

## GETTING THOSE PAPERS WRITTEN AND PUBLISHED

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### INTRODUCTION

The results of scientific research are useless unless they are communicated to others. Communication can occur in many ways, but the peer reviewed scientific journal article is still the standard for reliable dissemination of research findings. Writing and publishing articles in scientific journals requires hard work, practised skill and perseverance.

### WHY PUBLISH

Until you start publishing your research you don't really exist as a scientist. Publication is the surest way to get onto the scientific radar and hopefully stay there. Published journal articles (and now also e-journals) allow wide circulation of your research results and provide a secure and readily accessible storage system. Publication carries with it the "precedent principle" (i.e. the first to publish gets the credit), ensuring that you receive recognition for your scientific discoveries once they are published. If you are a postgraduate student, published papers can be used to support your thesis (some universities allow you to write your thesis as a series of publishable articles). A good publication record is essential for career advancement (job applications and promotion). You have probably heard the adage "publish or perish", but your publications must be good, otherwise it can be "publish and perish". Publication in peer-reviewed journals can provide the quality control you need.

There are other good reasons to publish. Scientific research is creative; crafting the results into a journal article is the culmination of this creativity. It can provide a great sense of achievement and personal satisfaction. Scientists have a responsibility to publish their findings, particularly as the taxpayer commonly funds their training and research. As an individual scientist, you also have a responsibility to your colleagues and the profession to advance the state of scientific knowledge by communicating your findings and ideas.

### WHAT TO PUBLISH

What have you done or discovered that the world should know about? Does it add to knowledge? This is what you should publish. Journal editors and reviewers will generally apply three tests:

1. Is it new?
2. Is it interesting?
3. Is it correct?

If your article meets these criteria it is worth publishing. Clearly there are degrees of interest and you need to decide whether the results are of international or local importance. There will be a range of data in your research findings. Focus on what is new to science; new ideas, new observations, descriptions of new areas. Remember that negative results can also be of interest, particularly if they disprove current theories and interpretations.

### THE WRITING AND PUBLICATION PROCESS

#### Getting started and outlining your article

The hardest part of writing is getting started. Writing a plan or outline is generally a good way to start. This is less daunting than launching straight into the text. Once a framework is in place it is easier to build on, and ideas will flow as creative thinking is stimulated. It may help to construct a graphical or diagrammatic outline. This is a good way to organise ideas that come randomly rather than in a logical linear progression. The initial plan can be the standard template for the structure of a journal article (Figure 1). It helps to have a potential journal in mind, as this may influence the overall structure of the article. Outlines can then be constructed for each part with headings defining the different sections. These commonly become topic headings in the article. Each section can then be planned in more detail (possibly down to paragraph level). As new insights and interpretations develop these can be allocated to the appropriate part of the structure, or the detailed plan can be modified or reorganised. Expect to refine and rewrite your plans many times. This approach makes it easier to maintain a logical sequence of ideas and arguments for the final article. As the article takes shape it will be easier to decide where figures and tables are required or which sections need strengthening with more information or better argument (or even additional data). While you are writing keep your audience in mind; imagine what information and explanation they will need to follow your presentation and interpretations. Table 1 summarises the functions and typical content of the various parts of the article.

**Table 1:** Parts of a scientific journal article and some guidelines for content.

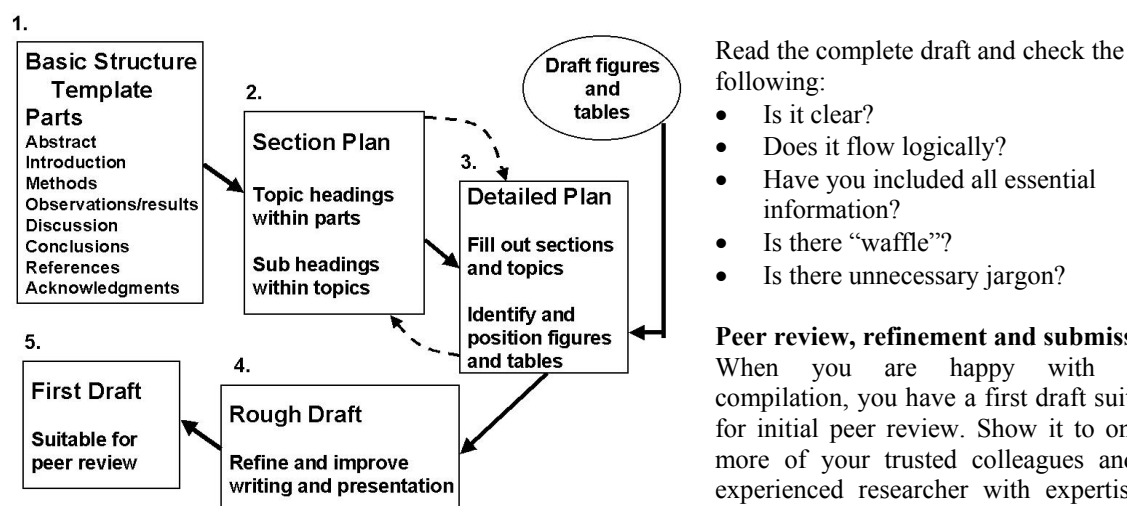
<b>Part</b>	<b>Aim and purpose</b>	<b>Content</b>
<b>Abstract</b>	Highlight the basic content. Attract the reader. Facilitate computer searches.	Succinct summary of main findings with brief introduction and conclusion (usually 100-250 words, depending on the journal). Separate list of keywords.
<b>Introduction</b>	Set the scene and give the article a context within existing knowledge. Delineate the objectives and the scope of the article	Outline of relevant background information from the literature. Rationale for the study and significance. Specific objectives. For field projects this will include an introduction to the study site or area.
<b>Methods</b>	Explain what has been done and how. Provide sufficient information for others to test or reproduce the observations and experimental results.	Brief and unambiguous description of techniques and equipment used. Appropriate references to methods developed by others. Detailed descriptions of new methods developed.
<b>Observations/ Results</b>	Describe what has been observed and discovered. Document and illustrate evidence.	Text describing the observations and experimental results. <b>Keep it objective.</b> Tables summarising numerical and other data. Figures (maps, photographs, diagrams) with explanatory captions including locations (GPS or map grid references).
<b>Discussion</b>	Interpret the observations and results in the context of existing knowledge. Provide a synopsis linking particular elements of the findings to support the conclusions.	Logical development of ideas and arguments to lead the reader through the <b>interpretation</b> to the conclusions. Reference to the work of others to show how the study confirms, challenges and contributes to knowledge in the area.
<b>Conclusions</b>	Summarise the major outcomes of the study. Suggest areas for further research.	Short outline highlighting the main findings and their consequences. Brief suggestions for future research.
<b>References</b>	Acknowledge the source of information and ideas published by others. Allow the reader to locate these publications.	Citations in the text with author/s and date. (some journals use numbers with footnotes or endnotes) Full description of reference in alphabetical order of first author (check journal format).
<b>Acknowledgments</b>	Acknowledge the support and contributions of others not listed as authors.	List of supporting organisations and funding agencies, List of individuals and brief phrase on how they have assisted.

**The rough draft**

Eventually a rough draft will evolve. This can be refined and improved, usually through a number of iterations. At this stage a target journal should definitely be identified and the article formatted according to the journal guidelines (usually given in one issue of the journal each year or available on the web). References can be compiled and formatted according to the journal style (EndNote and RefWorks are software programs that can facilitate this). Now is also a good time to check the expression, grammar, spelling and punctuation. Good expression is critical, firstly for getting your article accepted by a journal and secondly for encouraging others to read and understand it. The following are some tips for good writing:

- Create simple structures.
- Use short words in preference to long words that mean the same thing.
- Write short sentences.
- Use the active voice in preference to the passive voice.
- Be accurate and complete, yet concise.
- Keep to the point.
- Be consistent with the use of tense

There are excellent guides available to help you improve your grammar and expression (e.g. Anon. 1995; Glover 1995; King 2003).



**Figure 1:** An approach to compiling and writing a scientific article.

also help by checking the grammar, spelling and expression, as well as identifying jargon. This stage will give you the chance to “rest” the article. Familiarity with the text can blind you to errors and poor construction. Coming back to the article with a fresh view and comments from others can work wonders. The result will be a final draft suitable for submission to the selected journal. Before sending it off you may be required to have the article approved for publication by your boss or organisation head (as is the case in CRC LEME). You should also re-read the Journal’s instructions to authors and check the following:

- Title page format - font styles and size, alignment, format for authors’ names and addresses, corresponding author identified;
- Abstract – appropriate length and content (should summarise the important facts and findings with brief introduction and conclusion);
- Key words – these are a list of 5 to 8 words that are used in computer searching (select these carefully to direct the intended reader to your article);
- Text format – to journal guidelines (margins, line spacing, paragraph indentation, font style and size);
- Headings – in required style (appropriate hierarchy style by different font or numbers);
- Citations and references – complete, accurate and in the correct format in the text and reference list;
- Tables – in required format (font style and size, heading and footnote style, gridlines shown or hidden);
- Figures – appropriate size (how big will they be on the page?), legible lettering, symbols and line work clear and thick enough to stand reduction by the printer, self explanatory captions (the reader should be able to understand the basics of the figure without reference to the text), required format (common formats are .eps and .jpg, but many journals specify the range of formats accepted).

Examining a recent issue of the journal will give you a good idea of the style and format of figures and tables. Many journals require submission online using a template. Your submission will be rejected until it matches the required format. Some systems also assess figure quality and warn you if it is not up to scratch.

### Journal review

Once your article is submitted it will be examined by the journal editor for overall suitability and then sent to one or more, usually anonymous, reviewers (Figure 2). Some journals ask you to nominate suitable reviewers. The review process can take several months or more, depending on how busy or conscientious the reviewers are. Good reviewers will determine if the methods used are appropriate and the interpretations are supported by the results and observations. They will also assess the overall value of the work and comment constructively on any shortcomings in content, logic, expression or formatting. The reviewers will individually recommend the article be accepted (generally with some suggested corrections and revision), returned for major revision or rejected. Everyone has their own style of writing and reviewers should allow you your style as long as it is grammatically correct and succinct (see Webster 2003 for some interesting suggestions on style). The editor will assess the reviews and return the manuscript with an overall recommendation and instructions for improvement. Reviewers are not always right. If you believe they have erred or their suggestions are not valid state your case to the editor, who has the last say. If the article is rejected it is not necessarily because the work has no merit, it may be unsuitable for that particular journal or of a different level of interest. It may be possible to revise and re-submit the article to another more appropriate journal. Editors will often help with advice on this. After the article is corrected and finally

accepted you will be required to check the proofs before publication. Proofreading requires very careful inspection of the text, figures and tables, rather than normal reading in which you tend to slide over words. Slow down your reading or get someone not familiar with the text to read it. Scanning backwards can help, as it makes you focus on individual words.

### HELPFUL STRATEGIES

#### Plan on publication from the start

It helps to have the objective of publication in mind at the earliest stage of working on a project. This ensures that all information required for the published article is recorded as the research progresses (e.g. site details, photographs collected during field work, description of experimental apparatus).

It can be time consuming, difficult or even impossible to obtain some of this information at a later date.

#### Maintaining focus and productivity

In a busy working life, it is often the writing that falls off the end of the day. Set aside time to write (e.g. as a block, a particular day of the week or time during the day). A lot of this time is for thinking, a process that typically takes a lot longer than most people plan. Find the time of day in which you are most productive in your writing and go with it. If procrastination is a problem, start with an easy task to “ease yourself in” (e.g. checking the references, revisiting your plan or reading an existing draft). You may need a special location or environment to write effectively, generally one with minimal distractions (e-mail is a great distracter!). If you keep looking for distractions, complete the main distraction and then make a start. Once the writing is going well don’t interrupt the flow. Cultivate the habit of writing. Regular writing will make you a better and faster writer. Realistic deadlines can help you set priorities and organise your time. Don’t panic – get organised.

#### Multi tasking and motivation

Once you have the writing habit, it is often easier to write a number of papers together. Many researchers have about three papers in train at the one time, generally at different stages of preparation. Working on more than one paper provides the opportunity to switch effort when progress or motivation in one area is hindered or slows. You can use writing one paper as a distraction from writing another – at least you are still writing. Motivation is critical to the writing process. Motivation will be driven by your interest and excitement in the results of the work and the benefits derived from its publication. When motivation wanes look for ways to maximise these. Writing with others or with help from a mentor can also boost your morale and motivation.

#### Fostering a publication culture and ethos

It can be difficult for people working in an organisation or environment without a publishing culture to start writing and publishing papers. The individual has to be even more motivated and persevering than normal. Organisations that want their researchers to publish in scientific journals need to encourage and support this activity through recognition and reward. This can include having journal publications as an output for projects, incorporating publishing in strategic plans, recognising an individual’s published output in recruitment, assessment and promotion, and offering other incentives for high performance in publishing.

### A WRITERS’ CO-OPERATIVE

#### What is a writers’ co-operative?

A writers’ co-operative is a support group with the mutual goal of writing and publishing articles. The group can share experiences and helpful tips, hold workshops within the membership or with invited experts and encourage members in their writing. The group can also provide mentors to give advice, encouragement and review drafts.

#### How can a co-op help?

The main benefits of a writers’ co-op are in its networking and mentoring activities. A co-op can provide a means to raise awareness of issues related to writing and publishing, as well as direct and motivate the group

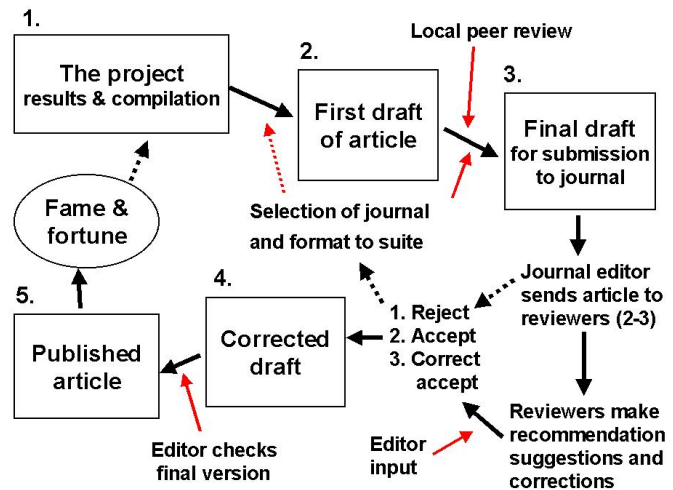


Figure 2: Basic steps in peer review and publication.

to achieve their writing and publishing aims. A co-op can provide greater feedback than is normally available, particularly at the early stages of writing. This is especially helpful for students and less experienced writers. Feedback and advice from peers is also generally less intimidating. Members can be directed to appropriate mentors for specific advice and help, without needing to know and seek these out individually. All of these benefits should increase the amount of writing and successful publication by members of the group.

### Experience of the LEME Writers' Co-op

A LEME Writers' Co-op has been meeting in Canberra since March 2005. Members are mostly postgraduate students (9), research staff (6), mentors (about 7) and each year some Honours students. The group has had some success in promoting a writing culture and encouraging students to publish their research, particularly for the annual LEME Symposia Proceedings. There is an incentive scheme rewarding students who have their first refereed journal article accepted for publication and several students have been rewarded so far. The co-op meets about once a month and sometimes more frequently (Figure 3). It has had several workshops with invited experts, including Professor Richard Webster (editor of the European Journal of Soil Science) and Clive Hilliker (graphic design and information technology officer in the School of Resources, Environment and Society, ANU). At the start, the group set the objective of each participant publishing at least one article in a refereed journal over a 12 month period. Some members have exceeded this and some are still getting there. The group maintains a list of papers in progress, which is circulated to keep everyone informed on progress. To date 8 papers have been submitted and another 13 are in progress.



**Figure 3:** Some members of the LEME Writers' Co-op.

The most successful aspects of the co-op have been the special workshops and the mentoring program. Members see these as providing clear practical benefits. There have been some difficulties, the main ones being maintaining regular contact and sustaining the momentum of the whole group. This will always be difficult as the members have many other commitments. There is a core of regular participants and others who have a loose attachment to the group, attending specific workshops or meetings. Over time some members have

dropped out. Nevertheless we believe the co-op has resulted in more writing and publication than would otherwise have occurred.

### TEAM WRITING

Much scientific research is by teams, with one or more members writing up the results. This can spread the writing load, while also providing peer support and mentoring to less-experienced team members. Alternatively, a well-practised specialist in the team can take charge of the writing. Team writing requires co-ordination and good communication. It is critical to have a writing plan. Specific tasks can be allocated to the different team members but everyone needs to be clear about their role and the timeframe for completion. In some cases only a particular member of the team can write up certain sections of the work. Generally a writing team leader, commonly but not always the research project leader, will organise regular meetings, workshops and circulate the drafts of the manuscript. These can be sent simultaneously to all members of the team or to each in sequence. The latter is more efficient when one or two members have made the main contribution. The "relay" approach also means that only one set of improvements or changes is made at a time. However it can slow things down. Team members can work remotely using e-mail but it is always beneficial to have face to face meetings to resolve issues interactively. Someone, usually the first or senior author, will need to refine the style and format so that it is consistent throughout the paper. Good teams can be mutually encouraging and synergistic (two or more heads are better than one).

There can be serious disadvantages with team writing. In a team, more than one person has to be motivated and active. Some members may hold up the complete group effort (i.e. the "convoy problem" - a convoy can only move as fast as the slowest member). This is a particular problem if that member is the only person able to compile a particular section of the article. Like everything in life, the more personalities involved the more

complex things can become. The order of co-authors on the completed article can be contentious. Ideally this should be established at the outset, although in some cases it may need to be revisited as the writing progresses and some authors are required to make a larger contribution. Fair practice is to list the person who has done the most work (i.e. total effort of research, interpretation and compilation) as first author. If all members of the team have contributed more or less equally authors can be listed in alphabetical order.

### **EXPERIENCE OF A RESEARCH STUDENT**

It is easy to feel a sense of achievement once the first draft of a paper has been completed. However, this is usually only the first step in a very long process. The draft must be checked by the co-authors (if any) and then sent to other experts for review. Their comments are useful for clarifying issues and language, but it usually means that numerous drafts will be required before the paper is ready for submission. Multiple reviewing can result in contradictory advice and you then you have the task of deciding which advice to take. Ensure that all scientific details are correct. It may be necessary to revisit the data during the drafting process. The interpretations arising from these “revisits” may involve corrections and complete changes from the original hypothesis. The more confident you are about the science, the better you are able to argue your point – even with eminent co-authors! Communication is important. Make sure all authors are clear and happy with the science and logic. Co-authors will not always have similar writing styles. The first author generally has the final say and may need to style edit sections written by other people to suit the expression of the overall paper.

The completed paper is important as a whole; however, the abstract is the most important part. It is the first and sometimes only section read by the audience, and prior to that, by the editor when deciding if the work is appropriate to the journal. In the abstract, be clear about the aims and significance of the research, and summarise the most important results. Do not simply list the work done. The abstract should be the condensed “essence” of the paper, emphasising what is ‘new’. Pay attention to the journal guidelines regarding word limit and citations within the abstract.

Universities often have academic skills centres which run short courses and workshops on writing skills and publishing. Make use of them. Some will even offer to read drafts for you. Having non-experts read your writing reduces dependence on jargon and improves the general expression of the paper.

Finally, once the manuscript is ready, make sure you leave enough time for the submission process. It can take longer than you expect. Online submission systems often require the creation of electronic accounts and passwords. Submission itself may take an afternoon! Details such as author affiliations are generally entered through a series of drop-down boxes or separate text boxes for each affiliation. You may be invited to nominate potential reviewers, again through a series of drop-down boxes. A cover letter to the editor is usually required, summarising the significance of the work and its relevance to the journal. Once everything has been entered, the system will usually compile the information into a single PDF file for the reviewers. This needs to be checked before the “submit” button can finally be hit. Then there is the long wait during the review. Once accepted, then you can bask in that sense of achievement!

### **CONCLUSIONS**

This article presents a brief guide and some tips for writing and publishing scientific articles. Hopefully it will assist the novice and restimulate the initiated. For most people, writing for publication is not easy, but it becomes easier with practice. Ultimately it comes down to ‘putting pen to paper’ or ‘fingers to keyboard’. Good luck and good writing.

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