We are all apprentices of a craft where no one ever becomes a master.

—Ernest Hemingway

Press on. Nothing in the world can take the place of persistence. Talent will not; nothing is more common than unsuccessful men (women) with talent. Genius will not; unrewarded genius is almost a proverb. Education alone will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent.

—Ray A. Kroc, Founder of McDonald's

DEFINITION AND NEED

The activities of scientists in the search for new knowledge are focused into a sequence of events we call the scientific method. Dissemination of the information discovered by the scientist is the last step in the scientific method, and publication of the information in written form is one of several vehicles for dissemination. This dissemination of these new discoveries in the form of writing may take place in one of several venues, including books, refereed periodicals, or nonrefereed publications (e.g., trade magazines or popular publications). The process of publication, especially publication of the information in a refereed journal, consists of many activities that must be completed sequentially in a clear and concise manner.

This book focuses on the steps in the process of preparing a manuscript for subsequent submission to a refereed journal in the life sciences. The dissemination of newly discovered information is critical to the advancement of science, and practicing scientists have a duty to complete the scientific method by publishing their information. However, for a variety of reasons, practicing scientists often do not complete this final step in the process efficiently. Science suffers because scientists "reinvent the wheel" when the information they need is locked in the mind or a filing cabinet of someone who has not published important information.

As a practicing scientist, you might start the task of publishing by asking yourself some simple questions. What is it that you enjoy most about being a scientist? How well do you like to communicate your results to other scientists? How well do you like to write? If you are like most of the scientists we have encountered, writing is not what you enjoy most about being a scientist, and the chances are good that you are not particularly eager to write.
Often, writing is not on the top-ten list of things that need to be done today, because it is human nature to avoid what we do not enjoy.

For many scientists, the thrilling aspects of science involve developing a hypothesis, conducting experiments, and collaborating with others who can offer new perspectives on and skills for solving the problem at hand. Writing about the research results is well down the list of motivators for many scientists. Yet, writing about our work is essential. And it can be rewarding, perhaps even fun. If you are a practicing scientist not already drawn to the act of writing, then we advise you to learn about writing and to learn to like it. Although you may find this difficult to imagine, your professional career and advancement will depend almost entirely upon your ability to communicate with other scientists. The better you communicate orally and by written word, the more rewarding will be your career as a scientist. Few activities bring more rewards to the career of a scientist than the act of publishing scholarly work.

The essential unit of publishing for a scientist is the refereed journal article, and all work done by a scientist, even the most preliminary experiments, should be conducted with a mindset that a refereed journal article ultimately will be the result of that work. Our overarching goal in this book is to help you develop the techniques and skills that make publishing in refereed journals as pleasant as possible. Let us begin with some basics regarding the contemporary meaning of publishing in refereed journals.

THE EVOLVING DEFINITION OF PUBLISHING

Decades ago, most scientists did not face the pressure to publish as frequently as they do today. A scientist may have worked for several years to examine an intellectual issue from numerous angles and, eventually, a publication might result, but sometimes there was none. The articles that were published, however, tended to be long and very thorough. The term "monograph" was sometimes used to describe such an article, with the implication that just one (mono) article contained all the known information about the topic.

Today, most scientists in the academic arena are under quite substantial pressure to publish at a greater rate. Consequently, contemporary journal articles are often shorter and more restricted in their focus, and, in most cases, the article is focused on just one or a few objectives. The quality of the content of the article remains critical, but the ability of a scientist to produce several shorter articles of high quality rather than one longer diatribe is a critical skill that can make or break a research career. Central to the development of this skill is an awareness of the so-called least publishable unit (LPU). The LPU has been described as the minimum amount of information (data) sufficient for a manuscript to be accepted for publication in a reputable, refereed journal (Broad, 1981).

An LPU must support at least one conclusion that your community of scientists (peers) will consider, and this conclusion should have the following features.

1. It should be original (the conclusion has never been drawn before).
2. It should be important (the conclusion is likely to have some kind of impact).
3. It should be based on research conducted by using accepted norms of the discipline (Broad, 1981).

Another evolving aspect of publishing is the ever-increasing array of venues in which you may choose to submit your manuscript. New journals are being developed and brought to publication at a greater rate than historical journals are being discontinued, and this leads
WHY PUBLISH?

Before we address this question of why publish, it is important that each of us critically analyzes ourselves to determine our motivation for publishing. There are several very good reasons why you should publish your work, and Peak et al. (2002) have a good discourse on this subject. We summarize their information here.

1. First and foremost, if you have new information, you have an irrevocable duty as a scientist to disseminate that information to other scientists.

2. Publication of research results permits scientists to study those results and use them to advance science, scientific thought processes, and, ultimately, benefit society via practical utilization of these new discoveries.

3. As an extension of no. 2, with help from our current information retrieval systems, it helps your information get out to a broader audience. This is extremely important, as all disciplines learn from high quality science conducted by people in different disciplines. For instance, many things we know today in plant science have their foundation in animal or medical sciences, and vice versa.

4. Most research today is made possible by funding from many possible entities. These may be large government programs, such as the National Science Foundation, the National Institutes of Health, and so on, state and local sources, and private foundations. It is imperative that you publish the results evolving from the funds the granting agency has invested in your research program.

5. As an extension of no. 4, publications in refereed scientific journals will increase your probability of obtaining continued funding for the same project, or funding to conduct other, related research projects. Success breeds success.

6. Publishing your results can lead to rewards such as promotions and recognitions by professional groups. Publications will strengthen your track record for these promotions and recognitions, and they will add credibility to your dossier. Conversely, not publishing your results can damage an otherwise promising career. Most academic units require a minimum of eight to fifteen publications in refereed scientific journals for promotion (and possible tenure) from one rank to the next highest rank.
Likewise, publications add a strong measure of credibility to the entire research team. A publication, or publications, in a refereed scientific journal is the benchmark by which almost all people measure success in research.

7. In virtually every research organization, except perhaps some industries, publication of research results in refereed scientific journals is the accountability factor used most for decisions affecting the life of that unit.

IN THE END, IT IS REALLY FOR THE SAKE OF SCIENCE

Why is publication so valued? At the simplest level, publications in refereed journals are the vehicles by which science advances, that is, the engine that carries science from one level to the next higher level. Refereed journals represent a repository where, ideally, only new, important, and verifiable data are reported and placed in context. As we will consider later, the referees, your peers, are critical, in fact so critical that the peer review process may frustrate you mightily from time to time. These peers determine the originality, importance, and soundness of your manuscript, and they attempt to "weed out" unoriginal, unimportant, or inadequate work by releasing the manuscript. This release may come in one of two forms. Peer reviewers may release the manuscript but recommend revision and resubmission. On the other hand, one or more of the reviewers may release the manuscript without a recommendation for revision and resubmission. Conversely, the acceptance of your manuscript by peer referees, either as is, or more commonly, with revisions, signifies that your work merits entering the permanent collection of scholarly information on the topic. That collection is available to all other scientists who can use it to shape future research questions and the conduct of future research investigations. Your accepted manuscript thus makes a permanent mark on science and advances our collective state of knowledge. It is a necessary part of science, and also a significant achievement for you, professionally.

We hope it is obvious that you have a responsibility to publish all your work that, at a minimum, meets the requirements of the LPU. Publication is essential to science because it is the engine that moves science forward; however, scientists still, sometimes, do not write (Boice and Jones, 1984). It is also essential to you, because it moves you forward professionally. In most instances, only those academic scientists and noncommercial research scientists who demonstrate the ability to publish their data regularly will have stable careers marked by achieving tenure, being promoted, and enjoying a favorable reputation. Publishing skills are critical lessons to learn as early as possible, because those lessons will carry you as far as you can go professionally.

WHY YOU SHOULD BE A GOOD WRITER

High-school students who write well are competitive when seeking entrance to colleges that are highly ranked. Undergraduate students with strong communication skills are recruited actively to become graduate students. A graduate student who has articles accepted during her or his Master of Science degree program will be actively recruited to continue their education and pursue a PhD. PhD graduates with multiple refereed publications are also particularly successful when they search for a postdoctoral, nonacademic professional, or tenure-track faculty position. In addition, a faculty member at a junior academic rank must
document their scholarship by publishing in refereed journals, or they will not move to higher ranks (Long et al., 1993).

We can also talk about this concept on a more practical level. Here are some important reasons why you should be a good writer.

1. Manuscripts that are written well are easy to read, and the reader finds them interesting to read and visually pleasing (Peat et al., 2002).

2. Manuscripts that are well written will move through the review process much more quickly. This will lead to it being more likely that the manuscript, which contains a record of all your hard work, will result in a publication (Peat et al., 2002). Reviewers and associate editors are busy people. They do not have time to correct your English and grammar. If your manuscript is written poorly, there is a chance it will not even be sent out for review until you revise it and resubmit it. This process of returning your manuscript, revision, and then re-submission will take several weeks, and that process does not even start until you have recovered from the painful exposure that your writing habits and use of English and grammar are not what they should be. The sooner you can correct these bad habits, the better.

3. If your manuscripts are written well, your peers will take you more seriously (Peat et al., 2002). The last thing a reviewer wants is to receive a poorly written manuscript (maybe from a friend) that is so poorly written they have to reject it on the basis of poor English and grammar before they get to the level of judging the science contained in the article.

4. Continued publication on a topic can also lead to continued funding via successful grant applications (Peat et al., 2002). As you publish more, it becomes apparent that you are becoming an expert (maybe the expert) in a given field or discipline. The more you are known for conducting good science and getting it published, the greater is the probability that you will receive continued funding. In addition, good writing skills developed while writing refereed publications will carry over to greater skills in writing grant applications.

5. As you become an expert in a field or discipline, your professional peers will call on you more often to be a reviewer of manuscripts in your area of study. Continued good work by you may lead to you becoming an associate editor, consulting editor, or editorial board member in your discipline. This is the icing on the cake, which will allow you to sharpen your skills even further, and this will advance your career rapidly.

6. The more you review journal manuscripts, the better a writer you will become. During the process of review of submitted manuscripts, you will learn things that you can do to make your writing better on several fronts. However, and maybe even more importantly, you will learn things not to do when writing.

7. As you learn to write better, the time required to write and complete a manuscript and submit it for publication will reduce (Peat et al., 2002). This will allow you to become more efficient in your writing. This also will lead to fewer frustrating encounters with the keyboard of your computer as you try to get a manuscript completed and submitted.

8. It is not necessary for you to be verbose to get your point(s) across to the reader. The journal article by Watson and Crick (1953) that explained (i) that DNA existed as a double helix and (ii) how genetic replication could occur was slightly more than one printed page. And we all know they were awarded a Nobel Prize for their efforts.
QUICK STARTERS AND CAREER DEVELOPMENT

The quicker a person starts writing and publishing, the faster their professional career develops, and the faster her or his number of publications accumulates (Boice, 1991). In essence, the number of publications the quick starter has over their professional career becomes a "snowball rolling down a hill." In this case, the gap between a slow starter and a quick starter continuously becomes greater throughout each scientist’s professional career. This is shown in our idealized representation in Figure 1.1, and it leads to a greater number of doors being opened professionally. The figure depicts the publication record over time of a theoretical fast starter and a slow starter. The slow starter begins a career after graduate school with no publications, whereas the fast starter has published two papers as a graduate student. Note how the difference between the two scientists becomes more pronounced over time.

Evidence supporting the importance of publication(s) in academic careers abounds (Blackburn et al., 1978; Boice, 1991, 1992), and quick starters develop accomplished careers that bring professional rewards that slower starters never attain. Books are available to help young professionals having trouble preparing manuscripts evolving from their scholarly work, and all levels of writers can benefit from this information (Boice, 1990, 1996).

SOME WORDS OF WISDOM

We close this chapter with some advice regarding the entire publication process.

1. Conceptualize every research activity you do in terms of the refereed journal article that could result from it.
2. Design every experiment you conduct, even preliminary or peripheral work, in a statistically appropriate manner so that publishing the work might be possible.
3. Never consider an experiment complete until it is published, whether it was or was not a preliminary or peripheral experiment.
4. If the work you are describing is good, and in your mind it should be published, then never accept release or rejection of a manuscript as the final outcome.
5. Do not take negative reviews personally and do not allow them to destroy your confidence and ability to function as a scientist, and for that matter, a writer. Remain positive about your writing ability, persevere to the end, learn from your mistakes, seek the help of good writers, and continuously hone your skills.

6. Learn how to write manuscripts for refereed journals, and then follow through until they are published. The quick starter attains a career level that slower starters do not achieve, and the rewards you will receive will be well worth the time and energy you will need to spend to become a quick starter.

REFERENCES


