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Demystifying the Academic Research Enterprise

Becoming a Successful Scholar in a Complex and Competitive Environment

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Show Time: Making Your Work Known to Multiple Audiences

Chapter Overview and Learning Objectives

Research and creative activity involve not only the generation of new knowledge but also the dissemination of associated outcomes. Without the latter, the value of the former is greatly diminished, in some cases to the point of irrelevance. This chapter discusses the importance of communicating research outcomes and highlights innovations, such as open access, for improving dissemination. It also provides insight on key strategies for communicating research outcomes with both general and expert audiences. After reading this chapter, you should

- Have a strong appreciation for the importance of communicating research outcomes and impacts to multiple audiences;
- Be able to explain the open access method of publication and the various options within it;
- Understand the broader concept of open science/open scholarship;
- Be aware of repositories for accessing federally funded research and creative activity and know which apply to your work; and
- Understand how to most effectively communicate your work to both expert and general audiences and the resources available to assist you.

11.1 Importance of Communicating Scholarly Outcomes

We generally describe research and creative activity as the generation *and* dissemination of new knowledge. In previous chapters, we discussed the generation component; that is, identifying sources of funding and problems to be studied, writing a grant proposal, collecting data and other information, and applying research methods across multiple disciplines. The other key

component—namely, dissemination—is extremely important as well because research and creative activity obviously are of limited value if the associated outcomes are not made known to others.

Communicating research outcomes is important for several reasons. First, it allows those performing the research, including students, to receive appropriate credit for their contributions and to build national and international reputations as scholars. Second, it ensures that other researchers, as well as practitioners, have access to previous work upon which to build. Third, private companies depend upon the outcomes of basic or discovery research to innovate new products and services. Thus, access to results is critically important to their mission and to maintaining US competitiveness in a global society. Fourth, dissemination of outcomes from publicly funded research ensures that taxpayers remain informed about how their dollars are used and the value of important discoveries being made. Fifth, dissemination, especially to the general public, inspires others—especially students, but also the general public—to become involved in research and creative activity. And last but certainly not least, dissemination enriches our lives directly, especially in the humanities, arts and fine arts, via exhibitions, books, and performances.

11.2 Traditional and Open Access Frameworks

Among the most frequently used forms of communication across all disciplines are journals (sometimes called archive journals), books, and monographs. Other forms exist, of course, including works of art, scripts and scores, performances, lectures, and exhibitions. I focus here principally on journals because they are the most common, and because books and monographs have notably different business models.

Individuals and organizations access journal publications in hard copy or digital form via subscription, purchase or loan. Researchers producing the content typically pay publishers to typeset manuscripts, prepare tables and refine images, and distribute the final versions to libraries and individual subscribers or buyers. However, researchers themselves are not paid for their articles; that is, they receive no royalties from them. Publishers also manage the review process as well as the volunteer scholars who donate time to serve as unpaid reviewers. Both for-profit and nonprofit publishers operate in this space, with the former generally on large margins and the latter often as part of professional societies that use some of the publication revenues to support member education and other professional development programs. This framework, though serving the research enterprise well for decades, suffers from a number of limitations in today's digital era.

First, institutional and even individual subscriptions often are expensive (particularly from for-profit publishers) and thus prevent some scholars, especially in certain disciplines and institutions (e.g., MSIs, ERIs, institutions that are resource-limited), from accessing content. Even books have become extraordinarily expensive, thus contributing to college costs and student debt.

Second, for research funded by the federal government, say NSF or NIH, users of research products end up paying for them twice—once as taxpayers who fund the research agency, and then as individuals or institutions who also pay, via subscription, to access results from the work their colleagues reviewed for free.

Third, removing barriers to access is seen as accelerating the progress of research, as described below with an example from the COVID-19 pandemic. Fourth, removing access barriers also stimulates inter/cross/multidisciplinary research (chapter 13)—for example, by allowing a researcher in biomedical engineering, or her institutional library, to easily access relevant journals in material science, medicine, physics, and mechanics. Finally, in many disciplines, scholars have to assign copyright (chapter 12) of their articles to publishers, both public and private, thus limiting or removing their ability to share freely with colleagues, especially online.

All of these factors have led the scholarly community to begin transitioning to a so-called *open access framework* for publications and data, and you should consult the references (e.g., Willinsky 2006; Royster 2016; Jhangiani et al. 2018; National Academies of Science, Engineering and Medicine 2018; Rabesandratana 2019; Science Europe 2022) to learn more about the history and details of open access, including the European model known as Plan-S. In it, products of research, such as individual articles, journals, monographs, and books, are made freely available online, for use without restriction and at no charge to the user. Costs for such access are assessed in various ways, as described below.

In science and engineering, open access is part of a broader concept known as *open science*. The National Academies of Science, Engineering and Medicine (2018, 18) lay out a vision for open science, which for the purposes of that study define it as follows: “As public access (i.e., no charge for access beyond the cost of an Internet connection) to scholarly articles resulting from research projects, the data that support the results contained in those articles, computer code, algorithms, and other digital products of publicly funded scientific research, so that the products of this research are findable, accessible, interoperable, and reusable (FAIR), with limited exceptions for privacy, proprietary business claims, and national security.” More broadly, the open science concept can include innovative open models of peer/merit review (chapter 7), collaboration (chapter 13), and facility sharing.

Although many for-profit and nonprofit publishers already offer various open access options (see below) in addition to more traditional ones and are moving in the direction of even greater open access, most private foundations that fund research already require full open access to publications and data, either immediately upon formal publication or within a specified period of time following it.

The concept of open access to *publications*, though notionally straightforward, actually is rather complicated in practice and contains a great deal of nuance in principles and practices owing to the array of stakeholders involved and their differing views and priorities (e.g., public and private publishers, funding organizations, academic libraries, college and university administrators and faculty, students, and the general public). Additional complexity arises owing to the considerable variation among disciplines regarding the manner in which scholarly outcomes are communicated, and the broad spectrum of open access now in existence.

A variety of open access publication options exists from which authors can choose. In the *gold open access* paradigm, which often is viewed by researchers as the most desirable model, a publisher, say of an open access journal, provides everyone free access to articles and associated content on the publisher website. For most open access journals, this is a one-step process that mimics traditional subscription journals. Namely, the article proceeds through the review process (chapter 7) and is posted when it is published.

Some gold open access journals offer other options, such as a two-step process in which the publisher first posts the final accepted manuscript on a so-called preprint or early release server. In the second step, the formally typeset version—which sometimes can take months to produce—is posted. This strategy dramatically reduces waiting time for access to content yet results in the creation of a formal archive version. Under gold access, authors are free to share (known as reuse) their manuscript and final typeset version without restriction via various types of open access licenses. Example licenses can be found on the Creative Commons website (<https://creativecommons.org/about/cclicenses>).

Obviously, someone has to pay for gold open access articles given they are shared free of charge. These costs are born by the author, their institution, or sometimes the organization funding the research and are known as article processing charges (APCs). In contrast to traditional publishing, in which the user pays for access via subscription (user-pull model), APCs shift the entirety of the payment responsibility to the author, or to the author's institution or grant funding source (user-push model). In reality, for many disciplines including my own (meteorology), authors have always had to pay charges for articles to

be typeset, tables to be constructed, and images or photos to be rendered. Consequently, APCs are not a fundamentally new or disruptive concept. Indeed, many federal funding agencies allow “page charges” to be included in proposal budgets (see chapter 6), though now the shift is toward APCs.

The next type of open access is *green*. In contrast to gold open access, in which the journal itself is known as an open access journal, green open access applies to any type of publication. In it, authors are given permission by a publisher to post or distribute near-final or accepted versions of their articles on their own or institutional websites, or place them in central repositories such as those operated by federal agencies (e.g., PubMedCentral [<http://www.ncbi.nlm.nih.gov/pmc>] in the case of the National Library of Medicine). This is known as self-archiving. The journal also posts the final typeset article on its website, though it is usually available only via subscription. A major advantage of this model is that authors do not pay APCs, though charges sometimes are levied.

In the *hybrid open access model*, publishers offer both open and restricted access options to authors depending upon their willingness or ability to pay APCs, or their strategy in utilizing the article.

Other models exist, such as *bronze*, *black and diamond*. The *diamond model* (sometimes also referred to as platinum), which is relatively new, is similar to the gold model with the exception that no fees are assessed to the author, their grants, or their institution. Consequently, neither reader nor author pays anything and access is immediate upon publication. Of course, costs still need to be paid, and thus diamond journals generate revenue from other sources, such as grants from federal government funding agencies, philanthropy, advertising, professional societies, and even academic institutions or consortia.

In some disciplines, preprint servers are used to post submitted articles which have not yet been peer reviewed (e.g., medRxiv). This practice is well known and sometimes valuable, but it became problematic during the COVID-19 pandemic as some articles, on the virus or associated disease, that appeared on centralized preprint servers ultimately were rejected for publication—though only after their results were discussed in the press, sometimes with fanfare, leading to belief of validity and causing understandable and unnecessary confusion for the general public.

Open access to *data* is vastly more complicated in light of the many steps through which data often pass (chapter 5). This leads to several questions. Does one keep only the raw data, the quality-controlled data, or data from various steps in between? Additional complexity arises owing to the wide array of formats in which data reside, storage and access frameworks, security, and policies for protecting privacy and propriety. And of course, what

responsibility falls to the researcher to assist those who wish to use the data but are having difficulty doing so?

Despite these and numerous other challenges, the community has developed a simple but profoundly important set of principles governing open data. Comprising the acronym FAIR (<https://www.go-fair.org/fair-principles/>), they consist of *findability* (data must be easily locatable by humans or machines), *accessibility* (ease of access including processes for dealing with sensitive or protected data), *interoperability* (defined in a broad sense to include ease of use with other data sets, different computers and archival systems, and other data formats), and *reuse* (as the word implies, easily recreated for a wide array of purposes, particularly with regard to reproducibility and replicability, discussed in section 4.7) of digital assets. These principles have helped guide the deployment of resources that are of great value to research and creative activity, as described in the next section.

11.3 Publicly Accessible Publications and Data

As noted in chapter 10, the White House in 2013 announced a new policy (Office of Science and Technology Policy 2013) that requires publications resulting from most federally funded research to be made available free of charge, in a publicly accessible online repository, within a specified period of time, usually a year following publication. The same is true of all data used in a given publication. The rationale is that research funded by the federal government (i.e., taxpayers) is a public good and should be made freely available to everyone, without restriction, after an appropriate interval that allows publishers to recoup their costs and authors to file patents and other protections (chapter 12). Although most federal agencies have implemented this policy for publications with some work remaining, they have been notably slow in addressing open access to data, for the reasons mentioned above.

In late summer of 2022, the White House issued guidance (Office of Science and Technology Policy 2022) requiring federal R&D agencies to update their public access policies. Efforts toward this rather landmark change were actually begun several years ago and were underway when I became director of OSTP. With the new policy, the White House is requiring that “all peer-reviewed scholarly publications, authored or co-authored by individuals or institutions resulting from federally funded research, [be] made freely available and publicly accessible by default in agency-designated repositories without any embargo or delay after publication.” The new agency plans are to be completed by the end of calendar year 2024 and be fully implemented within a year. Scientific data underlying the publications likewise are to be made freely

available. This extraordinary public access policy will dramatically improve access to scholarly publications in STEM fields and have a particularly positive impact on institutions which are financially constrained.

An excellent example demonstrating the value of public access to publications and their associated data can be found in actions taken at the start of the COVID-19 pandemic. At that time, I was serving as director of OSTP and convened a group of science ministers and senior science advisors from some 17 nations around the world. The purpose was to share, in an informal manner, information about scientific questions, challenges, and potential solutions for addressing the pandemic. For example, we discussed progress in testing protocols for disease detection, strategies for accelerating funding for research, and joint research projects and clinical trials. Other participants included representatives from relevant government agencies in each country, including the US Department of State. Although the group was informal, it did make one formal request of the global research enterprise: that both public and private publishers of articles relevant to the pandemic remove all distribution restrictions and make both articles and the underlying data freely available to all, immediately upon publication, in machine readable format for a finite but unspecified period of time. The latter point, known more generally as digital reuse, is an important benefit of open access, as illustrated in the example below.

Many publishers did so, and a parallel effort was undertaken in the US—the COVID-19 Open Research Dataset (CORD-19; <http://allenai.org/data/cord-19>)—to assemble the publications in repositories and make available to users globally, again free of charge, artificial intelligence and machine learning tools for analyzing digitally the thousands of publications being produced every month. Such analysis was critical owing to the fact that the traditional method of reading articles would have been far too slow and thus would have greatly inhibited progress. Both the publisher response to the international call, and the creation of CORD-19, are viewed as having greatly accelerated research progress and thus are a testament to the value of open and public access. A variety of information regarding open access articles, data, and their impacts is available at <http://sparcopen.org/why-open-matters>.

In the case of private companies funding research, rather than the federal government, the situation is somewhat different. Research performed at academic institutions, but funded by private corporations, typically is published or otherwise disseminated openly as well, though sometimes with delays of sixty to ninety days to allow for patent filings or other protection of the results (chapter 12). Such protection is of course very important if a company wishes to commercialize research outcomes. In some situations, proprietary data may

be withheld from a publication if doing so does not materially impact presentation of the findings. Most academic institutions will not accept private sector funding for research if publication is prohibited entirely, or if the embargo period for intellectual property protection extends beyond ninety days, because doing so can delay student graduation and also runs counter to the philosophy of open sharing of knowledge that is foundational to the academic research enterprise.

On the more extreme end of the scale is classified research. Although the majority of US academic institutions do not perform classified or otherwise highly restricted research, some do—including research involving export-controlled activities (chapter 10). It often is the case that such research results can be published in standard ways, though only if the classified or otherwise restricted elements are withheld.

A wide array of publicly accessible, online repositories exists—in virtually every academic discipline—for both accessing and contributing to large-scale data sets. The US Federal Data Strategy (<http://strategy.data.gov>) created a federal open data framework (<http://data.gov>) that contains “data, tools, and resources to conduct research, develop web and mobile applications, design visualizations, and more.” Specific examples of open data repositories include, in the life sciences, GenBank (<http://ncbi.nlm.nih.gov/genbank>), operated by the National Library of Medicine. GenBank is an online annotated collection of DNA sequences that can be applied to a huge array of research problems. In biology, the Global Plants database (<http://plants.jstor.org>) is a collection of nearly three million plant specimens. NOAA’s National Centers for Environmental Information (<http://ncei.noaa.gov>) is one of the world’s largest archives of atmospheric, coastal, geophysical, and oceanic research. And the Inventories of American Painting and Sculpture (<http://americanart.si.edu/research/inventories>) document more than 400,000 artworks in public and private collections worldwide. Countless other databases exist, several of which are operated by nonprofit organizations and focus on very specific topics (e.g., the Egyptian pyramids).

11.4 Communicating with Expert Audiences

Although the importance of disseminating outcomes from research and creative activity is fairly obvious, less clear is the issue of *when* such results are actually ready to be communicated. Virtually every researcher will tell you that identifying the completion point of a project is difficult. Additional questions always remain to be answered. Additional experiments always can be run. Tweaks and improvements always are possible. Yet, at some point in the

research process, one must declare an outcome ready for publication, performance, exhibition, or other means of dissemination.

Moving too quickly toward dissemination, without sufficient evidence for a given result or enough time spent developing the work, can be embarrassing, damaging to one's career, and deleterious to the scholarly enterprise. Such issues typically are identified and addressed during the peer review process (chapter 7). Also, sharing results in a public forum, formally or informally, can sometimes lead archive publications to decline the submission of a manuscript, or the United States Patent and Trademark Office (USPTO; <http://uspto.gov>) from issuing a patent (chapter 12). Consequently, one must be extremely careful in assessing *when* the time is right to share research results and also ensure that the results are of the highest quality, are produced with integrity, and represent the work of those involved.

Assuming your research results are in fact ready to be communicated, it is clear we, as a society, have available to us more options for communicating with one another—instantaneously and on a global scale—than ever before in human history. From social media to digital archives to real time streaming video, we are able not only to personally send information to vast numbers of people, but also receive feedback from them and even dialogue with numerous individuals simultaneously. It is within this massive and rapidly evolving ecosystem of communication mechanisms that dissemination of outcomes from scholarly research and creative activity takes place. Yet, in addition to the mechanism or mechanisms used, the communication must consider the audience, the goals of the communication, and ways in which the information being communicated likely will be used. Let us consider these elements separately.

As a researcher, your primary concern usually involves communicating outcomes of your work to peers, that is, to other scholars in your field of expertise, including students. The principal goal is to inform them of your work so they can use or build upon it, and also to identify yourself as having contributed to the existing body of knowledge. Such communication usually takes the form of refereed or archive journal publications, monographs, books, and juried performances or exhibits. The process by which scholarly research is evaluated for publication, presentation or exhibition varies across disciplines, but in general follows the peer/merit review model for grant proposals described in chapter 7. A great deal of communication also occurs at professional conferences, which involve both oral and written forms of dissemination as well as informal conversations.

The content being communicated in all of these examples tends to be deeply intellectual, utilizing terminology, diagrams, and other forms of expression

that, for the most part, are understood by experts. Such audiences are found at academic institutions, private corporations, private foundations, conservatories, and at federal government agencies and laboratories. These experts learn of new research results by perusing journals, receiving automated notifications from publishers, and scanning social media posts. Additionally, most organizations, including those which both fund and perform research, issue formal press releases about new research projects and outcomes, and these releases lead to articles in print, online posts, and televised media.

Note that some of today's most challenging and interesting research problems reside not within a given discipline, but at the boundaries of multiple disciplines (chapter 13). A good example is biomedical engineering, which encompasses biology, engineering, medicine, physics, mathematics, and chemistry. This raises the question of how an expert in biology, for example, most effectively communicates her research results to an engineer. This is not an easy task, and not until engineers and biologists have worked together for a while can a biologist pick up a journal of engineering and understand how a particular set of results relate to biology.

The solution, apart from journals that publish research performed at the boundaries of disciplines, such as biomedical engineering, is for researchers to learn how to communicate their discipline-specific research results in ways researchers from other disciplines can discover, view as being relevant, and also understand. You can learn more about methods for doing so in the exercises associated with this chapter. We discuss the issue of team and collaborative research in chapter 13.

11.5 Communicating with General Audiences

The communication of research outcomes to experts in one's field, and even to scholars in other fields, has been occurring for centuries and is a relatively straightforward activity. By analogy, if you love football, talking to a friend who also loves football and is informed about the game is both easy and fun. However, talking about football, and the excitement you have for it, with someone who has little or no knowledge of the game and perhaps limited interest in it, is an entirely different matter, especially if your goal is to help them *become* interested and appreciate it the way you do! The same is true for communicating research outcomes to another very important audience—nonexperts. This includes but is not limited to the general public, special organizations such as think tanks and topical special interest groups, formal or traditional media outlets, popular media, lawmakers and policymakers, political lobbyists, students, informal educators, and K–12 teachers.

Perhaps not surprisingly, this is an area where researchers often fall short because our world consists mostly of working with other experts—a world filled with jargon, methods, and resources that are mysterious and unfamiliar to those on the outside. Yet, the nonexpert audience is one of the most critical because, as described in chapter 3, the social compact for much of the research and creative activity performed exists between experts and the nonexpert taxpayer. Also, many researchers fall into the trap of using the “deficit model” of communication. In it, one sees general audiences as simply uninformed about a particular research outcome. Thus, all a researcher needs to do is explain the outcome and voilà—problem solved! Of course, life is not that simple!

Consequently, the first and most important rule in communicating with a nonexpert audience is to actually know that audience. Note that I said and have been saying “*with* your audience” and not “*to* your audience” because communication to nonexpert audiences should be a dialogue, not a monologue. In fact, I cannot tell you how many times I have seen an excellent researcher stand before a general audience and give their latest highly technical conference presentation with virtually no interaction whatsoever or recognition that they lost the audience after the first sentence. The result was a lot of blank stares and disappointed people, and the situation clearly demonstrated that the researcher did not take time to think about the audience and how to best convey scholarly information to them.

In that context, one should *never* view communicating with a general audience as needing to “dumb down the results.” I have had Nobel laureates ask me questions about my field of weather that were surprisingly simplistic—to me because I am an expert, but not to them because they are not. Please do not ever “look down upon” those to whom you are presenting if they are nonexperts. Remember, everyone is an expert in something!

With that preface, I strongly encourage you to actively seek opportunities to present your scholarship to nonexpert audiences. Give presentations or performances to the local Kiwanis and Rotary Clubs, the local Chamber of Commerce and Business Roundtable, or other civic and service organizations. Give presentations or performances at nursing homes, churches, and social clubs. Sign up with a local speaker bureau that helps organizations to identify speakers. You will find that numerous general audience venues exist, and that gratitude and personal fulfilment are high when you take time to engage with them.

Once you know your audience, think about how you can best interest them in your work by finding points of intersection between your research and their interests or lives. For example, a Chamber of Commerce might be interested to know how your work might help grow the local economy, while a civic fine

arts organization might be interested to know how your sculpture is being interpreted by various audiences. When engaging with such general audiences, be sure to avoid using discipline-specific jargon or other expressions with which they are likely to be unfamiliar. This is easier said than done, and developing this skill takes practice.

In the exercises provided with this chapter, you will find the Alan Alda Center for Communicating Science at Stony Brook University. As an actor, Alda shows researchers how to use improvisation, and other acting-based approaches, to help general audiences understand complex topics. Another excellent resource is the Technology, Entertainment and Design (TED; <http://www.ted.com>) series of presentations, available on the web. TED presenters are extraordinary and provide some of the best examples of communication with general audiences.

Also, when communicating with a general audience, have specific goals in mind. What points are you trying to get across and what do you want them to remember? You should never make more than three key points. If at all possible, use narratives, give common examples, employ analogies and metaphors, and tell stories that make your topic relatable. Engaging the audience directly is another excellent strategy. Surprise them by asking them a question right at the start and letting several people contribute answers. Make them a character in your story, even if that character is a planet, a molecule, or an animal. Have fun and make jokes, though being careful to avoid doing so in an offensive manner. Quite honestly, many presentations are dry and methodical. Switch things up by injecting humor and telling stories about yourself and the silly mistakes you made on the journey to the results you are presenting. Your audience will love you for that and remember much more of what you say in the process!

Of course, as you are well aware, we live in a world in which certain topics have become lightning rods for violent disagreement, protest, and even murder. Gun control. Abortion. Evolution. Immigration. Climate change. Sexuality. Please think carefully about the following.

The *scholarly study* of these or *any* other topics is extremely important and valuable. Discussion of research outcomes—which hardly ever are the final word on any given topic—*discussion* in a civil and respectful manner—is the hallmark of the research enterprise. We as a society cannot advance if we forget how to communicate or are unwilling to do so in a civil, respectful manner. Spirited debate and disagreement are foundational to research and creative activity, and they can and must occur without *ad hominem* attacks. It is up to you and me—as participants in the research enterprise—to reinforce these notions at every turn. Diversity, equity, and inclusion are extremely important,

as discussed throughout this book, and it is our high task to ensure they are authentic. That is, they must not place arbitrary limits on the topic to be discussed, the politics of those involved, or competing theories being addressed.

One final but very important point about communicating on notably divisive topics with general audiences, particularly involving one individual or a small group. If you know up front that the audience or individual disagrees with your position or results, you should not go into the conversation or presentation with the goal of converting them. Studies have shown that even researchers with the best of intentions, and employing the gentlest of approaches, tend to widen the gap of disagreement with their audience if they have even an implicit goal of showing why the audience is wrong. Few people enjoy being shown or told they are wrong, especially if moral or religious issues are at play.

Instead, you, as a researcher, should begin not by speaking, but rather by listening. Also, develop your presentation in a way that respects the views of others, even if you disagree with them, and use the opportunity to begin a conversation. Learning is a road that goes both ways, and building trust with those who disagree with you takes time and patience—and it rarely can be done via social media. So, do not use social media for meaningful debate about scholarly research. At the end of day, you have an obligation to serve as a role model by listening carefully and presenting your results in a manner that respects and considers the views, emotions, and values of others. In doing so you will not compromise your scholarship, but rather offer it in ways that others can understand and appreciate. And indeed, you may well learn to interpret your findings in new and interesting ways that lead you to become both a better scholar and communicator.

11.6 Special Circumstances and Other Helpful Hints

Although it is impossible to cover every possible situation in which communication of research results occurs or is important, I describe here a few of the more common and important ones.

First, when speaking with the press, be very careful and precise with your words. Things you say “off the cuff” and informally can still be “on the record” and thus may find their way into an article. Be careful. Also, realize journalists often are looking to highlight controversial or divisive issues or write an article with a particular edge that attracts readers and garners clicks. Ask to see the article before it is published to ensure accuracy of contents, especially direct quotes. Usually you will be denied, but ask anyway.

Second, learn the so-called elevator speech. In other words, be able to describe the essence of your findings, and their relevance, in plain language

in the time it takes to ride an elevator between a few floors, say while speaking with a member of Congress. This practice is being taught in academia via the “three-minute thesis.”

Third, if your results are to be communicated via publication in an archive journal, or by a particular press, learn which journals and presses are most appropriate for your topic, most prestigious, or have the widest reach and respect. Measures now exist, imperfect though they are, for assisting you with this task. They include journal impact factors as well as more qualitative, historical measures of prestige and accessibility, especially in the latter for traditionally underrepresented populations.

Fourth, you can track the extent to which your work is being used or formally cited by others using a variety of online tools. Such citation indexes (e.g., the h-index; Hirsch 2005) and other measures, though again imperfect but improving constantly, help assess the impact of your scholarly contributions in specific ways. Similar measures exist for patents, licensed inventions, and other products.

Fifth, if making an oral presentation involving visuals to expert or general audiences alike, make certain the images are relatively simple and can be seen clearly in the back of the room when projected. Clearly define terms that may be unclear, keep text to a minimum, and focus on making a maximum of three points. Additionally, be very careful to give attribution to figures and text that have been taken from previous work, whether formally published or not. A good rule of thumb is that a figure should be understandable on its own, without any explanation or accompanying text.

Sixth and finally, if giving a presentation, performance or exhibit, be certain all audio and lighting are properly configured. Testing of these and other elements is common practice and usually done quite well. However, as the scholar, you have the final responsibility of making certain everything is as it should be so that your work shines as brightly as it can. Nothing is as frustrating as losing time, especially if it is limited, owing to technical difficulties.

Assess Your Comprehension

1. List several reasons demonstrating the importance of effectively communicating research outcomes.
2. Define open access in the context of research and creative activity. Compare and contrast it with public access.
3. List and describe several limitations of traditional publishing and ways in which open access seeks to address them.

4. Describe, and compare and contrast, various models of open access publishing (e.g., gold, green, hybrid).
5. Describe challenges associated with open access to data.
6. Describe the four principles associated with FAIR access to data: findable, accessible, interoperable, and reusable.
7. What is the current federal policy, developed by the White House Office of Science and Technology Policy (OSTP), for open access to publications and data?
8. In what ways is research, funded by private companies, handled differently, with regard to publication of results in comparison to that funded by the federal government?
9. What factors should you consider in determining whether your research results are ready for presentation?
10. What issues should you consider when communicating your research results to peers?
11. What issues should you consider, and what things should you avoid, when communicating your research results to general, nonexpert audiences?
12. List opportunities to communicate research results to nonexpert audiences.
13. How can you, as a researcher, most effectively communicate your research results if they pertain to topics that are politically or socially sensitive?
14. List important things to remember when communicating with the press.
15. Why is a brief (e.g., three-minute) summary of your research, for a general audience, valuable, and when might you use it?
16. What tools exist for you to judge the quality of professional journals and the impact of your research on your or other fields of scholarship?

Exercises to Deepen Your Understanding

Exercise 1: Suppose a member of Congress representing your district will be casting his or her vote on a new bill regarding a controversial issue or topic about which you are passionate. Currently, this member is undecided as to which way he or she will vote. You have been given an opportunity to deliver a three-minute presentation to this member, the day before the vote, to share your thoughts about the topic. For this exercise, write a script for a three-minute presentation you believe would best convince your member to seriously consider your point of view.

Exercise 2: The concept of open access publications generally is accepted as valuable for accelerating progress in research, particularly because it empowers individuals and organizations that historically have been unable to access the literature. However, differing viewpoints exist on a variety of key issues depending upon one's role in the scholarly research enterprise (e.g., researcher, student, head of an academic library, university provost, university vice president/vice chancellor for research, large for-profit publisher, large nonprofit publisher, professional society publisher, and the general public). For this exercise, use the literature and other information available to compare and contrast the positions on open access of several of the aforementioned groups. What federal government policies would you recommend to accelerate open access, and what implications would they have on the groups you selected?

Exercise 3: Communicating effectively with a nonexpert on a complicated topic is a challenge, though one that increasingly is important to the research enterprise. Select a topic that most interests you, perhaps from an earlier exercise (for example, the one for which you have performed a literature review), and prepare a two- or three-minute video overview of the topic using your smartphone. Use graphics as you see fit and invite someone to operate the camera for you. Now, watch the videos linked at <https://vimeo.com/253144273> from the Alan Alda Center for Communicating Science (<http://aldacenter.org>). Note how the removal of jargon greatly improves the ability of people to understand your work! Re-record your video presentation after following instructions in the Alda Center videos and compare it with your original version. Which do you feel is more effective, and why? Although the Alda Center videos speak to issues in science, the concepts are applicable to all disciplines.

Exercise 4: A wide variety of venues exist in which to communicate the outcomes and impacts of research and creative activity. They include but are not limited to church and civic organizations, nursing homes, college dorms, coffee shops, bars, and private companies. Given the sorts of topics in research and creative activity that most interest you, which venues would you select for communicating your work to nonexpert audiences, and why? Would you use different approaches based upon the organization or venue? How might you use social media to achieve the same goals, and what specific approaches do you believe would be most appropriate for different social media venues (e.g., Facebook, Twitter, Instagram, LinkedIn, etc.)?

Exercise 5: As described in this chapter, preprint servers increasingly are being utilized to publicly post scholarly articles prior to their formal review or

prior to a decision regarding such review. This strategy brings benefits to the research enterprise but also has shortcomings. Investigate the use of preprint servers by multiple publishing outlets, both traditional and open access, and explore how such servers have impacted research and public opinion regarding the COVID-19 pandemic. Note in particular preprint server papers on the topics of COVID-19 and SARS-CoV-2 that have been discussed in the press, only to be withdrawn or discredited. What consequences resulted from such situations, and what recommendations would you offer to improve the use of preprint servers?

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