

Publish or Perish: Writing Scientific Manuscripts for the Digital Age

ABSTRACT: In the world of networked science, it isn't enough to be published—you have to be found. In addition to selecting the right journal to showcase your work, taking advantage of search optimization techniques and social media tools will help disseminate your research to a broader audience. Furthermore, selecting appropriate keywords and visuals will help your article stand out amid the growing sea of scientific content. There are also new metrics available to help you better understand the influence of your work. Your research is important. Help it get the impact it deserves. This guide provides information and tips that will help you write a manuscript for the digital age.



The phrase “publish or perish” was coined to describe the pressure to rapidly and continuously publish research in order to establish, sustain, and further your career.¹ Like most researchers, you probably begin your investigations with an online search; where you have access to more information than ever before. In 2012, Chemical Abstracts Service (CAS) indexed nearly one million articles, out of which nearly half covered research at the interface of chemistry and biology.² It is more important than ever to use all appropriate methods to ensure your work is discoverable. Suffice to say, it is no longer enough just to be published. You have to be found.

You may have more power than you realize to broaden your audience and ensure your work is found where researchers are looking. Scientific research has become increasingly interdisciplinary; therefore, there is more research to filter through. Your audience is also much broader than ever before, but you can miss them if your manuscript isn't written for the digital age. By following a few basic tenets of search-engine optimization, you can improve your placement among the search results produced by any search engine, including popular international sites such as Google and Yahoo as well as regional sites such as Baidu in China. Effective article titles and optimized visuals help your research to stand out in online tables of contents, while well-chosen metadata helps major research databases such as PubMed³ and SciFinder⁴ match your article to the right search queries.

Searching is only the beginning of the equation. Rather than waiting for researchers to find your work via a search, you can actively engage the scientific community online via social media by generating topical discussions related to your work. These efforts not only promote your work, but can also advance your own way of thinking and help you make new connections for future collaborations. Also, new tools for measuring the reach of your article provide more information than Impact Factors alone, reflecting the actual contributions of your work across many disciplines.

This guide provides you with specific tips to help you increase the visibility of your work in today's interdisciplinary environment, along with thoughts from fellow researchers who work at the interface of chemistry and biology.

THE DISCOVERABLE ARTICLE

Title

Make sure your manuscript is written for discoverability. The title and abstract in particular must engage both readers and search engines.

“Usually, I have a quick look at the title. If interested, then I go to the abstract. If it's not an interesting title, I just forget it.”

—Professor Weiya Ma, MD, Ph.D.

McGill University

The title should concisely and accurately describe the content of your manuscript to a broad audience. Include key words that best describe your work and reflect the fields of study it encompasses.

You don't want to overload your title with a bunch of keywords, but conversely you shouldn't shy away from a lengthier title if it allows readers to better understand the content of your manuscript. A study published in the *Journal of the Royal Society of Medicine Short Reports* noted:

“A longer, more comprehensive title is both more likely to contain any given search term and, therefore, be identified, and also if the title provides a clear description of the study or its findings, is also more likely to be identified as relevant on the initial search screening process.”⁵

The use of appropriate keywords within your title will also help distinguish your article from articles addressing similar topics. Some journals have character or word limits for the title, so, if you know where you want to publish, check if there are any restrictions on title length.

A clever title alone is not sufficient to attract additional attention to your article. Your title must also be explanatory. A title such as *A Dialogue between the Immune System and Brain, Spoken in the Language of Serotonin*⁶ is both, ensuring recognition for the work.

Keywords

Internet search engines often assign priority to keywords that appear in the article title as well as in the abstract and body of the article, so use the terms from your keyword list in the article title, abstract, and body.

Some journals may choose the article keyword list from the article itself. In those cases, double-check that you have chosen the right terms in the manuscript title, abstract, and text to maximize the likelihood that the journal will choose those same terms as the keywords.

Choosing the right keywords merits some thought. Consider first how different segments of your audience are likely to search. Would they search for disease name, chemical compound, or family? Would readers from another field search by scientific method?

Choosing less specific terms may help your article appear in more results sets, but may also place your article at risk for getting lost among lengthy search results. On the contrary, a more specific term narrows results for a more targeted audience, but may miss some searchers working in related areas. An example of this is the use of the term “degeneration” vs “neurodegeneration.” Try a few searches on candidate terms to see how many results you get and whether or not they are relevant. Then decide which terms are most representative and appropriate for your manuscript.

Abstract

Article abstracts are typically made openly available to researchers, providing you the opportunity to present a summary of your findings to a broad audience. If a reader is viewing your article’s abstract, they are likely either interested in your work based on the title or trying to better understand what your research is about. According to Professor M.G. Finn of the Georgia Institute of Technology:

“The abstract is a miniature manuscript in its own right, and should be able to convey the basic justification, most significant findings, and most important implications of the scientific work reported in the article.

Start with the core: a list of the most important new results in your article. Then add enough introductory information at the beginning (usually 1-3 sentences) so that a reader can understand the context in which the results should be set. Add a sentence or two at the end, if you wish, to describe the significance of the findings: what do they mean for the field? It is not a grant proposal, so avoid speculation or descriptions of future work.

Then, re-read the abstract and trim any excess information or explanations that are not required to understand the key information and lessons. Lastly, re-read it out loud, and adjust for style so that the information is clear and can be easily understood. A good abstract attracts readers to your work, but it often takes a lot of time to write – don’t leave it for the last minute!”

—Professor M.G. Finn, Ph.D.

School of Chemistry and Biochemistry

School of Biology

Georgia Institute of Technology

Editor-in-Chief, *ACS Combinatorial Science*

Visuals

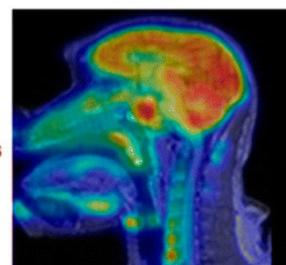
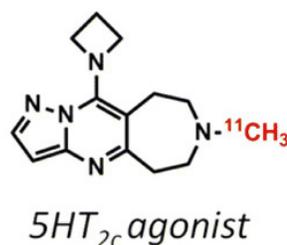
Visuals also aid discoverability. A good image will draw eyes to your article in the journal table of contents or results list. Many journals, such as those published by Cell Press and ACS Publications, include a

table of contents image for articles. Take advantage of this opportunity by choosing an attractive graphic or photo that creates the best possible impression of your article and subject matter. Generally, this is a “big picture” image—save the more specific images (e.g., tables, spectra) for your article. If a data table really is your big-impact piece, make it visually appealing. Here are some other tips for visuals:

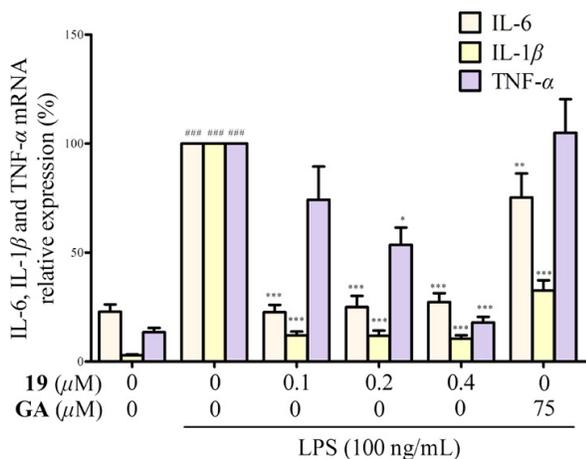
- Graphics should be simple, but informative
- Use original, unpublished artwork created by you or one of your coauthors
- Do not include a photograph, drawing, or caricature of any person, living or deceased
- Do not include postage stamps, currency from any country, or trademarked items (e.g., company logos, images, and products)
- Use large, easy-to-read headlines in a sans serif font such as Helvetica
- Do not use font type smaller than 6 pt and ensure that your text is large enough to be legible if its size is reduced
- Minimize grid lines and other potential visual distractions
- Provide a clear legend for charts
- The use of color can enhance your image; however avoid the use of green and red in close proximity and use shapes or patterns/shading in addition to color for individuals who have trouble distinguishing one color from another

It may be helpful to think of your table of contents (TOC) and/or abstract graphic as a single PowerPoint slide that tells the story of your article. Ask someone who hasn’t read the manuscript if they understand what the paper is about based on the graphic. Is critical content missing? Can extraneous material be removed?

Examples of good graphics and figures:



Above: Table of contents graphic from *ACS Chemical Neuroscience* article: Synthesis and Evaluation of Methylated Arylazepine Compounds for PET Imaging of 5-HT_{2c} Receptors.⁷ DOI: 10.1021/cn300223d



Above: Figure from *Journal of Medicinal Chemistry* article: Discovery of a Potential Anti-Inflammatory Agent: 3-Oxo-29-noroleana-1,9(11),12-trien-2,20-dicarbonitrile.⁸ DOI: 10.1021/jm301652t

THE RIGHT JOURNAL

Now that you have optimized your manuscript, publish it in a journal where it can be found by the broadest, most relevant audience. Take a look at what your research results prove, the methods used, and the implications of your experiments before choosing a journal to publish your work.

Much of today's research crosses disciplinary boundaries. Do you want to target your research to a specialized niche? Or does your research call for a wider, more interdisciplinary audience? Some publishers such as the American Chemical Society (ACS Publications) offer journals that do both. You should review the scope of potential journals of interest, which is typically found in the author guidelines or the "about" page on the journal's website. Also review recent research; most reputable journals will have sample content available.

The Impact Factor⁹ is a popular gauge, but also consider publication speed, author fees, the quality of the peer-review process, and the audience your article will reach before choosing a journal to publish your manuscript. Some journals, such as those published by the American Chemical Society, do not charge fees for publication and offer optional services such as *Just Accepted* Manuscripts that allow you the option to have your article posted online, prior to technical editing and formatting, within hours of acceptance.

"The reviewers were competent, constructive, and fast. The final evaluation and decision were made within a week, and a week later the almost perfect proofs were on my desk. This is hard to outmatch." [In reference to a manuscript submitted to the ACS Journal *Biochemistry*]

— Professor Hans-Jurgen Apell, Ph.D.
Membrane Biophysics Group
University of Konstanz

Next, consider the visibility of the journal itself. How widely available is the journal in universities, research institutions, and corporations? Do you have access to the journal at your institution? Have you seen it cited in other research of interest?

Also consider the journal's visibility in major research databases such as PubMed's MEDLINE, SciFinder®, and Web of Science. You should also evaluate the journal's visibility across the wider Internet and within

specific scientific communities. Consider how quickly major databases index the content from your journal of interest. For example, SciFinder® adds articles published in ACS journals within seven days of publication.

"I definitely would like a journal that is listed in PubMed, because that's where most people start to look at things."

— Professor Khosrow Kashfi, Ph.D., FRSC
School of Biomedical Education
The City College of New York

"It [SciFinder®] had very much a reputation of being chemistry focused in the past, but this is no longer the case. SciFinder covers a lot of different databases; it covers chemistry, it covers biology, and pharmacology, indeed many other branches of science. I use it as much for the biology as I use it for the chemistry."

— Nick Terrett, Ph.D.
Chief Scientific Officer
Ensemble Therapeutics

Inquire if the publisher of the journal you are considering has a public affairs or communications office dedicated to increasing the visibility of the research published in the journal. These departments help garner publicity and well-deserved public recognition of journal authors, not only within their scientific community but also among the general public. If you are coordinating a press release with your own university or corporate press office, consider reaching out to the public affairs office that works with the journal where your research is published, as they may issue an additional press release.

Below is an example from the ACS, whose Office of Public Affairs reads every abstract published in the ACS's 40+ journals, creating podcasts, videos, and media kits to promote the selected authors' research to the scientific and general media.

"As a result of the ACS PressPac, I saw press releases around the world highlighting my research¹⁰, with very many positive comments from the public. I scientifically benefit from greater publicity, which improves my career. It generated some new collaborations from academic & industrial institutions. My colleagues, peers, friends, and neighbors have commented very positively, recognizing my work, and I am proud of that. I have also received speaking invitations for conferences. It gives me positive energy and more enthusiasm towards my research, and professionally it helps to uplift my career."

— Professor Sivanesan Dakshanamurthy, Ph.D.
Clinical & Experimental Drug Discovery Program
Georgetown University Medical Center

AN AUTHOR'S ONLINE PLATFORM

While you are likely very busy with your ongoing research efforts, do not dismiss blogs and social media as outlets to promote your research. With search and discovery taking place primarily online, your website, blog, or social media channels can serve as important tools to announce your articles and encourage discussion, especially since these postings can appear in future search results. Devoting even 10-15 minutes once or twice a week can raise the visibility of your research substantially.

If you have a website or blog, take advantage of them to link your peers and colleagues to your published work. Even a very brief blog post that includes keywords from your article and title creates a record that can turn up in Google searches, enabling researchers to link to your research. If you publish in an ACS journal, you can include

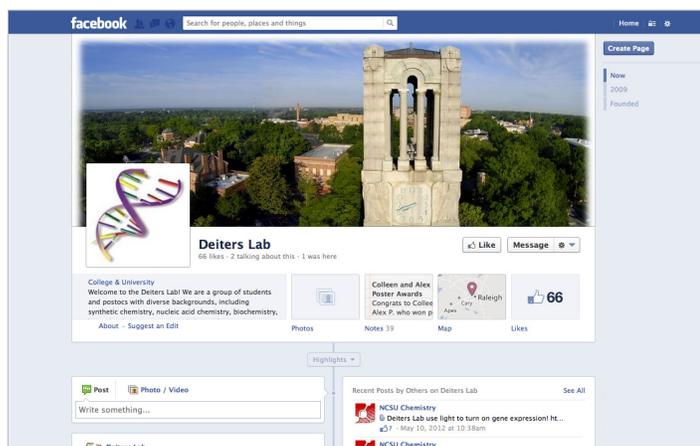
a permanent link to your article using the ACS Articles on Request link¹¹ which provides free access to your article. Whether or not you blog about your new research, keep a complete online CV with up-to-date links to all your articles on your website and on professional networking websites such as LinkedIn.¹²

Consider announcing the publication of your articles and any references to your research on Twitter, your lab group's Facebook page, online scientific forums, and LinkedIn groups related to your field. If you are already using Facebook, Twitter, or a scientifically oriented platform such as ACS ChemWorx¹³, Mendeley¹⁴, or ResearchGate¹⁵, you know that posts are more likely to generate a response when they are appropriate and timely. Contribute regularly to remain a visible and trusted voice, even when you do not have an article to promote.

If you are not currently using Facebook to promote your research, consider setting up a Facebook page for your lab where you and your colleagues can post updates, photos, and links to your published articles and talks. Most Facebook accounts are personal in nature, but Facebook allows users to set up free pages for specific topics or groups. Users of ACS ChemWorx can also set up similar pages called Project Pages that can be publicly viewed. You can even add a social plugin or "like" button to your other lab web pages to encourage further sharing of your posts.

As an example of an effective social media presence, the Deiters Lab from North Carolina State University has a Facebook page¹⁶ where they link to published research articles from the lab as well as awards, upcoming talks, and poster presentations.

LinkedIn provides a forum similar to Facebook for professional connections, helping you find and stay in touch with colleagues from around the world. LinkedIn is a great place to post your CV. They offer a timeline where you can post updates, including articles, poster presentations, and lecture announcements. LinkedIn also provides a diverse mix of subject area discussion groups, for example, the Medicinal Chemistry and Drug Discovery Group and the Protein Biochemistry and Biophysics Group.



Screenshot of Deiters Lab Facebook Page

ACS ChemWorx is another professional site with social media tools and an electronic reference manager, all designed for scientists. It allows you to collaborate and share your research with like-minded individuals.

Many scientific organizations host online communities in specific topical areas. For example, the ACS *Chemical Biology* Community website¹⁷ facilitates communication and information sharing among

researchers interested in the latest innovations in chemical biology.

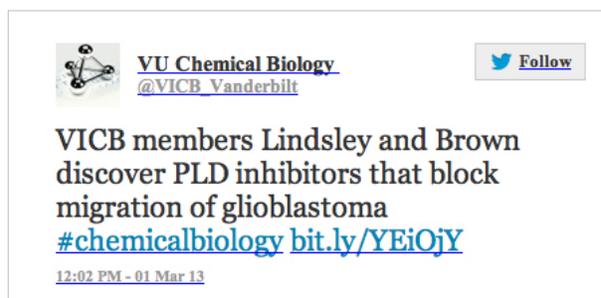
On Twitter, tweets can be personal, topical, or both. Generally, the more engaged you are with other users and post within specific topics, the more relevant discussion and Twitter followers you will attract. Watch for hashtags before a topic of interest (e.g., #toxicology) or conference name (e.g., #EB2013). When you do tweet about your articles, use hashtags to increase the visibility of your tweets. Encourage coauthors to retweet to help spread the word. If the journal you have chosen to publish in has a Twitter feed, mention their handle in your tweet. Often the journal will retweet your tweets to a broader audience.

Monitor your Twitter account for replies to and questions about your tweets (tweets that begin with your Twitter handle (e.g., @<handle>), as well as messages, which are shown on a separate tab in your account. Respond to queries to engage other users and keep the conversation going.

With all social media, regardless of the privacy settings, it may be possible that online content is copied or otherwise spread beyond your initial post. Avoid posting sensitive or proprietary content and be sure to only share links to your final published article of record to avoid violation of any prior publication restrictions.

Social media sites assess impact by the number of users who in some way connect with you, either by "liking" or "following" you or by commenting on or forwarding your posts. Web services such as Klout¹⁸ have begun to translate this social media impact into a metric called the Klout score.

Regardless of the social media platforms you choose, it is important to participate regularly as a member of the community, not only when you have an article or a presentation to announce. Use these forums to share articles of interest, make connections, and build your reputation. A brief visit once a week to relevant sites can maintain your visibility as an active voice in the community and also provide a source of inspiration and ideas.



Screenshot of @VICB_Vanderbilt tweet

CONFERENCES

Scientific conferences may be thought of as the original "social networking." Presenting posters, asking questions of session presenters, or simply having lunch with a fellow scientist can prove beneficial for expanding the reach of your research. Sharing research insights at a conference or anywhere can spark new ideas and collaborations. There are a multitude of venues for networking and communicating your work. Link up with neighboring labs or those across campus who work in similar fields or are tackling the same topics from a slightly different angle. This type of networking can also bring dividends for project grant-writing and future experimental collaborations that call for interdisciplinary approaches.¹⁹

METRICS

Journal Impact Factors and Citations are common measures of a journal or an article's influence. However, neither fully captures how much your research might influence your field and related disciplines. Impact Factors also vary considerably by field and can be affected by the number of papers a journal publishes, so be careful when applying comparisons.

“Citation indices and impact factors have become a really popular thing that people look at. But I tend to think more about readership, how broad the audiences are.”

— Professor Anthony D. Baughn, Ph.D.

Department of Microbiology

University of Minnesota

Page-view statistics—provided by your network administrator, web hosting service, or a tool such as Google Analytics—can tell you a lot about what visitors to your website or blog are interested in reading and even what part of the world they come from.

Another metric often discussed in the scientific community is the *h*-index.²⁰ The *h*-index can be used to demonstrate your impact on your discipline based upon the number of articles you have published and the number of citations those articles have received. Databases such as Web of Science will generate your *h*-index for you. Some journal publishers provide immediate, defined metrics for your article. For ACS journals, you can set up ACS Citation Alerts²¹ to send you an e-mail whenever your article (or any article of interest) is cited. Or you can visit ACS ChemWorx to track the number of citations and downloads of your ACS articles.

Several new online services are experimenting with aggregating broader measures of your article's influence by examining the article's connections and references across the Internet. For example, the beta version of ImpactStory²² gathers information from social media, literature databases, online reference management tools, and more to report the relative impact of a given article or online project.

BE FOUND

In the world of networked science, it isn't enough to be published—you have to be found. The tips and information in this guide were designed to help you get your work discovered by the broadest, most optimized audience. You now have tools to measure your impact, ideas for platforms where you can engage and share your work with like-minded scientists, and ways to ensure your article stands out among the growing body of scientific research.

And while publishing alone is not enough anymore, it is the first step in sharing your work. Be sure that you choose a publisher that is committed to advancing your work and giving it the global impact it deserves.

ACS Publications is the publishing arm of the American Chemical Society, with over 130 years of commitment to advancing the fields at the interface of chemistry and biology. ACS Journals are all led by Editors who are active researchers. These journals do not charge author publication fees and have some of the fastest submission-to-web publications times in scientific publishing. With open access options and dissemination to over 5,000 institutions around the globe, ACS is committed to helping you share your research with the world.

Visit pubs.acs.org/bio to learn more about the ACS Journals at the interface of chemistry and biology. Here you can view a customized list of journals relevant to your specialty as well as journals that will give you a slightly different perspective on your field. Get free issues

of these journals, sign up for e-alerts, watch a video that highlights interdisciplinary innovations, and learn how to submit your research to the leading journals at the interface of chemistry and biology.

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