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How to keep up with the scientific literature

By Elisabeth Pain | Nov. 30, 2016 , 4:00 PM

Few aspects of scientific work may be as crucial—and yet as easy to neglect—as reading the literature. Beginning a new research project or writing a grant application can be good opportunities for extensive literature searches, but carving out time to keep abreast of newly published papers on a regular basis is often challenging. The task is all the more daunting today, with the already vast literature continuing to grow at head-spinning speed.

To help you keep track of the literature and avoid feeling too overwhelmed, *Science* Careers asked scientists in a diverse range of fields to discuss how they integrate searching for papers, and **reading them**, into their working routine. Their responses have been edited for brevity and clarity.

Why is it important to keep up with the literature, and what are the challenges?

Without keeping up with the literature, I can't know what other people are doing or contextualize my work. In addition, through reading the literature I can find potential solutions to scientific barriers I am facing in

my own research. But I do find it difficult to integrate this task into my daily routine. The demands on scientists in terms of outreach, administration, grant writing, teaching, and more are tremendous, and there are only 24 hours in a day.
- ***Lynn Kamerlin**, associate professor of cell and molecular biology at Uppsala University in Sweden*

Staying up to date with the literature is perhaps the single most important skill that remains crucial throughout a researcher's career. Without knowing where the current gaps are, your findings will either be old hat or too out in left field to be cited right away. But there certainly are challenges. One of them is that reading papers can feel like dead time, because it is such a slow and absorbing process, and there are so many papers out there to digest. Reading can also feel disheartening, as you will often find that other people have already published on what you thought was a really novel or original idea. And so it can all too easily happen that this important task of investing in your knowledge gets prioritized lower than all the other apparently more urgent duties that you have as a scientist.
- ***Denis Bauer**, team leader in transformational bioinformatics at the Commonwealth Scientific and Industrial Research Organisation in Sydney, Australia*

Our job is to push the frontier of what is already known, so we need to be aware of where this frontier is. However, trying to stay up to date with the literature is tremendously difficult. As an assistant professor, my job is to not only do research but also to teach, obtain funding, do professional service including peer review, give talks, attend committee meetings, and more. This constant multitasking makes it difficult to carve out time for keeping up with papers. Another challenge lies in the immense amount of new work that constantly gets published. The number of journals and venues is very large, and it continues to grow. This is further aggravated if you work in a field that is multidisciplinary, because then this number is multiplied, becoming barely manageable.
- ***Belen Masia**, assistant professor of computer science at the University of Zaragoza in Spain*

It is extremely important to find what you need in the scientific literature, but it's difficult for anyone to block out the necessary time. For young scientists in particular, there is the additional challenge of trying to stay on top of newly published literature while still building up knowledge of their research areas.
- ***John Borghi**, former librarian and postdoctoral fellow at the California Digital Library in Oakland, California*

Keeping up is essential, no doubt about it. To be able to provide novel results, you have to know what has been done before you. Plus, you want to benefit from all the ideas, data, and interpretations that have accumulated in the literature right up to that point. But it's certainly hard to keep up. Thousands of papers are published daily. Another challenge for me is that my research is multi-faceted, so I need to read in my broader field, which covers a lot of ground.
- ***Juan Jose Negro**, senior staff scientist in evolutionary ecology and conservation biology at the Doñana Biological Station in Seville, Spain*

Our function as scientists is to push the envelope and create new knowledge and understanding, so we always need to be as up to date as we can be in our areas. But keeping up with the literature is potentially an overwhelmingly large task, and there are no deadlines attached to it. And so, among all the other things that I have responsibilities for, it often feels hard to prioritize.
- ***Jehannine C. Austin**, associate professor of psychiatry and medical genetics at the University of British Columbia in Vancouver, Canada*

To make a contribution to scientific research and effectively teach my students, I need to be very familiar with the current state of knowledge and with what ideas and methods are being used at the frontier of my field. But I find that keeping up with the literature always comes with a trade-off: Do I spend more time on

my research projects, or do I read the latest papers?
- ***Ina Ganguli**, assistant professor of economics at the University of Massachusetts in Amherst*

How do you find new papers you ought to read, and the time to read them?

To keep on top of my specialty area, I carry out regular, systematic literature searches using a tool called **PubCrawler**. PubCrawler automatically searches online publication databases using key search terms that I set up, and it sends me a weekly email highlighting all the new and potentially relevant papers, with a link to the abstract or full text. I find out about other recently published papers I ought to read from email alerts I get from the key journals in my area. I also become aware of new publications through colleagues who email me, and from social media. Twitter is an underutilized resource in science, but it's great—if you follow the right people—for keeping your finger on the pulse of new work that is coming out.

Regarding finding the time, unless I am actively writing a grant or paper, it is harder for me to keep up with the literature, because it's not an urgent, immediate, deadline-driven need. So I have a set time once a week, on Mondays, to look at the output of my literature searching tools. I sift through it all and then at least skim the papers that I find most relevant. I read journals' tables of contents when I get them, usually also immediately downloading and at least skimming the papers that I find of most interest. Thorough reading of the full papers may be more sporadic.
- *Austin*

The tools I use to keep track of new literature are **Feedly**, which allows me to subscribe to the RSS feeds of relevant journals; a string of **PubMed updates**, which capture any relevant literature published outside those journals; and Twitter, which helps me identify what literature the broader scientific community is talking about.

I like spending a few minutes every morning skimming recent publications for articles that are especially interesting or relevant to my work. Coupled with a regular block every Friday devoted to more critical reading and lots of note taking, this generally allows me to stay up to date. Whatever routine you decide to set for yourself, I think the key is to find a way to interact with the literature regularly.
- *Borghi*

I continuously monitor the growing literature using the **updates** feature in **Google Scholar**, which recommends a selection of new papers to read based on your own publications. Monitoring the handful of main conferences in my field throughout the year, plus a couple of other relevant venues, also does a good job. Many conferences eventually publish their proceedings, and so whenever the lists of accepted papers get published, I also go through them as soon as I can and look at the papers that seem the most relevant to me. Sometimes, reading the abstract suffices. Other times, if it is closely related to my research, I print it for when I find time to go over it in more detail. Also, I make a point to regularly look at what leading researchers in my field publish and to talk to my peers.
- *Masia*

To know when relevant papers are published, I rely on alerts that the journals automatically send to highlight new publications that cite papers I found of interest previously. There is also substantial activity on social media, with journals promoting and researchers discussing new articles. **Reddit Science's Ask Me Anything, or AMA,** forum discussions are a great way to hear about innovative research and talk to the authors directly. Recommender systems such as **PubChase** can also be great tools to hear about new papers early. However, most recommender systems find papers based on how similar they are to papers you previously read, which inevitably limits your exposure to tangential ideas that may be important to your research. I therefore like going through the tables of contents of my favorite journals.

In terms of how I find time for dealing with the literature, I usually go through email alerts as I get them to quickly become aware of the most important new publications. I also find that tweeting or blogging about one paper a week, or a day, is a good incentive for reading in depth. Twitter is particularly good, as it forces me to condense the paper's relevant outcomes down to 140 characters, which then promptly triggers my memory as I go through my Twitter feed. Other advantages of Twitter are that it helps me find researchers with similar interests and helps me build a brand.
- *Bauer*

One way I keep track of new papers being published is by subscribing to emails that include the tables of contents of the top or most widely read journals in my field. In economics there is usually a long publication lag, so I also have to be aware of working papers getting published and new publications being presented at conferences and in seminars. Attending events and talking to others are very important ways to find out about the latest papers. I also follow some blogs written by economists and several economists on Twitter who tend to write about new papers.

To deal with the time pressure, I try to be efficient in how I scan the literature. I find it very useful to at least read through the titles and abstracts of the latest papers published in the journals, and then I decide carefully which papers I should read extensively.

- Ganguli

To keep up with new papers being published, I use a combination of RSS feeds from journals in my field, Google Scholar Updates, the reference manager **Papers**, and **recommendations from senior scientists on Faculty of 1000** or directly from colleagues. Twitter is also becoming increasingly valuable as a tool for spreading exciting research, and I strongly recommend getting networked through social media. The volume of literature out there makes keeping track a collective effort, and it's also good to have a venue for promoting your own work amid the sea of information.

But while I continuously scan what's coming out, finding the time to read multiple papers in full is more difficult. And so, every few weeks, I try to download as many papers as I can—both newly published papers that are relevant to my work and older papers that I recently became aware of—and read them in chunks as the week progresses. Still, summer is best for reading—I have fewer teaching and administration obligations, so this is when I can really catch up with the literature.
- *Kamerlin*

How do you go about conducting more extensive background literature searches?

For general background reading in my field, I usually start by looking at new articles that have cited my work, as the likelihood that I am interested in what they have to write about is much higher. Similarly, I look at both recent and past citations to papers I found interesting to find further reading. For more targeted literature searches, Google—both Google Scholar and just the normal search bar—and PubMed are great. If I am moving into a new area, I usually contact colleagues, including people I know through conferences, and ask them if they have recommendation lists for me.
- *Kamerlin*

I find that, nowadays, searching for past literature is the easy part. Search engines and Google Scholar, together with other tools which allow users to follow citations, do a good job. If discipline-specific conferences or journals exist, I also go through the papers published in them, going at least 5 years back. What I find much more challenging is how to organize the works that I read and knowledge I acquire, and

how to search back through them. I first set up a dedicated digital database using existing tools. **Mendeley** is a well-known example; I myself use **JabRef**. Then I archive hard copies of most of the papers I read, with the main contributions written on their front page. It is of no use going through a bunch of papers if you are unable to remember what you read in them.
- *Masia*

For historical searches, I usually start with PubMed, searching terms that make the most sense to me and expanding my scope of those search terms if I get limited results. Once I have a selection of key or index papers for a topic of interest, I pull the relevant papers cited within them. I also find out which papers later cited my index papers, for example by finding them on Google Scholar. Often, through this process, I am able to develop new search terms to use in PubMed, so I may then again start the whole process iteratively.
- *Austin*

When conducting literature searches, I like to simultaneously look backward and forward: If I find a paper that I think describes a topic particularly well, I look at both the papers it cites and the papers that cite it. Tools like PubMed and **Web of Science** each have their own strengths and weaknesses but, if I'm trying to gain insight into a topic described in a paper, I typically start by using Google Scholar to look at the papers that reference the one I'm reading.
- *Borghi*

For broader searches, I have been applying "**Ten Simple Rules for Searching and Organizing the Scientific Literature**" for several years now with good results, although the technologies have changed slightly over time. Today, I usually start from the article that made me interested in the topic (what I call the seed paper) and read the papers that are cited in the references. For this I use **ReadCube**, as it helps prioritize papers by the number of citations they have. Then I also try to find a review article on PubMed, which helps me identify other research groups in the field whose work might not have been referred to in the seed paper but is nonetheless important. Finally, I try searches for research articles in PubMed and Google Scholar with very precise keywords and choose new seed papers from there, starting the process all over again. Eventually, this helps me establish connections between different schools of thought.
- *Bauer*

Does the literature sometimes feel overwhelming? How do you prioritize what to read, and how do you reduce the chance of missing an important paper?

It's easy to feel overwhelmed with the flow of information. The decision to be made is one of sensitivity versus specificity. I tend to prioritize specificity (whether the papers I find are on target for me) and accept lower sensitivity (I'm not going to find everything that could potentially be relevant). I have drawn a line that makes sense for me based on the principle of diminishing returns. Of course, where exactly to draw this line is likely different for everyone.

Regarding how to make sure nothing crucial escapes my attention, I try to send links to papers that I find to colleagues and students whom I think might be interested in them, given what I know about their work. My hope is that, in turn, they will send things that they come across to me too, and then perhaps I will miss less. I also find that, when I am writing grants and papers and engaging in more thorough systematic literature reviews, I can catch up on things I may have missed.
- *Austin*

It is important to be exposed to ideas and approaches from other disciplines, but there can be an overwhelming amount of information if we try to read everything that gets published, and sometimes it is difficult to know where to draw the line. I prioritize the papers that are directly related to my own projects,

especially when I am writing literature reviews for publications or grant proposals. I also prioritize reading papers from the top journals in my main research areas to keep on top of which topics and methods are at the frontier of knowledge. And then if I have some spare time, I also try to read papers that are a little bit further from my main research topics.

There are certainly some times when you have that “I can’t believe I missed this paper” moment. But usually, if the papers are important enough, you will eventually find out about them through conference presentations, conversations with colleagues, Twitter, blogs, magazines, or other channels. You just hope you don’t have that moment when reading a report from a referee who isn’t happy that you missed an important citation!
- *Ganguli*

The number of papers out there makes it impossible not to miss important papers, especially when you are working in multiple disciplines. So I prioritize my reading in terms of what is most immediately relevant to what I am working on, and then I fan out from there as time allows.
- *Kamerlin*

Trying to read too broadly, too deeply, or too quickly is a sure path to information overload. So don’t try to read it all at once! Scientists who are feeling overwhelmed by the flow of information should take a step back and think about what exactly they’re looking for in the literature—and then prioritize the papers directly related to that question. It also helps to realize that, ultimately, a single scientist can’t read everything. A group of scientists navigating different branches of the literature can however cover a lot of ground. Personally, I’ve benefited greatly from collaborators and friends working in fields adjacent to my own pointing me toward things they’ve come across.
- *Borghi*

Are there any potential pitfalls that you’d like to highlight for young scientists? Do you have any further advice?

Young scientists sometimes tend to neglect the literature. They look at a number of related papers when they start working on their project, but then they fail to keep looking for more papers as their research—and the work of other researchers—progresses. They also rarely go back to the literature they’ve searched and read, even though it remains a great source of inspiration.
- *Masia*

Talk to librarians! Depending on their area of expertise, they may be able to give you specific advice about accessing important papers or navigating the scientific literature. Even if they don’t have specific subject area knowledge, librarians are an often-untapped source of knowledge about how scholarly information is organized, evaluated, and disseminated.
- *Borghi*

Remember that we walk on the shoulders of giants. Einstein would be a notable example, and Darwin’s work is still as relevant to evolutionary biologists today as it was in his day. In other words, don’t limit your literature searches to the 21st century.
- *Negro*

At the early stages of your research career, it's especially important that you take the time each day to get up to speed with the literature. I would recommend trying the different tools available and experimenting with your reading routine until you find what works for you. There are so many great options out there, and people have different tastes in terms of what they are comfortable with. Also, don't be afraid to ask your

adviser for literature recommendations. Finally, it's a good idea to set up a physical or virtual journal club to share papers and discuss ideas with your peers.
- *Kamerlin*

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