.

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