

AMS Primer on Open Access

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Introduction

Open access (OA) refers to published scholarly content (such as journal research articles, and books) made openly available in online digital form. This content is free of charge at point of use, free of most copyright and licensing restrictions, and free of technical or other barriers to access (such as digital rights management or requirements to register to access).

Communicating and sharing discoveries is an essential part of the research process. Any author of a research paper wants it to be read, and the fewer restrictions placed on access to those papers means that more people may benefit from the research. In many ways, the OA movement is very much in line with the shared mission of researchers, scholarly societies, and publishers.

Journal publishing programs perform many services for researchers including peer review, communication, and career advancement. In society publishing programs, revenue from journal publishing directly supports the important work societies do on behalf of their scholarly communities.

How do we maximize the dissemination of knowledge while at the same time maintaining both a high level of quality and a sustainable financial future for our professional society, the AMS?

The OA movement can be traced to a letter from the year 2000, signed by around 34,000 researchers, demanding publishers make all content free after 6 months. The signatories of the letter said they would boycott any journals refusing to comply. In 2002, the accepted definition of OA was encapsulated in the [Budapest Open Access Initiative](#) declaration.

While the threatened boycott never materialized, an antagonistic tone was set, and this has marked much of the discussion around OA to the present day. There has been a lot of unproductive argument and invective, rather than efforts to find common ground. Unfortunately, advocacy for rationale discourse has floundered, leading societies such as the AMS to consider how to tread independently a path of balance and reason.

OA Categories

The AMS on the one hand recognizes openness as important, but also wants to balance this ideal with pragmatic business models to allow the AMS to continue providing services to the mathematical community.

Approaches to OA may be considered in terms of *what* is made open, *when* it is made open, and *where* it is made open. Taking a peer-reviewed journal article as an example, three stages may be distinguished:

Stage 1 - Author's original: this is the author's un-refereed draft manuscript intended for consideration by a journal, also called a preprint. Authors usually retain copyright over this version of the manuscript.

Stage 2 - Accepted manuscript: this is the author's final refereed manuscript accepted for publication by a journal, containing all changes required as a result of peer review. From this stage, copyright is typically assigned to the publisher, or an exclusive license is granted.

Stage 3 - Version of record: this is the final published, citable article available from the journal's website. Copyright is now retained by the publisher as an exclusive license.

Bearing in mind these OA stages, there are a number of OA models in use today.

1: **Gold OA** is usually meant to describe when journal articles (*version of record*) are freely available to the reader immediately upon publication because the author has paid an article processing charge (APC). It is worth noting this changes the business model for a journal from being reader-centric (reader or library pays to access the article) to author-centric (author pays for OA).

2: **Green OA** is seen when articles (most often the *accepted manuscripts*) are made freely available at no cost to the author or reader. This can happen when the author deposits the article in an external repository (e.g. personal web page, their institution's noncommercial repository, arXiv.org) or the article (*version of record*) becomes open in the online version of the journal after a time delay known as an embargo period.

3: **Diamond/Platinum OA** is when articles (*versions of record*) are freely available immediately upon publication with no cost to the author or the reader. The majority of fully open access journals listed in the Directory of Open Access Journals follow this model. These journals tend to be small ones with private grant funding or financial support from the host institution or library.

Journals publishing articles exclusively under the gold or platinum methods are called "fully OA". Journals that employ a combination of the traditional subscription model along with some OA options are "hybrid" journals. A hybrid journal has some content that requires a subscription ("behind the paywall") and some that is freely available ("open access"). A "mirror" journal shares the same editorial board as a traditional subscription model journal but is itself a separate, gold OA publication. The difference between "hybrid" and "mirror" journals matters, as there is currently some controversy from certain funding agencies pertaining to this distinction. This will be explained more below in the discussion of new funder-driven OA initiatives.

AMS and OA

The AMS has released a memo on OA (<https://www.ams.org/government/open-access.pdf>), designed to describe how the culture of mathematics is different from other scientific fields:

- a. Approximately 25% of AMS authors receive research funding from a federal agency, with the result that there are limited funds available for gold OA publishing.

- b. The intellectual property of a mathematics article lies in the article itself, rather than the article being a report of an experimental study, and these articles are as valid today as they will be in 30 and even 300 years.
- c. The article of record, published in a journal of record is important for a mathematician's progress in the field, for example in securing tenure and further grant funding. The article of record coexists with preprints in progress hosted on arXiv,¹ and mathematicians value the complete ecosystem of preprint-to published-article-of-record.
- d. Advances in mathematics occur more slowly than in many other science fields. According to a recent study on journal usage,² mathematics is at the extreme for the life of journal articles. Across all subject disciplines, journal half-lives peaked between two and four years.³ Seventeen percent of all journals had usage half-lives that exceeded six years, however, with mathematics journals at the extreme – 36% of the mathematics journals examined had usage half-lives exceeding six years.
- e. AMS also provides [Mathematical Reviews](#) - an important, subscription based discovery database for mathematicians, with a host of tools available to support mathematicians in their research and teaching endeavors.

The AMS currently has two gold OA journals with APCs discounted to \$750 – *Proceedings of the American Mathematical Society Series B* and *Transactions of the American Mathematical Society Series B*. These journals were launched in 2014 as spin-offs (“mirror” journals) from their parent journals. While they share the same editorial board, the Series B journals are considered new journals and are thus still awaiting an Impact Factor.

Articles published in our AMS gold OA journals are distributed under the terms of one of the following licenses:

- The [Creative Commons Attribution-Noncommercial License \(CC-BY-NC\)](#), which excludes commercial use. This license lets others remix, tweak, and build upon the article non-commercially; the new work must credit the original article and be noncommercial.
- The [Creative Commons Attribution License \(CC-BY\)](#). This license lets others distribute, remix, tweak, and build upon the article, even commercially, as long as credit for the original article is given.

Authors retain copyright to their articles under both CC-BY-NC and CC-BY.

The AMS is fully compliant with green OA. AMS authors may post an accepted manuscript, pre-publication version of a journal article on their personal web page, on their institution's noncommercial repository, and on arXiv.org. In this model, there are no processing fees, and the article is included in a subscription journal. All [AMS subscription research journals](#) are green OA journals.

The embargo period for AMS journals is five years. This means all AMS version of record articles are publicly available (“open”) five years after publication.

¹ <https://arxiv.org/help/general>

² <http://www.publishers.org/usagestudy/>

³ *Usage half-life* is defined as the time taken for a group of articles to reach half of their total number of downloads.

Some funding agencies require their authors to publish green OA articles within one year of publication. In these cases, the AMS works with the non-profit organization [CHORUS](#) to facilitate free access to the accepted manuscript version of the article (not the version of record) following the allowable embargo period of one year. Through CHORUS we can track these articles and this may be seen at the [CHORUS dashboard](#).

Benefits, Risks, and Politics

The AMS publishes a broad portfolio of high quality journals. When considering the benefits and risks of adopting OA models for journals, it is important to note there are significant costs associated with publishing journals. These costs include, for example, expenses related to editorial office management, peer review management, technical manipulation of LaTeX files, workflows for tools such as AMS Math Viewer, systems for processing, presentation and sale of print and online products, marketing and strategic journal development, public awareness, in-house expertise on best-publishing practices as outlined here (<https://publicationethics.org/>).

Benefits of OA

There have been few rigorous studies. One such study is ([Davis P.M. \(2011\) vol25 no.7 2129-2134](#)). Their research shows that OA articles received significantly more downloads than the subscription articles and reached a broader audience, basically twice as many full text html views, a 62% increase in pdf downloads and more than 30% more unique visitors. Citations, however, remained flat—despite wider readership there was no similar increase in citation of OA articles.

The results indicate that OA is a valuable tool for broadening access to the research literature. OA publishing extends information beyond the research community, to those who consume the literature but don't necessarily create new research.

A recent report from ([Digital Science – January 2019](#)) indicates countries that have invested in OA publishing over the last decade have typically increased their level of international collaboration.

Risks of OA

Gold OA

Gold OA appears to be effective for increasing access to journal articles, but it also introduces some unintended consequences. The business model for Gold OA shifts from the readers (who currently pay, or have their institutional libraries pay, to access articles) to authors (who now must pay, or have their institutions or funders pay, to make their articles available to be read).

OA costs are now landing on the author rather than being distributed across a large number of readers. This creates a system where you have to pay to publish. In our discipline of mathematics, the percentage of federally funded researchers is relatively low at around 25%. Other scientific fields rely more heavily on federal funds, as seen in this chart from the National Science Foundation (<https://www.nsf.gov/statistics/2016/nsb20161/uploads/1/8/at05-20.pdf>)

Much of the drive toward gold OA comes from the biomedical world, where research funding is more widespread. Although many societies and publishers are launching new gold OA journals, with fewer mathematics researchers having access to funding, one size cannot fit all.

For established journals that have been in existence for many years, the equation is different. A society such as the AMS relies on subscription revenues to generate income, which enables it to provide services to its members and the global mathematical community. *For the AMS, subscription revenues account for approximately 70% of its operating income.* It is naïve to anticipate that APCs could adequately replace subscription revenues. Indeed, the modest APC we now have for our B-series journals do not fully cover the costs associated with publishing that one article, let alone generate revenue that could be made available to the general AMS operating budget.

While many researchers consider current APC rates too high, the reality is that they would likely need to be a lot higher for most journals to remain sustainable. For a gold OA journal, the only revenue comes from the articles you accept. The more stringent the quality control, the greater the effort (and expense) of reviewing and rejecting articles.

Green OA

Green OA comes with a different set of risks. Green OA relies on the continuing existence of subscription journals, yet requires those journals to give away their content. To balance the risk of lost subscriptions, most green OA journals have an embargo period, a period of time that allows the journal exclusive rights to the article. This gives the journal a chance to earn some revenue before it opens up access to all. At the AMS, this revenue not only pays the costs of producing the journals, it also provides additional revenue for the AMS operating budget. For AMS journals, the embargo period is 5 years (although as described above, we work with authors whose funding prescribes shorter embargo periods). Default embargo lengths across all scientific journals seem to be 6 or 12 months.

Platinum OA

Platinum OA has seen some success in scenarios where funds are available to ensure continued publication of a journal with no charge to the author or reader. A successful example is seen in [ACS Central Science](#) from the American Chemical Society. It is unclear if this model can scale across societies, given that significant resources are needed to publish such a journal in perpetuity.

Copyright

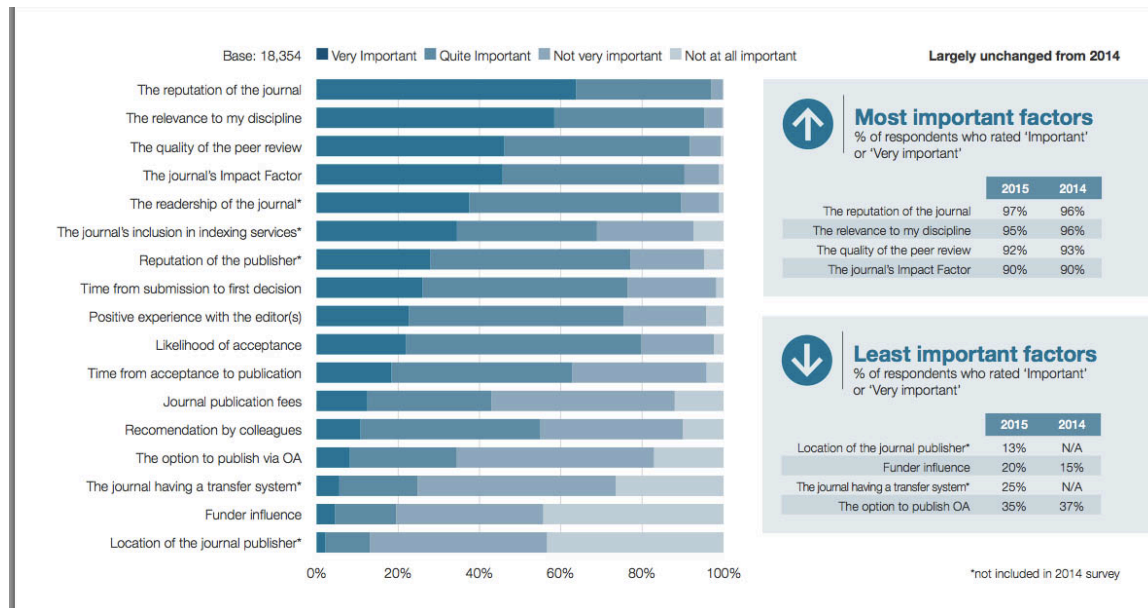
The AMS offers creative Commons licenses for its gold OA journals (our Series B journals) of CC-BY, or CC-BY-NC.

Most researchers are unaware that when publishing under a CC-BY license they are giving away their intellectual property. When an author pays an APC, they are paying for a publisher to not only publish their article, but also allowing their content to be monetized in new ways, by both the chosen publisher, and also by other commercial entities, as long as there is attribution to the author, potentially at high prices. Indeed, it is unclear what recourse an author has if a commercial entity fails to credit content to the author. As

artificial intelligence and machine learning tools grow more sophisticated, the ability to monetize content in new ways will be of increasing importance commercially.

Priorities of researchers

Below are some of the results of a 2015 survey from *Nature*. This chart shows responses of science researchers in how they choose which journal to submit their article to. Top reasons are journal reputation and relevance, quality of peer review and impact factor. OA is fourth from the bottom.



In general, OA remains a low priority for most researchers, mathematicians included. In fact, one can make the argument that in mathematics --with virtually all mathematical research existing on arXiv--we already have OA. This survey suggests that researchers are more likely to think of themselves as authors, rather than as readers. As authors, OA is not a primary concern.

Emerging business models

The forces behind the expansion of OA are economic. Library budgets are flat, if not declining. Commercial publishers, driven by Wall Street's demands, must continually increase their earnings. In a flat economy, they can do this by acquiring more and more of the current market. This is why we're seeing so many mergers and acquisitions, such as Springer and *Nature* recently becoming one company. Gold OA publishing has become a priority for many of the larger publishers. Gold OA fits in here because costs for launching a new journal, with significant APCs, mean that each article is paid for as it is published. There is no need to consider how to replace existing subscription revenues as these are new journals, and additive to the current market. Indeed, many of the larger commercial publishers are seeking other sources of revenue, such as with author workflow tools.

“Big Deals”

For many years, large commercial publishers have successfully engaged the market through “Big Deals.” In these deals, libraries, groups of institutions and even countries subscribe to large packages of journals. These big deals offer significant discounts over a la carte journal subscription. Institutions have recently been pushing back on such deals because of their cost. Most recently, the University of California system terminated its “Big Deal” arrangement with Elsevier. This means that the University of California will no longer have access to Elsevier content.

“Read and Publish”/“Publish and Read” Deals

Adding to the complexity of the sales environment for journals is the emergence of a new type of deal, reflecting the shift of many of the larger publishers to gold and hybrid OA publishing. The deals are called “Read and Publish” (RAP) agreements, with a more recent iteration of these called “Publish and Read” (PAR) agreements. In such models, institutions pay a fee to make all of their own authors’ work immediately OA. The deals are based around agreed levels of APCs as well as access to reading the content.

Without going into too many details, RAP and PAR deals shift the economics – whereas the “Big Deals” sell journal content, these new arrangements are dependent on publishing OA articles and determining who pays for the APCs. RAP and PAR deals differ on whether the institution is paying primarily for its own authors’ APC costs, or for the ability to access content.

In reality, the amount of money appears, in one way or another, to be similar to that generated from the Big Deals – for now. Institutions who publish growing numbers of OA articles may ultimately pay even more than the Big Deal prices.

The University of California system terminated its Big Deal arrangement with Elsevier. The negotiations most likely failed when they could not agree on an acceptable Read and Publish arrangement. What is interesting in this case is that the University of California felt comfortable closing itself off from Elsevier content when faculty output in the UC system comprises 10% of all articles published in the United States (although not 10% of the articles published by Elsevier overall).

Large consortia of institutions in both Germany and Sweden left Elsevier in 2018 and libraries are no longer able to access Elsevier content. On the other hand, Wiley recently successfully signed a 3-year PAR deal with the German DEAL Consortium. Some interesting numbers have been made public in this agreement. This agreement provides access by the consortium to all of Wiley’s 1420 hybrid journals, 178 closed journals, and 11 gold OA journals. The DEAL consortium’s authors publish around 10,000 articles across all Wiley journals, and APCs will be covered by DEAL for those publishing in hybrid OA journals. For those DEAL consortium authors wishing to publish in Wiley’s gold OA journals, Wiley will provide a 20% discount on the APC.

For societies such as the AMS, the RAP/PAR deal approach gives rise to concern. The AMS is a medium-sized society publisher with relatively few journals. The AMS relies on selling subscriptions and some limited bundles. For the AMS there is significant risk to adopting an RAP/PAR business model approach to selling journals. The problems include:

- In an RAP/PAR deal, all authors in an institution making the deal are encouraged to publish in OA journals, both hybrid and gold. In addition the APCs are paid by the institution.
- If a large institution is making the deal, then a significant number of articles are now being made openly available to all.
- Small institutions with low numbers of math faculty will see much of the content they want to read now openly available to them, and may consider cancelling their own subscriptions.
- Mathematicians at these smaller institutions are also not part of any RAP/PAR deal, and, as such, these smaller institutions may not be able to pay APCs for their authors to publish openly. This puts mathematicians at smaller institutions at a disadvantage compared to their colleagues at larger, dominant institutions.
- Politically, there may be resistance from larger institutions, who would effectively be underwriting OA for smaller institutions and the public.

The effect of moving to an RAP/PAR deal on the AMS may be profound, and a deep analysis of potential outcomes, both in terms of access and revenues would need to be undertaken.

Subscribe to Open

Another model for AMS to analyze is Subscribe to Open developed by the non-profit publisher, [Annual Reviews](#). It is designed to motivate collective action by libraries who are asked to continue to subscribe even though the content will be published OA. A 5% discount off the regular subscription price is offered to existing customers. If all current customers continue to subscribe, then that year's content is made available OA and all the back files are also made available OA. None of this content is opened if the number of subscribers decline, which discourages free riding. Libraries are not locked in to these arrangements, with a new arrangement negotiated annually. Any institutions that do not renew and who later return, do so at the list subscription price and do not receive the 5% discount. This model uses the conventional subscription process and existing library budgets, avoids the need to invest in transactional payment infrastructure, minimizes customer disruption by using routine library accounts payable processes, and avoids the prohibition some libraries face in paying for things that would otherwise be free.

Annual Reviews piloted this model with one title and received a 25% increase in citations and a 300% increase in downloads. These downloads were not only from the users of the 2,000 subscribing institutions but also from a further c. 7,000 institutions who can now be approached with data about why they might wish to subscribe and support the journal. In 2020 Annual Reviews will extend this model to 5 journals or 10% of its portfolio.

Politics of OA

Funders and Government

Another factor in the developing OA landscape is the role of funders, be they private or governmental. Funders in the US are taking a different approach than funders in Europe, while funders from other regions in the world are to some extent waiting to see how current initiatives play out.

United States

For mathematicians in the US, the most relevant federal funding agency is the National Science Foundation (NSF). The main driver of federal policy on OA is through the Office of Science and Technology Policy (OSTP). OSTP issued a [memorandum](#) in 2013 setting a goal to make federally funded science, including peer-reviewed publications and digital data, freely accessible to the public. All federal funding agencies with over \$100m in annual research expenditures subsequently developed plans for public access to research results.

The NSF, who is the largest funder of mathematics research, requires that:

"...either the version of record, or the final accepted manuscript in peer-reviewed scholarly journals and papers in juried conference proceedings or transactions (also known as "juried conference papers") be deposited in a public access compliant repository designated by NSF; be available for download, reading and analysis free of charge no later than 12 months after initial publication; possess a minimum set of machine-readable metadata elements in a metadata record to be made available free of charge upon initial publication; be managed to ensure long-term preservation; and be reported in annual and final reports during the period of the award with a persistent identifier that provides links to the full text of the publication as well as other metadata elements..."

The NSF mandates its funded authors to place either an accepted manuscript or version of record in one of two repositories within 12 months of publications. Authors must use either the NSF's own repository ([NSF-PAR](#)), or they may use [CHORUS](#), which offers the added benefit of allowing access to the article directly from the publisher's site. The AMS is a member of CHORUS (in fact, Robert Harington currently serves as an officer). This allows the AMS to be compliant for authors who are subject to funder mandates, such as the one from the NSF. This also simplifies compliance for the author, while also making it easier for readers to access the articles directly from our journal websites.

Europe

Europe is taking a different tack. The most recent and highly publicized funder initiative comes from a group of 16 funders in 13 countries called [cOAlition S](#). This coalition has released a set of principles, called Plan S, for authors funded by any of the cOAlition S funders, which it intends to push forward as a mandate.

It is worth noting that Plan S is being taken seriously, but as of writing this report it is not in force, nor appears to have a path to enforcement. Plan S funded outputs comprise around [7% of global papers published](#). The basics are as follows:

Open Access journals or Open Access platforms	Deposition of scholarly articles in Open Access repositories	Transformative agreements
Authors publish in a Plan S compliant OA journal or on a Plan S compliant OA platform with a CC BY license.	Immediately upon publication, authors deposit the final published version of a scholarly publication (version of record), or an author's accepted manuscript in a Plan S compliant repository. The document is immediately OA (with no embargo) under a CC BY license.	Authors publish OA with a CC BY license in a subscription journal that is covered by a transformative agreement that has a clear and time-specified commitment to a full OA transition.

Compliance with Plan S is quite complicated. Without going into all the detail, the highlights are:

- The journal/platform must be registered in the Directory of Open Access Journals (DOAJ) or in the process of being registered.
- All scholarly content must be openly accessible (journal website or dedicated platform), and free to read and download immediately upon publication, without any kind of technical or other form of obstacles.
- The journal/platform must enable authors to publish under a CC BY license.
- The journal/platform must offer authors/institutions the option of full copyright retention without any restrictions, i.e. no copyright transfer or license to publish that strips the author of essential rights.
- The journal/platform must have a solid system in place for review according to the standards within the relevant discipline, and according to the [standards of the Committee on Publication Ethics](#) (COPE). Details on this must be openly available through the website.
- The journal/platform must provide automatic APC waivers for authors from low-income countries and discounts for authors from middle-income countries.
- The journal must not have a mirror/sister subscription journal with substantial overlap in editorial board to avoid business models charging for both access and publication. Such journals will *de facto* be considered hybrid journals (see 'Transformative Agreements' below).
- Transformative Agreements: cOAlition S acknowledges that some publishers have established mirror journals with one part being subscription based, and the other part being OA. Such journals are not compliant with Plan S unless they are a part of a transformative agreement (an agreement to eventually move a publisher's entire journal portfolio to gold OA) since they *de facto* lead to charging for both access and publishing in the same way as a hybrid journal does. Funding for publishing in such journals will only be supported under a transformative agreement. It is worth noting that AMS OA journals are defined by cOAlition S funders as "Mirror" journals.

Reactions to Plan S

Looking further afield, a number of countries are expressing tacit support for Plan S. China and India, for example, are expressing public support for the European Plan S approach, yet there is little, or no funding available to participate in such arrangements.

A recent proposal called Plan U has been suggested by the founders of [bioRxiv](#), which is the biology equivalent to arXiv. This plan suggests that true OA could be achieved if funders mandated that all their funded researchers deposit their accepted manuscript in the appropriate preprint repository – arXiv, bioRxiv, chemRxiv for example.

Summary and Recommendations

There is enormous complexity in the range of OA models available to researchers, funders, institutions, societies and publishers. Some are optional models and others are mandated.

Through the activities of Robert Harington (Associate Executive Director, Publishing), Karen Saxe (Associate Executive Director, Government Relations) and Catherine Roberts (Executive Director), the AMS will continue to engage in relevant discussions among funders, institutions, publishers, and researchers. Karen Saxe and Robert Harington have visited the Office of Science and Technology Policy to discuss open publishing models in context of the discipline of mathematics. Robert Harington is an officer of CHORUS, sits as board member of the Society for Scholarly Publishing, and is a “Chef” at the widely read publishing blog (6000-8000 daily readers) called [The Scholarly Kitchen](#). Catherine Roberts will present the closing keynote address at the STM Society Day Publishing conference in DC in April 2019. The intent of these myriad efforts is twofold: to inform the mathematical community about important publishing developments, while ensuring the culture of mathematics is well-understood in the publishing world.

The range of OA initiatives that may be forced on society publishers clearly represents risk to AMS’s ability to generate operating income. Many societies are feeling pressured to move into publishing arrangements with larger publishers in order to benefit from the economies of scale, infrastructure, and access to consortia benefits that only larger publishers currently provide. For the AMS publishing program to remain financially healthy and independent, a balance of new and existing publishing models will need to be deployed.

For the AMS, it is worth remembering that relatively few of our authors are directly funded and thus are unlikely to be mandated to comply with Plan S. For many AMS authors, the complexity of the OA publishing landscape leads to confusion as to what approaches are better for them, their library, their favorite journals, and their professional society.

The AMS position on OA is to take a balanced approach to journal publishing. On the one hand, it is worth noting that the majority of mathematical articles appear in an early version, openly available on arXiv. On the other hand, the move towards OA publishing models is something the AMS needs to take seriously. The AMS currently has a number of journals providing freely available options for authors. *Proceedings of the American Mathematical B*, and *Transactions of the American Mathematical Society B* are both gold OA journals (although these mirror journals are seen by Plan S funders erroneously as hybrid journals). *Representation Theory* and *Conformal Geometry and Dynamics* are freely available journals with copyright held by the AMS, or author depending on the circumstance. These are not defined as OA journals as there are no Creative Commons reuse licenses attached to them. The AMS ECBT explicitly decided not to develop its existing journals, nor any new journals as hybrid OA journals. This decision was taken in light of ethical concerns about hybrid journals, as well as a desire to separate the business of publishing entirely from the editorial decision to publish an article.

The AMS needs to take account of the inexorable drive towards openness, be it open research, open source software development, and open access publishing models. In considering how to move forward, we need to take account of the AMS mission, the nature of mathematical research and cultural differences between math and other disciplines, as well as perceptions among mathematicians in the US and beyond. Of primary importance is to develop models that do not place existing publishing revenue streams at risk.

The AMS should explore appropriate OA business models, while maintaining subscription models for a balanced offering that provides options for all authors – funded, or not-funded. Further analysis of a range of OA model scenarios will need to be performed, including gold OA models, Subscribe to Open models, etc. The AMS Committee on Publishing has established a sub-committee to investigate launching a new journal(s) where OA models, including diamond OA, are being considered. Whatever the AMS does, it is clear that the burden should not be placed on individual researchers.

For a brief overview of the AMS position on OA see:
<https://www.ams.org/government/open-access.pdf>