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Editorial

# How to write a compelling (materials) science paper

*Materialia* is run by a tight group of early- and mid-career scientists who believe that, as editors, we play an important role in helping colleagues disseminate their science. We wish to thank readers and authors for the trust they have demonstrated in us and in this new journal. Over 1600 authors have contributed to nearly 300 articles published in our first year of existence. We have greatly enjoyed reading about all the excellent materials science research that authors have shared with us since we launched last year.

Because we are a relatively new journal, and because we have a broad scope, we see many different kinds and qualities of manuscripts come across our desks. This variety, as we find our footing in the materials science community, gives us a good sense of the breadth of writing practices that characterize materials science manuscripts. We hence feel that we are in a particularly good position to offer insights into the process of manuscript evaluation regarding writing. Therefore, we would like to offer a brief guide, a manifesto of sorts, for aspiring authors on how to write a strong journal article. Many of our points echo those made by other editors at other journals [1–4]. As a whole, our guide definitely reflects our own personal preferences and standards here at *Materialia*, but we might be so bold as to suggest that the principles herein might also be good guidelines for author success at other materials science publications and maybe even for scientific journals generally [5].

First and foremost, we affirm that writing is an important part of science. Data does *not* speak for itself: we do not publish raw data and we do not publish photocopies of lab notebooks. There needs to be some extra care and thought put into presenting work for a wider audience, and that is the process we call scientific writing. Whether researchers like it or not, a piece of work is only complete when it is communicated to, and often validated by, scientific peers.

Second, we affirm that all scientific manuscripts, whether they are full research reports or letter communications, should be generally structured the same way: introduction, materials/methods, results, and discussion/conclusion. This is meant to reflect the flow of ideas, not to dictate specific headings. Papers that combine headings as “results and discussion” or “discussion and conclusion” are fine as long as the ideological flow is in order. The discussion should never be omitted, since this is where science usually happens, in the interpretation of the results collected and presented.

A scientific manuscript should be shaped like an hourglass. It should start general at the beginning, become more specific in the middle, and then become more general again at the end. The introduction goes from general to specific and is the place for contextualizing the topic, research question, and hypothesis. Researchers must motivate their work and explain why they bothered to undertake it – which includes explaining how other people beyond themselves might find the research question interesting. The discussion goes from specific to general and is the place for contextualizing the results that were obtained. Researchers must explain why their results are significant. Other questions to address in the discussion include: What is different about the field now that the results are obtained? How are the results similar to or different from related works? How can other researchers use the results? What future experiments might the results inspire? (Fig. 1).

All papers should necessarily bridge to other scientists, who are very often working in connected fields but perhaps not in the exact same community to which the authors belong. This means that authors need to make an effort to avoid unnecessary jargon, and use specific yet clear vocabulary, which implies that sometimes definitions need to be reiterated. *Materialia* does not impose constraints on article formatting, e.g. word limits, but we propose that simple and concise sentences often convey a message most clearly. Using the first-person active voice can help in this regard, especially in the introduction and discussion. We also encourage the inclusion of necessary references, positioned appropriately in the text. At the point of submission, we also encourage authors to submit a single file with all figures included close to where readers would expect them in the final version, to help the work of the reviewers.

Discussions are perhaps the most often neglected part of manuscripts that we see here at *Materialia*. If authors go straight from talking about the result of their final experiment, to a conclusion that is simply a summarized re-hash of all the experiments they have done, then the authors have neglected to take the discussion seriously. If authors neglect to discuss the significance of their results, we might assume that there is no significance to the results. As other editors have noted [3], manuscripts that describe routine analysis of routine materials with entirely predictable results are not entirely compelling, and we are likely to reject such manuscripts, especially if the authors do not make a case for how the results impact the field at large. The impact does not have to be Earth-shattering, but it should be noteworthy to an intended audience. Especially at the very end of the conclusion of the manuscript, readers should be left with a general sense of the impact of work, not simply a repetition of the specifics of the results. We ask authors to please format their discussion and conclusion as a narrative, not a bulleted or numbered list.

We note that some editors use the term *scientific report* generally to describe a publication that does not examine novelty, originality, or impact [6]. We affirm that here at *Materialia* we do care about, and evaluate, these aspects of manuscripts we receive, even if we may choose to emphasize the quality of the work overall.

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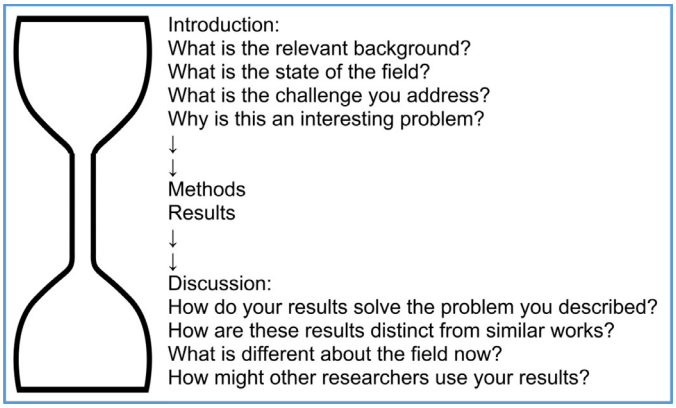


**Fig. 1.** The hourglass figure of a scientific manuscript, going from general, to specific, and back to general again, with potential questions to be addressed.

Also, we ask authors to take into consideration that we are a general interest and broad scope materials science journal that covers many subdisciplines. That should be reflected in the manuscript's writing and contextualization. The articles that we seek to publish may not have strict constraints on format or length, or even on a specific kind of material; we mainly expect that the scientific content is about how the structure and function of materials are related. If the introduction and discussion are too narrow, we might judge the paper to be inappropriate for our overall audience.

The abstract should be an extremely brief shrunken-down version of the entire paper. It should follow the same general order as the manuscript itself: it should give some background and motivate the challenge addressed (introduction), describe the experimental framework (methods), tell readers what was found (results), and describe how the results answer the challenge and why the report is noteworthy or significant (discussion). Some authors think that the best way to start out the first sentence of the abstract is with the most important result obtained. We disagree and think that abstracts that are structured as we have outlined here are more appealing to readers.

We ask that authors be consistent in the ordering of experiments throughout the manuscript. For example, if authors describe X-ray diffraction, transmission electron microscopy, and X-ray photoelectron spectroscopy in that order in the methods section, they should ensure that the results section follows that same order. All acronyms should be defined where appropriate. Once authors have introduced an acronym, they should use it consistently throughout the manuscript, to help with clarity. Authors should remember that the description of methods is crucial to enable reproducibility of work by peers. This is one of the key purposes of publishing scientific work, after all. Therefore, authors should provide a clear description of experiments in a way that allows others to reproduce the experiment and build upon the work to move the field forward. Although some experimental setups and procedures may be similar to those used in previous work, we still encourage authors to adjust the description, first to avoid self-plagiarism, but also to make sure that the methods and protocols reflect their own actions precisely. Too often do we see direct copy-paste in these sections, which is not good practice.

Finally, we encourage authors to show some excitement about their results! We are all scientists and engineers, but we are not in the business of simply printing technical instruction manuals. Manuals are for when someone has already bought the hardware and just wants to know how to operate the machinery. Instead, we are in the business of publishing scientific research articles, and part of the job of these reports is to convince the reader of the importance and significance of the work therein – it is in part a subtle sales pitch. Palpable author passion goes a long way in achieving a compelling report. Researchers should be professional in their tone, and absolutely avoid hyperbole and empty hype, but they do not have to write like a robot. Researchers should make highlights and be excited about their work [7].

For authors who struggle with their writing and know it, there are plenty of good resources out there designed for self-help. Elsevier's Researcher Academy is a particularly good resource [8]. Author Aid is a good resource especially for researchers from historically underprivileged geographies [9].

We know that not every paper published at *Materialia* follows these writing guidelines exactly, and that is fine. Sometimes we can see through writing that does not meet our ideal standards to the quality of the results that are being described. Sometimes we cannot. We may be a journal that accepts transfer submissions from other *Acta Materialia, Inc*. family journals (as well as direct submissions), but we are still seeking to publish the best research that comes our way – and an important part of strong research is strong writing. We suggest following the guidelines we have described here for the best possible chance of a successful and impactful publication, here at *Materialia*, and perhaps even beyond.

## Declaration of interest

Authors declare no conflict of interest.

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