experience have been developed in studies involving research institutes in sending and receiving countries, e.g., the Mexican Migration Project (Princeton University), the “push and pull factors of international migration” project (a joint project of Eurostat and NIDI, Netherlands Interdisciplinary Demographic Institute), and the Migrations between Africa and Europe Project (led by INED, the French National Institute for Demographic Studies).

Training. We propose M.Sc. and Ph.D. programs in migration and population diversity. These should adopt a holistic perspective integrating demography, economics, analytical sociology, geography, cognitive anthropology, political science, and international migration law. The programs should ensure that migration issues are properly treated in the production of statistics and the formulation of policies.

Our recommendations could help expand and improve the evidence base available for public debates and policy formation. Our hope is that these debates will lead to policies to promote full participation of all population groups in society and turn diversity into a valuable asset in a globalizing world.

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SCIENTIFIC COMMUNITY

Preprints for the life sciences

The time is right for biologists to post their research findings onto preprint servers


A preprint is a complete scientific manuscript (often one also being submitted to a peer-reviewed journal) that is uploaded by the authors to a public server without formal review. After a brief inspection to ensure that the work is scientific in nature, the posted scientific manuscript can be viewed without charge on the Web. Thus, preprint servers facilitate the direct and open delivery of new knowledge and concepts to the worldwide scientific community before traditional validation through peer review (1, 2). Although the preprint server arXiv.org has been essential for physics, mathematics, and computer sciences for over two decades, preprints are currently used minimally in biology.

The ASAPbio meeting (Accelerating Science and Publication in biology) was held on 16 and 17 February 2016 to explore the wider use of preprints for disseminating ideas and results in the life sciences. The ~70 invited participants included junior and senior working scientists; and representatives of public and private funding agencies, industry, databases, and scientific journals. All talks and breakout sessions were streamed over the Internet to encourage community participation, and a full record of the meeting is available (3). The meeting goals were to analyze the roles that preprints might play in communicating results in biology and to debate the potential advantages and disadvantages of greater use of preprints for the progress of science, career development, and the integrity of the scientific record. In the three sections below, three classes of attendees—academic scientists, funders, and publishers—provide their perspectives on the meeting and its outcomes.

ACADEMICS’ PERSPECTIVE


Motivated by frustrations in the slow speed of publishing (1, 2), and with other junior and senior life scientists participated in the ASAPbio meeting. Physicists have embraced sharing their work as preprints for 25 years. Paul Ginsparg, founder of arXiv, described how physicists, mathematicians, and computer scientists check arXiv when they wake up each morning to learn about advances in their fields. Even though physicists publish their work later in journals, arXiv has become THE way to communicate new discoveries. Ginsparg also described how preprints empower younger scientists to move their work and careers forward.

Knowledge and opinions of preprints varied among the ASAPbio attendees at the start of the meeting, but many came to appreciate their benefits. Currently, the time between manuscript submission and paper publication is unpredictable and can be long. Depositing a manuscript in a preprint archive makes the work publicly available almost immediately. Posting preprints has the added benefit of democratizing the flow of information and making it available to all investigators across the globe, while allowing journals to make their own judgments of appropriateness and interest after peer review. Publicly available preprints provide an opportunity for authors to obtain feedback beyond the few scientists who see the manuscript during peer review. Finally, preprint archives also document the history of the ideas, as old versions of a manuscript are maintained even after revisions of the work are submitted.

Ginsparg was emphatic that a preprint, because it has a time stamp and is publicly available, plays a key role in establishing priority of discovery. But will this model be widely accepted by biologists? Some suggested that the archive could be flooded with weak papers meant only to assert priority. But decades of experience have demonstrated that scientists do not post poor-quality work on arXiv because of the impact on their reputations; we expect professional biologists to behave similarly. After hearing various points of view, ASAPbio at-

ONLINE SURVEY

Tell Science what you think about preprint servers at http://scim.ag/1T5Lkfl
tendees, in a private and optional poll, voted nearly unanimously in favor of preprints being used for establishing priority (4).

If preprints are to help early-career scientists, their use in hiring and promotion is of paramount importance. The ability to cite preprints in grant applications and progress reports would benefit scientists at all career stages. Although not peer-reviewed, a preprint provides tangible evidence of a scientist’s most recent work, which is often of greatest interest to review panels. Again, by private ballot, nearly all of voting attendees thought that preprints should be considered as evidence of achievement in evaluations for academic advancement and for funding (4).

We also debated the use of preprints in reporting results of clinical studies. In its favor, some argued that clinical research would benefit from more open and timely access to data and that papers published in respected medical journals can also be misleading or wrong. Some who were opposed questioned whether research involving human subjects might require additional safeguards in scrutiny by institutional review boards and disclosures of conflicts of interest. As occurred in the physical sciences, different fields in biology and biomedical research may come to embrace preprint archiving at different times and to different degrees.

What would help promote the use of preprints by life scientists? Several steps are essential: broader acceptance of preprint posting by journals (in process and well on its way); the development of search engines for finding and linking preprints to published versions of manuscripts; and the recognition of preprints by grant, hiring, and promotion committees. These steps will likely come. But, motivated by the meeting, many ASAPbio attendees (P. E. Bourne, M. Chalfie, D. A. Colón-Ramos, S. L. Díaz-Muñoz, D. G. Drubin, M. B. Eisen, J. S. Fraser, C. W. Greider, J. K. Polka, R. Schekman, B. Stillman, R. D. Vale, H. Varmus, K. VijayRaghavan, L. B. Vosshall, C. Wolberger) are not waiting: They have taken a step toward embracing a new culture of science communication by posting a preprint this year, most of them for the first time.

FUNDERS’ PERSPECTIVE


By the end of the ASAPbio meeting, funders felt that preprints, operating in parallel with peer-reviewed publication, could play a valuable role in communicating research results.

An important issue was whether funders would recognize preprints in grant proposals and/or when reviewing the productivity of a researcher. In grant applications, funders typically ask applicants to identify relevant "peer-reviewed publications" along with the relevant persistent identifiers. Applicants are often invited to detail “other scientific contributions”—which could be used to list preprints—but this section is typically less well-populated and may well be considered less important by external reviewers. Equally, the annual reports from funding agencies focus on peer-reviewed research outputs. However, this somewhat ambivalent approach to preprints is not the consequence of an explicit policy but rather reflects the hitherto limited use of preprints by biologists. From discussions at ASAPbio, our group of funders has identified the following benefits and challenges of preprints.

Benefits. From the perspective of a research funder, we can see substantial benefits from the widespread adoption of preprints. Apart from the obvious benefit that research findings become available more quickly—an important consideration given data showing that the median review time at journals has grown from 85 days to >150 days during the past decade (5)—preprints provide funding agencies (and those reviewing funding proposals) with a more current and complete view of a researcher’s ideas and progression of work than does a formal, peer-reviewed product of research.

Preprints enable reviewers to assess an applicant’s ideas by scrutinizing the research findings, rather than using the journal name (or its impact factor) as a proxy for quality. Funders are keen to uphold the principle that funding decisions should be based on the merit of the research.

Next, preprints provide reviewers with an opportunity to see—in real time—reactions from the community and how the researcher responds to these.

Finally, preprints offer an opportunity for early-career scientists to demonstrate productivity and to provide evidence of independence. Preprints also offer more opportunity for early-career scientists to get peer feedback, especially if they lack the professional networks or the funds to attend conferences.

Challenges. The biggest challenge of using preprints to help inform funding decisions is that they represent work at various stages of development and, by extension, of varying degrees of quality. This puts even more
The benefits of preprints are clear: they allow scientists to widely disseminate their work, to engage with and improve the work in the extended scholarly community, and to provide clear guidance to authors about their studies. Thus, citations to preprints could have a different format and be separated from citations to the peer-reviewed literature. Optimal commenting and discussion formats on preprints remain to be defined and can range from direct communication with authors to public, signed comments.

The raison d’être of a preprint server is the sharing of research findings without delay, but preprints are not necessarily only an alternative or a preliminary step to publishing in formal journals. Posting of units of information smaller than research papers should be encouraged, as long as the data reporting allows others to replicate the work. The value of sharing review articles and commentaries as preprints is less clear.

In summary, if, as is the case for physics preprints, the community engages in constructive and objective discussion of preprints, both the scientific community and journals are likely to benefit directly.

CONCLUSIONS
Preprints could play important roles in accelerating scientific progress; they could serve the needs and foster the careers of scientists; and, in cooperation with existing journals, they could enhance the current system for communicating results and ideas in the life sciences. However, preprints are relatively new to biology, and many questions remain unanswered. Will funding agencies encourage the use of preprint servers? Will all journals accept manuscripts for publication after they have been disseminated as preprints? Will the life sciences community find ways to make biology preprints easily discoverable? And will researchers themselves decide to submit, cite, and evaluate work presented in preprint form? The cooperative spirit displayed by the attendees at ASAPBio gives hope that these complex issues, as well as others that limit the communication of scientific ideas and results, can be addressed in a productive and thoughtful manner.

REFERENCES AND NOTES

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