Essentials of Scientific Writing

Book · January 2014

CITATIONS
3

READS
20,076

1 author:

Abebe Kirub
Freelance Consuitalt in Science Communications
22 PUBLICATIONS **15** CITATIONS

SEE PROFILE

ABEBE KIRUB አበበ ቅሩብ

Essentials of Scientific Writing

Essentials of Scientific Writing

Abebe Kirub አበበ ቅሩብ

"If the reader is to grasp what the writer means, the writer must understand what the reader needs"

George D. Gopen and Judith A. Swan

ISBN: 978-99944-53-98-6 This publication of this book is financed by Farmer's Research Group II (FRGII) Project of JICA

Acknowledgements

I have had a great deal of help in writing this book from a number of resource persons. Of course, omissions and inaccuracies are entirely my responsibility, but I thank all my colleagues who have kept these to a minimum. I am also very grateful to my mentor MS Helen van Houten for her immensely helpful comments and suggestions. I am very much indebted to Dr Fentahun Mengistu, Director General of Ethiopian Institute of Agricultural Research for his encouragement

Preface

This book is written with practising scientists, researchers, and stuidents in mind. The publication has three main aims. First to encourage the communication of science to a wider audience; second, to give a few tips on how you can do it well; and finally to point you towards the manyother resources available to researchers who want to help to improve the public understanding of science and technology.

Scientific communication is a multi-faceted subject that is undergoing a profound transformation. Doing justice to it in a couple of hundred pages is still difficult, so in this book I presented summaries from several angles and of key points from examples of successful science communication information resources, openions and

comments from experienced researchers, scientists, students, trainees, practitioners, and my own experiences. The book is prepared with detailed data, information, and arguments, as well as extensive references with the most recent updates. I presume this book can help to ensure that your first experiences of science communication are highly rewarding too.

Abebe Kirub

Contents

Introduction

THE MAJOR OBJECTIVE OF THIS BOOK is aimed at enhancing scientific paper writing and communication skills of agricultural researchers, educators, and students. Specifically it is my stretched intension to provide essentials to better plan, writes research findings, and designs their contents, which includes write them up, improve contents and styles, and submit to publishers.

Finally, those who feel empowered to write scientific papers successfully and present their findings to the public with paramount assurance are expected in the writing ecosystem.

Scientific papers and technical documents are essential means of communication between scientists; therefore, the efficacy of the content depends on the quality of texts. Besides an author of the paper colleagues,

reviewers, and an editor participate in the process, helping the author to improve the text.

I agree with everyone who identifies the purpose of science communication takes the same basic information and treat it in different ways to convey the same message to different audiences. One other issue is the way in which the content of any information is packaged is crucial to be understood by an audience. If the person reading the material cannot understand it, the effect of the work is lost entirely.

Therefore, before planning a manuscript you should be able to align it with your paper by considering

- reputation
- appropriateness of your subject and its quality
- appropriate readership
- frequency of publication
- circulation
- publishing criteria and style
- budget to meet printing charges

The characters of a good or successful paper could be listed as follows

- presents an accurate account of the investigation
- has logical flow

- is clearly written and easily understood
- follows a particular style of discipline
- is free from jargon and local slang
- has appropriate and adequate illustrations
- does not contain plagiarized information
- contains original results

Why do Research?

RESEARCH MANAGERS, DONORS, AND GOVERNMENT OFFCIALS ask you to write a research paper for several reasons. The following are the major reasons:

Research teaches methods of discovery

Explanation on a topic prompts researchers to discover what they know about a topic and what others can teach them. Beyond reading, it often expects researchers to venture into the field for interviews, observation, and experimentation. A researcher may not arrive at any final answers or solutions, but would come to understand the different views on a subject. In the final paper, researchers will synthesize their ideas and discoveries with the knowledge and opinions of others.

Research teaches analytical skills

A research project requires you to investigate a subject, gain a grasp of its essentials, and disclose your findings. The success of research will depend on your negotiating power on the various sources of information, from journals, research reports, reference books in the library, online resources and from special archival collections of the most recent articles in printed periodicals.

The web-based resources from the Internet, with its vast quantity of information, will challenge a researcher to find reliable sources. If you conduct research by observation, interviews, surveys, and laboratory experiments, you would most likely discover additional methods of investigation.

Research develops inquiry-based techniques

With the participation and guidance of your research team and other colleagues, you are making an inquiry to advance your own knowledge as well as increase the data available for future research by others.

Research teaches thoughtfulness

As you wade through the evidence on your subject, you will learn to discriminate between useful information and unfounded or ill-conceived comments. Some

sources, such as the online resources from the Internet, will provide timely, reliable material but may also entice you with a worthless and undocumented opinion.

Research teaches judgment

Like a judge in the courtroom, you must make perceptive judgments about the issues surrounding a specific topic. Your decisions, in effect, will be based on the wisdom gained from research on the subject. Your paper and your readers will rely on your logical response to your reading, observation, interviews, and testing.

Research teaches argument

In most cases, a research paper requires you to make a claim and support it with reasons and evidence. For example, if you argue, "applying chemical fertilizer has increased plant toxicity," you will learn to anticipate challenges to your theory and to defend your assertion with evidence.

Purpose of Scientific Writing

TO BE ABLE TO WRITE CLEAR AND SIMPLE LANGUAGE in research is perhaps the most generally useful of all educational skills. Whatever your specialty, you will need at some time to write reports and proposals, to present technical information or to compile statements different kinds. As a researcher, the influence that you have on daily activities depended very much on your ability to put your thoughts in writing. More immediately, you will need to be able to write clearly and intelligibly.

A century ago, James Barrie commented, "the scientist is the only person who has anything new to say and who does not know how to say it." You may agree or disagree with this sentiment. Beyond the shadow of a doubt, whatever you performed in the laboratory, field

experiment, or surveys are worthless if you are unable to communicate the result in a form, which others can understand. In the contemporary competitive life, there is also another reason why scientists must write: it could be summed up in the maxim “publish or perish.” It is common, when a scientist applies for a new post one of the principal criteria to assess the applicant's suitability is the number of publications listed in the curriculum vitae.

On one hand, papers published by a researcher in any research or educational establishment are considered as fair indexes of the researcher's activities; on the other end of the scale, however, this should not let the Institution researcher, educator or student to lose sight of the fact that manuscripts, which are accepted and found worthy of publication, really are a measure of research or development capabilities of the researcher.

At a more basic level, before you joined your institution, as a researcher, educator, or a student you have obtained a recognized academic qualification. Nevertheless, science communication aimed at broadening your experience is not given in all of the universities locally even abroad. The overall effect is that most researchers are not taking use of language

seriously, let alone to consider it a skill, which they must acquire as part of their professional education. This does not mean that every individual has become an expert in the finer points of grammar synthesis and analysis. To communicate clearly does not require a technical mastery of grammar as much as a grasp of the mechanics of constructing a concise and coherent report.

Whenever you write it is always for the benefit of a reader, thus, it is always necessary to remember the needs of that reader. A researcher must write clearly, not obscuring the message and not leaving the reader to puzzle out the sense of what the researcher wants to say. Provision of an informative title and effective headings and sub-headings; presentation of information in a logical order, including all the steps of argument; clearly illustrated evidence and examples: these are the essentials of scientific writing and they are not difficult requirements to meet.

Briefly, it is the major focus of this publication to bring to your attention the facilities of science writing. When going back to your duty center, you will realize that science writing is an art, which can, and should, be learned. I will assure you that it will not be difficult to develop the necessary skills in this respect.

This book included ideas and strategies for tackling problems associated with scientific writing.

Finally, I would like to recite from the famous English writer of the 17th century, Francis Bacon, "Reading makes a full person; conference a ready person; and writing an exact person. " So, sit comfortably and let us begin.

Writing with the Reader in Mind

INFORMATION IS INTERPRETED MORE EASILY AND UNIFORMLY, if it has to be placed, where most of readers expected to find it.

The primary function of a scientific writing is to transmit a message—to convince the reader and the community that this is important research. It is therefore a good strategy to think about the message before sitting down to write.

Readers do not simply read; they interpret. Any piece of prose, no matter how short, may "mean" in 10 (or more) different ways to 10 different readers. This methodology of reader expectations is founded on the recognition that readers make many of their most important interpretive

decisions about the substance of prose based on clues they receive from its structure.

As science becomes increasingly interdisciplinary, researchers often find themselves writing for audiences that have very different perspectives and goals of their own. Therefore, if one goal of writing is to produce content and prose that serves these diverse readers, how do we decide what readers need.

Science is often hard to read. Most people assume that its difficulties are born out of necessity, out of the extreme complexity of scientific concepts, data, and analysis. Most authors argue that complexity of thought does not lead to impenetrability of expression; we demonstrate a number of rhetorical principles that can produce clarity in communication without oversimplifying scientific issues. The results are substantive, not merely cosmetic: Improving the quality of writing actually improves the quality of thought.

The fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication. It does not matter how pleased an author might be to have converted all the right data into sentences and paragraphs; it matters only

whether a large majority of the Reading audience accurately perceives what the author had in mind.

Therefore, in order to understand how best to improve writing, you would do well to understand better how readers go about reading. Such an understanding has recently become available through work done in the fields of rhetoric, linguistics, and cognitive psychology. It has helped to produce a methodology based on the concept of reader expectations.

If the reader is to grasp what the writer means, the writer must understand, what the reader needs. Information is interpreted more easily and more uniformly if it is placed where most readers expect to find it. These needs and expectations of readers affect the interpretation not only of tables and illustrations but also of prose itself.

Readers have relatively fixed expectations about where in the structure of prose they will encounter particular items of its substance. If writers can become consciously aware of these locations, they can better control the degrees of recognition and emphasis a reader will give to the various pieces of information being presented.

Good writers are intuitively aware of these expectations; that is why their prose has what we call shape and color. **I**nformation is interpreted more easily and more uniformly if it is placed where most readers expect to find it. All in all authors should respect the rights of their audience. They should also stand technicians of the information content.

In summary, the substance of science comprises more than the research and recording of data; it crucially includes the act of interpretation. It may seem obvious that a scientific paper is incomplete without the interpretation of the author; it may not be so obvious that the paper cannot exist without the interpretation of the reader. In other words, authors cannot simply record data. In any recording or articulation, no matter how haphazard or confused, each word resides in one or more distinct structural locations. The resulting structure, even more than the meanings of individual words, significantly influences the reader during the act of interpretation. The question then becomes whether the structure created by the author (intentionally or not) helps or hinders the reader in the process of interpreting the scientific writing.

Overview of Research Communications

THERE ARE SEVERAL WAYS which are open to scientists who want to deliver information on their research results. The major ones include the following:

Research communications

- research journals
- research reviews
- conference papers
- theses

- book chapters
- annual reports
- newsletters
- project proposals

- lectures
- meetings with individuals
- leaflets
- posters

Extension communications

- extension manuals
- newspaper reports
- magazine articles
- radio and TV broadcasts
- video
- demonstrations (field days)

Each of these has specific uses. Showing a cartoon strip would probably be inappropriate at an international conference and delivering a research paper would be useless to most farmers. Effective communication depends on delivering the right message in the right way to the right audience. Many excellent scientists do not write well because they do not take the time to try to communicate skillfully. With a little effort, all scientists can make their work more comprehensible to a general audience and can learn to adapt their presentations to given media.

Every research scientist should expect to have to write for each kind of research communication listed before sometime during his or her career. Extension or media professionals, on the other hand, more often produce extension and popular materials.

The key point is "effective communication depends on delivering the right message i the right way to the right audience."

Audiences

Readers of scientific research fall into different groups. The most common audience groups include

- researchers
- policy makers
- donors
- politicians
- research managers
- university teachers
- business people
- extension agents
- information professionals
- students
- farmers

Purpose of science communication

Science communications has different intents. That is, it takes the same basic information and treats it in different ways to convey the same message to different audiences.

The way in which the technical content of any publication is packaged is crucial to its understanding by an audience. If the person reading the material cannot understand it, the effect of the work is lost entirely.

Requirements for Producing Publications

Before you start planning a manuscript for publication, you should target a publication for your paper. Your choice of a publication will often influence the format and style of your paper. Different publications, especially journals have different styles and different rules of presentation for the material they publish.

Choosing a Journal

Most journals receive many more papers than they can possibly publish, and the best journals have high rejection rate. If you are a beginning writer, you stand a better chance of having your paper accepted if you select a less prestigious journal. Should you try an

international journal or a local or regional one? It probably requires more effort to write a paper for an international journal, but the rewards are also greater because greater numbers of readers will come across your paper if it appears in an international journal. On the other hand, local journals need the support of good scientists and writers to increase their value and readership.

Format of a Research Paper

RESEARCH is an organized and logical activity, and therefore reporting research must be well organized and logical.

Writing scientific papers

One common question researchers often ask is, why should scientists write research papers? The many reasons include helping advance knowledge, supporting the progression of a professional career, satisfying the donor who provided the funding for research, and of course, becoming famous. The most important reason to write research papers and reports is to communicate that effective communication is vital for science to progress.

Characteristics of a good scientific paper

A good scientific paper should

- present an accurate account of the research investigation
- be clearly written and easily understood
- follow the particular style of the scientific discipline
- be free of jargon and local slang
- have appropriate and adequate illustrative material
- not contain any plagiarized material (plagiarism is a serious offence and is a serious charge against an author)

A good scientific paper values the following general comments

- "Between" is used for two things "among" for three or more. Therefore, "the pesticides were applied *among* the three crop varieties," not "the pesticides were applied *between* the three crop varieties."
- Do not use "however" as a conjunction, as "Urea is a useful chemical fertilizer, however should be applied based on soil test results." This sentence is a run-on. "However" requires a semicolon or period preceding it, as "Urea is a useful fertilizer; however should be applied based on soil test results." The same holds true for "therefore."
- Be careful with word pairs that are often confused: that/which, affect/effect, its/it's

- Choose/chose, advice/advise, accept/except, proceed/precede; between/among; less/fewer
- The words "who" and "whom" refer to people; they do not refer to animals
- It is not appropriate to use first person *plural* in a single authored work. For a single authored work, use "I." For two or more authors, use "we."
- Avoid strings of prepositional phrases: "Several regions of the brain have been implicated in the recognition of kin," might be written, "Several brain regions have been implicated in kin recognition."
- Avoid overused expressions and clichés
- Strive for verbal variety; do not begin every sentence in a paragraph with "I."

Structure of a research paper

Introduction

```
What did I do?
and what were the objectives?
what did I want to find out?
```

In general, a good Introduction:

- tells why the reader should find the paper of interest
- tells why the author carried out the research
- gives the background the reader needs to understand and judge the paper

Specifically, it:

- defines the nature and extent of the problems studied
- relates the research to previous work, perhaps by a brief review of literature, which is clearly relevant to the problem
- explains the objectives and method of investigation, including, if necessary, the reason why a particular method was chosen
- defines any specialized terms or abbreviations to be used in what follows

When writing the Introduction, you must lead logically to the hypothesis or principal theme; state the hypothesis clearly; and Introduction does all that it should in no more than two typewritten pages

Be aware that the following are the common mistakes in writing the Introduction:

- too much or not enough information
- unclear purpose
- lists
- confusing structure
- first-person anecdotes

In summary, the introduction should establish the existing state of knowledge of your research topic and then identify the specific focus of your work in the following manner:

- start with a relatively broad background of the topic you are investigating. Include relevant citations from primary literature and other appropriate technical references
- Progressively narrow the scope of the ideas considered so that the reader is led to the specific topic that you are studying. Using primary literature, justify how this topic requires additional study.
- In the last sentences of the final paragraph, succinctly state 1-3 specific objectives or hypotheses that your study addresses. A crystal-clear statement of objectives/ hypotheses is critical. Virtually all material in your manuscript should directly pertain to these objectives and hypotheses.

Materials and Methods

What did you use and how did you use it?
What did you do and how did you do it?

The simplest way to organize this section is chronologically. You must provide all the information needed to allow another researcher to judge your study or actually repeat your experiment. The section includes:

- design of the experiment
- any plants or animals involved, with exact descriptions (genus, species, strain, cultivar, line, etc.) as needed]
- materials used, with exact technical specifications and quantities and their source or method of preparation. Generic or chemical names are better than trade names, which may not be universally recognized
- assumptions made
- methods followed, usually in chronological order, described with as much precision and detail as necessary.

Standard methods need only be mentioned, or may be described by reference to the literature as long as it is readily available. Modifications of standard techniques should be described. If the method is new, it should be described in detail. Methods of interpreting data should be described as well as methods of finding data.

For more success in writing the Materials and Methods section of your paper, you should be able to consider the following fundamental aspects

- there are no ambiguities in abbreviations or names
- all quantities are in standard units
- all chemicals are so specifically identified that another scientist can match them exactly in repeating the work

- every step is stated, including the number of replications
- all techniques are described, at least by name, if they are standard or in as much detail as needed if you have modified a standard technique or devised a new one
- nothing is included that does not relate to the results that follow
- there are no unnecessary details that may confuse the reader

In addition, you should be able to avoid the following mistakes in this section:

- too little information
- information from Introduction
- verbosity
- results/ sources of error reported

In summary while writing the Materials and Methods section, you need to describe what you did in such a way that other scientists can follow and duplicate your experiment. One of the most difficult things in writing a Materials and Methods section is deciding how much detail to give the reader. Too much detail can make this section excessively long. You should try to be concise, but complete.

Results

What happened?

This is the core of the paper, presenting the data that you have found. It is usually easy to follow the results if you present them in the same order as you gave the objectives in the introduction. Well-presented results

- are simply and clearly stated
- report representative data rather than endlessly repetitive data
- reduce large masses of data to means, along with the standard error or standard deviation
- report repetitive data in tables and graphs, not in the text
- repeat in the text only the most important findings shown in tables and graphs
- include negative data what was not found if (but only if) they affect the interpretation of results
- give only data that relate to the subject of the paper as defined in the introduction
- refer in the text to every table and figure by number
- include only tables, figures and graphs that are necessary, clear and worth reproducing

As much as possible avoid

- repetition of data

- unnecessary negative data
- unnecessary figures or graphs
- unnecessary words

The following are common mistakes you may include in recording your results.

- raw data
- redundancy
- discussion and interpretation of data
- no figures or tables
- methods/materials reported

This section describes the results of your work and includes a summary of the data found in your tables and figures.

In summary, write your results with accuracy, brevity, and clarity. Use a good topic sentence for each of your paragraphs. Avoid discussing the results. Save such comments for the Discussion section. Summarize statistical analyses.

When referring to a particular table or figure, they should be capitalized; for example Table 1, Figure 6, etc. However, not all results deserve a separate table or figure. As a rule of thumb, if there are only a few

numerical results or a simple conclusion describes the results in the text instead of in a table or figure.

Discussion and Conclusions

What does it all mean?

Have you explained the meaning of the results and their implications for future study application? This is the most difficult part of the paper, in which you pull everything together and show the significance of your work. Your reader should not end up saying, "So what?"

A good discussion

- does not repeat what has already been said in the review of literature
- relates the results to the questions that were set out in the introduction
- shows how the results and interpretations agree, or do not agree, with previously published works
- discusses theoretical implications of the work
- states conclusions, with evidence for each
- indicates the significance of the results
- suggests future research that is planned or is needed to follow up the results

Make sure, if you have:

- dealt with each of the originally stated objectives
- followed the order of your original objectives
- introduced previously (most likely in the introduction) the subject of each conclusion, so that none comes as a surprise
- avoided unnecessary detail or repetition from preceding sections
- reported previously all methods, observations or results referred to in this section none of these should be mentioned for the first time interpreted the results and suggested their implications or significance

The following are the common mistakes in dealing with discussion section of a paper

- failure to summarize
- irrelevant review of literature
- no mention of limitations
- unwarranted conclusions not supported by the data
- combined with results
- new results discussed
- broad statements/ long sentences
- incorrectly discussing inconclusive results
- uncertain data sources
- missing information

In summary, this section is often the most challenging section to write. In this section, you should interpret your data and draw conclusions regarding your hypothesis. **Avoid repeating the results section**. Evaluate your data and their implications in a broader context. Consider the following key points:

Title

Attracts the expert and interests the casual reader
Determine the success of your article in search and retrieve

The title of your paper will probably be read more than any other part, both by scientists scanning the contents of a journal and by those depending on searches through bibliographic databases, which always carry the title and author but may or may not carry abstracts. The title may be reprinted in bibliographies and subject indexes, stored in bibliographic databases, and cited in other articles. A good title may help future researchers find important information; a poor title may hamper them from doing so.

A good title for a research report:

- contains as few words as possible

- describes the contents of the paper accurately
- describes the subject as specifically as possible within the limits of space
- avoids abbreviations, formulas and jargon
- usually omits verb and is only a label
- contains key words, for the benefit of information retrieval systems
- create a title that match the most commonly searched keywords for your topic

In handling the title of your paper make sure if you:

- reduce unnecessary words, especially like "*Some notes on ...*" *or* "*Observations on...*" ; make your title come to the point
- write a title that is accurate and specific
- do not promise more than is in your paper; usually a title reports the subject of the research rather than the results
- include as many key words as possible, as they will be used for indexing and computer searching
- make the most important words stand out, usually by putting them first
- follow the style preference of the journal for which you are writing

In summary, be concise but descriptive, although you do not want to be vague or incorrect. This is your first chance to grab the reader's attention.

Authors

The names should

- be complete enough to ensure proper identification; if there is any chance of confusion, use full names instead of initials
- include only people who are truly authors
- be listed in a logical order, for instance, alphabetically or in order of importance to the work being reported
- each be followed by an address, presented according to the style of the journal

The following are key points for your consideration

- only people who have made important contribution to planning and carrying out the research should be listed as authors
- anyone listed as an author should also have helped to draft the paper or have revised important parts of it
- as collecting data is not enough to make a person an author, technicians and other helpers are usually mentioned in the acknowledgements

- each coauthor should give final approval to the version that is to be published
- unless names appear alphabetically, the first person listed is considered the senior author; others may be listed according to the importance of contribution to the experiment. Sometimes the program or project leader or the center manager wants to be considered an author of all papers coming from the organization; a proper place is as the last author, recognized as a position of importance
- the battle to get listed as an author may become severe; it is wise to agree on authorship and order even before the study begins, although they may be changed later

Abstract

Stimulates the expert to read the paper and supplies the casual reader with definite information

The abstract should be definitive rather than descriptive; that is, it should give facts rather than say the paper is about something.

A good abstract

- is short usually 200 to 250 words, usually in one paragraph
- stands on its own, is complete in itself (it may be published separately in secondary sources)

- reports the objective of the research, its extent or scope, the methods used, the main results including any newly observed facts, the principal conclusions and their significance
- contains all key words by which the paper should be indexed. These are sometimes listed separately below the abstract (Some journals do not prefer separate key words)

In handling the Abstract, as much as possible avoid:

- references to tables or figures, as these appear only in the paper
- abbreviations or acronyms unless they are standard or explained
- references to literature cited
- any information or conclusion not in the paper itself general statements or; findings should be given as hard facts

The following are common mistakes in writing an Abstract

- too much background or methods information
- figures or images
- different font sizes
- duplicate words: e.g., in the in the
- punctuation errors
- poor grammar/word choice

- references to other literature, figures or images
- use of numerals to start a sentence: e.g., 12 children took part in the study
- use of words that do not exist
- undefined abbreviations or acronyms
- contradictory information
- poor structure

Conference poster abstracts

Researchers, educators, and students attend the annual scientific meetings of their professional societies or institutional scientific forums. At most, of these meetings, a large part of the program is made up of papers and poster presentations given by members of the society, covering the latest work being done in the field. Although the information presented may be timely and of great interest to those in the field, the only written record of these papers and posters is usually the abstract that was submitted by the presenter for review. These meeting abstracts may find their way into publication in a variety of ways. They may appear

- as part of a journal sponsored by the society, or institution either in a regular issue, in a special issue, or as a supplement

- as a handout to those attending the meeting and perhaps others who request a copy or in electronic/ digital formats that may be distributed at the meeting.

Acknowledgements

Who helped me?

Here, you can thank any institution or individual who helped significantly in your work. This may be a granting agency that supplied funds, a laboratory that supplied materials, or a person who gave advice. You can say here if your work arose from your thesis. If there is no separate acknowledgements section, you may include such material in the introduction or as a footnote or endnote.

References

Who have I cited in the text?

The reference list must include all works cited in the text and no works not cited. You should follow the style of the journal in citing and listing references. Citations are the reward system of scientific publication. To cite someone is to acknowledge that person's impact on subsequent work. Citations are the currency by which we repay the intellectual debt we owe our predecessors.

Failing to cite sources deprives other researchers of the information contained in those sources, and may lead to duplication of effort.

This section is the most difficult to format. Each journal has different formatting instructions for citations. Read the author instructions for appropriate formatting and check recent issues. Check to make sure every space, period, comma, etc. are perfect. This section can drive editors mad if not properly formatted. Include in the list all works cited in the text.

Two widely used systems of referencing are the author-date (Harvard System), the most common in recent uses, and the number system. There is also the citation sequence system, commonly used in medical sciences.

Citations of references

Textual citation

Use name and date for published works

- Minale Simachew (1999) states that… Or … (Minale Simachew1999)
- ASARECA (2003) indicated…. Or … (ASARECA 2003)

For co-authored published works, write the first names of both authors and the date for two authors.

- Getachew Belay and Hailu Tefera (2006)….
- (…EIAR and ARARI 2007)

If more than two authors, give the first name of the first author and use *et al* to mean 'and others'

- Aster Bedaso *et al* (2001) reported….

When referring to different materials published by the same author, give the first name of the author and the publication dates, separated by commas.

- Mulatu Kelemu (2000, 2001) …Or (Mulatu Kelemu 2000a, 2000b)

If two authors with the same first names have published in the same year, include the initial of the surname of the author cited.

- (Steve A. 2000) where there is also (Steve B. 2000)

For unpublished works, write 'unpublished '

- (Taye Chilot, unpublished) or (MoA, unpublished)

For personal communications, write 'personal communications' next to the name of the person communicated

- (Bedada Tulu, personal communications)

Handle second-hand citations in one of these ways.

- Seid Ahmed (2005) cited in Hailu Tefera(2007) discusses … Or

- Hailu Tefera (2007) quoting Seid Ahmed (2005) discusses…

In listing references, usually give the material you actually referred. Do not over cite the same source.

Order of references

Arrangement of entries is dictated by house styles. The most common arrangement is as follows, in the most common author/date system. Arrange references in alphabetical order of the surnames of authors. If a first author in a list of entries with two, three, or more authors is the same, arrange them in the following order.

- Smith R P and MD Clegg. 2002
- Smith R P and GT York. 2000
- Smith R P, MC Saxena and OD Zilch. 2000
- Smith R P, GT York and MD Clegg. 2001
- Smith R P, JG Andrews, RW Judd and H Johnson. 2002

In co-authored entries, use surnames of only the first authors for alphabetizing. If two or more entries have the same author(s) in the same publication year, alphabetize the entries by title and use lowercase letters (a, b, c, etc.) to separate their identity.

- Tilahun Belay and Ahmed Ali. 2009a. Chemical control of insect pests…
- Tilahun Belay and Ahmed Ali. 2009b. Survey of lentil insects…

Listing references

A published work in a reference list should contain

- author
- date
- title
- publisher and
- place of publication

In listing references, the following are the most common approaches

Journal articles

Author (s) name (s). Date. Title. Journal name in full, volume number: beginning and ending page numbers.

For example, Nicks R E. 2010. Early abortion of colonies of leaf rust, *Puccinia hordei,* in partially resistant barley seedlings. Canadian Journal of Botany 60: 714-723.

Books

Author (s) name (s). Date. Title. Publisher, place.

For example, Getachew Alemayehu and Sacher GA. 2002. Mineral cycling in southeastern eco-systems. Prentice Hall, NJ, USA.

You do not need to include reprint dates, if any, and use first publication date. In case of revised editions, use the date of revised edition and indicate next to the title which edition you used.

Part of a book

Author's name. Date. Title of part. Publisher, Place (city).

Forexample; Legesse Dadi. 2009. Farming systems in the tropics. 2nd ed. Oxford: Clarendon Press. Pp. 157- 84.

Chapter in a book

Author's name. Date. Title of chapter. Pp. *In:* Name (s) of ed (s). Title of book. Publisher, city.

For example, Gebremedhin Hagos. 2007. Agroforestry in the Indian subcontinent: past, present and future. Pp 117-40. *In:* Steppler HA and Amare Molla (eds.). Agroforestry, a decade of development. Nairobi, ICRAF.

Entire proceedings

Name(s) of ed(s) (sponsoring institution, if there is no editor). Date of publication. Title of proceedings, date of conference, place of conference. Publisher, total pages.

For example, AAU (Addis Ababa University). 2011. Proceedings of the international workshop on grain legumes, AAU, 18 Jan 2010, Addis Ababa, Ethiopia.

Hawtin G and Alemu Gebregiorgis (eds). 2010. Faba bean improvement: Proceedings of the faba bean conference, EIAR/ASARECA 7-11 May 2010, Addis Ababa, Ethiopia. 398pp.

Papers in proceedings

Author of paper. Date of publication. Title of paper. Pages. *In:* Proceedings (name of workshop), name of editor (s), if any, sponsor, date of workshop, place held, publisher's address.

For example, Kidane Giorgis and Yadav DS. 2010. Some agronomic considerations of pigeon peas and chickpeas. Pp31-61. *In:* Proceedings of the International Workshop on Grain Legumes, EIAR, 18 Jan 2009, Addis Ababa, Ethiopia.

Published reports

Author/institution. Date. Title of report. Publisher. Place. Total pp.

For example, EIAR (Ethiopian Institute of Agricultural Research). 2007. EIAR Annual Report 2007. EIAR, Addis Ababa.

Part of report

Author/institution. Date. Title of part. Pp. *In:* Title of report. Publisher, Place.

For example, EIAR (Ethiopian Institute of Agricultural Research). 20010 Successes with value chain. Pp 45-53. *In:* EIAR Annual Report 2009. EIAR, Addis Ababa.

In press works

Journal articles or book chapters accepted for publication may be included in reference lists by indicating at the end of the entries (titles) that they are "in press." Theses may be included by indicating at the end of the titles whether they are MA/MSc/PhD theses. Do not list unpublished works in reference list. Write (Undated) in cases of 'no date' (to date this is not common).

References from the website

Citations from websites sources are discouraged as the sources are posted on the net only for a limited period. If

you still find it a must to cite them, in addition to all the details discussed before for the different categories, include date of retrieval and the website the information was posted on.

The most basic entry for the Internet/ a website consists of the author name(s), page title, website title, sponsoring institution/publisher, date published, medium, and date accessed.

- name of the author(s)
- title of the document as it appears on the website
- organization providing the information (if applicable)
- specific address or URL. Some servers will generate pages 'on the fly,' which result in very long web addresses. If this is the case, just provide the general URL of the website (i.e. www.imdb.com)
- date of the document/web page
- date you last accessed the page (using the international format of "day month year")

Example: Solomon Bekele. "The effects of chemical fertilizer on growth and yield performance of banana." Ethiopian Institute of Agricultural Research. June 27, 2011. http://www.eiar.gov.et/media/history/archive.html (accessed 15 May 2011).

Radio/TV

The most basic citation for a radio/TV program consists of the episode title, program/series name, broadcasting network, the original broadcast date, and the medium.

"**Episode Title**." *Program/Series Name*. **Network**. **Original Broadcast Date**. **Medium**.

Newspaper

In citing a newspaper article, you should include the following information in your reference list. The exact style will vary according to the citation system you are using:

- author'(s) if known or title of newspaper if not.
- year of publication
- title of article
- title of newspaper
- day and month
- page number(s) and column letter

Example

Meseret Teka. 2009. Our agrobiodiversity: gazing the future. Ethiopian Herald. 15 March 2009. p. 3.

Film

The most basic entry for a film consists of the title, director, distributor, year of release, and medium. You may also choose to include the names of the writer(s),

performer(s), and the producer(s), as well as the film's original release date.

Film title. Dir. **Distributor**, **Year of Release**. **Medium**

The citation should begin with the film title italicized, followed by a period. If the film is dubbed in English or does not have an English title, you may begin by including the title as translated in English, followed by the original title in square brackets.

Footnotes and endnotes

Footnotes and endnotes, which are the same thing, except for where they are placed within a paper usually in three different ways:

- for citation purposes: showing the reader where the information came from originally
- credibility-building: by referring the reader to other sources of information besides those used in the paper
- commentary not related to the thesis of the paper: when it may be necessary to help your reader understand something he or she may not be familiar with

Footnotes and endnotes are not used for citations, only for comments and explanatory notes. To be avoided wherever possible. Footnote handles should be placed *after* punctuation marks, never immediately before punctuation marks.

As you write your manuscript, you can use **them** for extra bits of information, which are surplus to requirements in the main body of the manuscript, such as extra details about the subject, or interesting quotes. However, remember that when writing footnotes, just as when you are writing the main body of your manuscript, you should draw out the *relevance* of the material you are using. Use them to enhance the impact of your argument.

In general footnotes

- are used to provide information that is not essential to the thesis of the text
- used sparingly
- statements, for which there is information in the footnotes, are superscripted with a sequential number that corresponds with the relevant footnote
- footnotes page is placed at the end of the text preceding the reference list page
- footnotes are numbered with superscripts. One space exists between the superscript and the first word of a footnote. For example, [1] Berta Lemma..., [2] Paulos Dubale...
- footnotes are double-spaced

In as much as possible, remove footnotes, place them in the text, and list the reference at the end.

Figures, tables and equations

Tables and figures are useful for displaying large amounts of quantitative information. They help the reader organize information and internalize it. Be sure that the title of the table or figure clearly describes its contents.

When presenting data in tabular or graphical form, provide an adequate legend or caption explanatory text that draws the readers' attention to interesting or important trends. Figures and tables produced on a computer will typically have better visual impact than those drawn by hand. Software programs such as Excel provide good graphing abilities. Both are supported by the College. Figures and tables done by hand must be clearly and neatly drawn and lettered. Although most word processing software now allows the integration of text, tables, and figures, placing graphics or tables on separate pages at the end of a paper is also acceptable.

Think about what you want to show the reader before you create a figure. Just because a computer program

generates a attractive graphic does not mean that it conveys meaning.

Avoid three-dimensional graphics—these figures rely on a non-planar sense of spatial perspective and do not allow for accurate presentation or interpretation of results.

Each table, figure, or equation must be numbered and referenced in the text. Each table and figure must have a legend. A legend consists of text describing what the figure or table shows. The legend should be detailed enough that the figure or table makes sense if read separately from the paper. Table legend placement is above the table; figure legend placement is below the figure.

Tables: Presents lists of numbers/ text in columns

Figures: Visual representation of results or illustration of concepts/methods (graphs, images, diagrams, etc.)
Captions: Must be stand-alone

Figures and tables should be

- high resolution

- neat, legible labels
- simple
- clearly formatted
- indicate error
- detailed captions

The following are essential guideline in constructing tables

- state the unit of measurement, usually in SI system. If non-metric units are used in your investigation, convert to metric units
- if percentages are used, for example to describe solutions distinguish between percentage by weight (w/w) or percentage by volume (v/v)
- decimals should be preceded by zero, for example 0.23 g
- use power of 10 to avoid numbers with long strings of zeros,; for example, 23 400 000 could be written as 2.34×10^7
- for column headings follow designation of units with '000 to indicate thousands and use 12 as the entry for 12 000
- avoid using a dash (—) in tables, rather indicate whether no data were available, data or item not applicable, or whatever may be the circumstances, using footnote if needed
- do not cram too much data into a single table

- give the table a clear and concise title, which immediately tells the reader its contents
- the heading should state what the table exhibits, not what the table is all about
- arrange the data in columns to make them easily understood
- make column headings short
- data should be rounded, for example, 56.3, not 56.32681
- do not use numbers with multipliers in column and raw headings
- do not use scanty data that could be placed in text
- table field should contain at least eight items
- use appropriate symbols to identify items that are explained in footnotes
- every table should be numbered sequentially
- put analyzed and summarized data not raw data in tables
- a table should be self-explanatory

In summary tables and figures should be put into a contextual framework in the corresponding text. A table of strains used should be mentioned in the Materials and Methods section, a table of results should be summarized in the Results section, a figure showing a biosynthetic pathway should be described in the Discussion section, etc. Tables and figures should present information in a format that is easily evaluated

by the reader. A good rule of thumb is that it should be possible to figure out the meaning of a Table or Figure without referring to the text. Tables and figures should typically summarize results, not present large amounts of raw data. When possible, the results should provide some way of evaluating the reproducibility or statistical significance of any numbers presented.

In scientific writing, the most common types of illustrations are

- line graph to demonstrate relationships among data or dynamic comparison
- bar graph to compare quantities
- pie chart to show proportions of a whole
- photographs for accurate representations
- flowchart to show a complicated process or system
- maps to show the distribution of data or show study or survey locations
- line drawings to illustrate objects, or specimens

Equations

Equations are numbered consecutively, with equation numbers in parentheses flush right, as in Eq. (1). Insert a blank line both above and below the equation. First, use the equation editor to create the equation. If you are using Microsoft Word, use either the Microsoft Equation Editor or the Math Type add-on for equations in your

paper, use the function (Insert>Object>Create New>Microsoft Equation *or* Math Type Equation) to insert it into the document. Please note that "Float over text" should *not* be selected. To insert the equation into the document, do the following:

- select the "Equation" style from the pull-down formatting menu, and hit "tab" once
- insert the equation, and hit "tab" again
- enter the equation number in parentheses.

Be sure that symbols in your equation are defined in the Nomenclature or immediately following the equation. Also, define abbreviations and acronyms the first time they are used in the main text.

Units of measurements

Units of measurement should be metric or SI (International System). The common Metric (SI) units include the following

Acceleration	meter per second squared	(m/s^2)
Angle	radian	(r)
Angular Acceleration	radian per second squared	(r/s^2)
Angular Velocity	radian per second	(r/s)
Area	square meter	(m^2)
Density	kilogram per cubic meter	(kg/m^3)
Energy	Joule	(J) or (N-m)
Force	Newton	(N) or ($kg\text{-}m/s^2$)
Frequency	Herz	(Hz) or (1/s)
Impulse	Newton-second	(kg-m/s)
Length	meter	(m)
Mass	kilogram	(kg)
Moment of a Force	Newton-meter	(N-m)
Power	Watt	(W) or (J/s)
Pressure	Pascal	(Pa) or (N/m^2)
Stress	Pascal	(Pa) or (N/m^2)
Time	second	(s)
Velocity	meter per second	(m/s)
Volume (solids)	cubic meter	(m^3)
Volume (liquids)	liter	(L) or (10^{-3} m^3)
Work	Joule	(J) or (N-m)

Numbers

Numbers are tricky to report. The general rule is to write out numbers below 10 as words (for example; one) and express numbers above 10 (for example; 10) as numerals.

Write out numbers nine and under and use numerals to represent numbers 10 and over.

Incorrect: *The dead fish was eighteen centimeter in length.*
Correct: *The dead fish was 18 centimeter in length.*

Remember that there are exceptions to this rule.

Use Numerals to Express Values under 10 that are compared to or used in the same sentence with numbers over 10

Incorrect: *There were 23 spider mites and five fruit flies.*
Correct: *There were 23 spider mites and 5 fruit flies.*

Values preceding a unit of measurement

Incorrect: *seven cm, eight grams*
Correct: *7 cm, 8 g*

Values representing percentages, ratios, fractions, and decimals

Incorrect: *two percent, three to four, five-sixths, seven hundredths*
Correct: *2%, 3:4, 5/6, .07*

Values representing the number of participants, date, ages, or points on a scale

Incorrect: *eight farmers' children were interviewed, ages six to nine, scored three on a six-point scale*
Correct: *8 farmers' children were interviewed, ages 6 to 9, scored 3 on a 6-point scale*

Use words to express numbers that begin a sentence.

Incorrect: *12 dead fish were dissected. . .*
Correct: *Twelve dead fish were dissected. . .*

When there is a conflict between these rules, such as when listing a specific amount (*typically written as a numeral*) located at the beginning of the sentence (*typically expressed in words*), use this example to guide you.

Incorrect: *2.00 g of hydrochloric acid was used to determine. . .*
Correct: *Hydrochloric acid (2.00 g) was used to determine. . .*

Scientific usage

In writing science, the following are major conventions that should be strictly followed up.

- gene names and their abbreviations, as well as Latin words and their abbreviations, should be in italics, *e.g., Ultrabithorax, Ubx, ergo, in situ, et al., etc.* Note that some journals choose to ignore these rules
- data is the plural of datum. Therefore, "…the data were collected…" not, "the data was collected."
- the plural of species is species; the plural of genus is genera
- the word prove is generally avoided outside of mathematics. In science, you cannot prove a hypothesis. The best you can hope for is that your hypothesis *is supported* by the data, or that your data *are consistent* with your hypothesis. If an idea repeatedly stands up to experimental scrutiny and is consistently not disproved, then it becomes relegated to the status of a theory, such

as the Theory of Evolution or the Chromosome Theory of Inheritance

- Be careful of attributing intent to organisms when talking or writing about evolution. Birds did not evolve wings in order to fly. Natural selection does not work with a particular goal in mind, such as flight. Instead, it works through random variation followed by differential survival and reproduction. While suggesting that birds evolved wings in order to fly is convenient shorthand, it misses the fundamental principle of evolution by natural selection
- Be aware of tense. The results of others are usually discussed in the past tense, "Asaminew Tesema, et al (2009) found that…" The Methods section of a research paper 3 is also written in the past tense (it has already been done by the time the paper is being written). However, the results section of a paper is written in present tense. Grant proposals describe procedures that have not yet been done, and should be written in future tense
- A scientific name is composed of two words: a genus name and a species epithet. The first letter of the generic name is always capitalized and the specific name is not capitalized. Both words must be written in italics or underlined. Generic names should be written out in their first appearance in the title, abstract, and main text. If they are subsequently mentioned in one of these locations, they may be abbreviated. It is also advisable to

mention the English name for your organism. For example, "Caterpillars of the lycaenid butterfly *Jalmenus evagoras* were studied…" Later, "*J. evagoras* caterpillars were studied…" While most scientists know that *C. elegans* is a nematode, it is helpful to provide a common name for less-known organisms

- The generic names of some common model organisms, *e.g.,* Drosophila and Arabidopsis, are now used as common names, too. When these names are written in isolation, they are being used as common names and are not italicized. In conjunction with a specific epithet, they are scientific names and must be italicized. A final note: *Jalmenus* sp. refers to a single unspecified species in the genus *Jalmenus*. *Jalmenus* spp. refers to two or more species in the genus *Jalmenus*. Note the use of italics on these intentionally ambiguous names.

Formatting Conventions

In reporting your research findings, you should be able to abide by the following conventions in formatting your manuscript

- pages should be numbered; the first page usually does not have a number because it is understood that it is page one

- avoid series of parentheses, such as: (Abera Tufa 2009) (Figure 1). Combine the information: (Abera Tufa 2009; Figure 1)
- in-text citations are always inside end punctuation: "…higher fitness (Almaz Tefera 2006)." Not "… higher fitness. (Almaz Tefera 2006)"
- every in-text literature citation must have a full citation in the References section and *vice versa*
- figures and tables should be numbered in the order they appear in the text
- figures should be cited as (Figure 1) or (Fig. 1), not (see Figure 1) nor (see Figure 1 attached), *etc*. The same rules apply for references to tables
- if you use an abbreviation, you should define it after its first use in the paper. For example, "Addis Ababa University (AAU)..." After this, simply use AAU.

Checklists

While writing you should be able to make sure the following checklists are properly addressed

General

- does each paragraph focus on a single idea or point which is introduced/summarized in the paragraph's first sentence? A paragraph is like a mini-essay
- is the flow of logic clear from paragraph to paragraph? From your draft, you should be able to (re)write the

outline of the paper–in fact, just from the first sentences of the paragraphs

- did you repeat key points in several sections to emphasize them?
- did you spend a lot more time on logic and clarity than grammar and sentence structure? Nevertheless, avoid complicated sentences.

Abstract

- does the abstract avoid distracting technical details?
- is it clear from the abstract why the work is new and worthy of publication?

Introduction

- did you clearly explain the reason why the work was done – the existing problem?
- did you clearly and briefly explain what you did to make progress – what is new?
- did you cite pertinent work done before? Even by people, you may not like
- did you read the introductions of several related papers to be sure you explained the ideas properly and cited the important work?

Materials and Methods

- did you remind your readers why a new/old method was used?
- did you provide enough information so a reader could exactly reproduce your results?

Results

- did you make sure the main results are not buried?
- did you save commentary and speculation for the Discussion section?

Discussion and Conclusions

- did you clearly explain what is new, as compared to previous work?
- did you avoid repeating information from the Results section?
- did you admit the limitations of your work?
- did you describe future applications, improvements, and generalizations?
- could a reader in a rush read just the Conclusions and learn just about everything?
- did you avoid exaggeration and let the data speak for itself?
- did you acknowledge everyone who helped, including funding agencies?
- did you go back to the 'General' section above and double-check those paragraphs and logic – even in the Results section? And is every paragraph in the right section?
- did you make several revisions of the entire manuscript (after completing a first draft)?
- did you check journal-specific formatting – section order; figures; tables, references?

Writing Research Paper

TO WRITE WELL, it is first necessary to plan effective writing. Words must be arranged in a logical order and should be carefully chosen to say what the writer means, clearly and concisely. Unless you are an experienced writer, do not try to write a research paper from start to finish. The basic technique of research is a planned approach to a clearly defined problem. This is the same way to approach writing a paper. The structure of the paper will come from the subject itself, the purpose of the paper, and the intended audience.

First, you must decide that you have a message to deliver. Otherwise, you are likely to quit halfway through, believing that writing papers is too difficult. Once you are sure of what you want to say, you can

apply some of the simple principles described here to help you start and finish writing a paper.

To help you decide this, look at your work objectively, as if someone else had written it. Put yourself in the place of an editor or a referee. They will be asking themselves the question, "*Why should I publish this paper?*" You have to make sure that the answer is "*Because it is a good piece of work.*" You must be sure of the worth of your work, because what you write will have to stand up to the examination of the editor and the criticism of referees.

Once you are sure that you have the material to write a paper, you must think about audience. *Why are you writing the paper?* You are writing it so that it will be read, and for that to happen, it must be published. Many authors do not consider this, they see the paper as an object in itself and do not think about who will be reading it. From the very start, you should aim at getting the paper seen by the right audience. To do this, you should direct your paper toward a specific journal that is read by the people you want to reach.

An effective writer is clear in his message. An effective writer anticipates potential questions from reviewers

and readers and answers those questions in the paper. An effective writer correctly interprets their data and delivers an accurate message. An effective writer uses efficient formatting and writing to save the reader time.

More than anything, scientific writing should force you to express your ideas clearly and in the proper order, to fill in logical gaps, to sort out hypotheses from blind assumptions from conclusions, and to make your point forcefully and clearly

Planning

Look at the way the articles in the journal you have chosen are subdivided. This layout will give you a valuable clue about how to start planning your article. Most types of research article follow the classic IMRAD pattern;

Building your plan You should write a paper systematically, building it as you go, gradually, rather than trying to do the whole thing at once. You must have a plan.

First, decide on the main sections of the article. This will give you an overall plan that will help in your next task, which should be to plan separately what to include in

each division. Look at a single heading, for example, Materials and Methods. Think about what materials you actually used and jot down a list, using working headings such as chemicals, animals, equipment, soils, etc. You likely already have noted these in your laboratory bench notebook.

Your approach will be easier once you are sure what should go into each section. Go through the whole paper like this, making lists of headings so that, when you have finished, the plan of the article is in front of you. Now you can stand back and think. What have you left out? Is there a title for every part of your work? Have you repeated something? Should a particular heading be moved to another section? Spend some time doing this, because it will make your work much easier in the end. Writing from a plan is always easier than making up your plan as you go along.

In building your plan consider the following

- decide on the main sections
- plan what to include in each section
- think what is left out, repeated or misplaced
- select references you will want to mention in the text
- make sure the details of references are complete

- examine all your evidences again
  - for relevance and vitality
  - need for all tables and figures
  - anything left out
  - too much detail or not enough

Using your plan Now that you have your master plan, what should you do? Some people will start writing, because they feel confident that they know what they want to say. If you can do that, excellent, but if you still do not feel confident, you can continue your systematic approach even further before you start writing. You should not feel that you have to plan the whole paper in one sitting. You can split up the planning and writing to fit your time. Carry a note pad with you, or some cards, and whenever a thought comes to you, quickly write it down. This process is especially useful for the Discussion section, which always requires a lot of thought and interpretation. Very often, an important idea or a few fine sentences suddenly appear, apparently from nowhere, and you should record these thoughts as soon as they come or you will forget them.

Remember the references As you plan the sections and make your notes, also remember to make notes about the references you will want to mention in the text so that, at the end of the

planning, you will have an outline of your reference list as well. As you select references, list them on cards, a card for each, or on computer, making sure to copy all the details you need to make each reference complete. Get the complete information on a reference you think you might use while you are doing your reading and library searching. You may find it difficult to retrieve some of the information if you try to do it later when the reference is no longer at hand.

Review the Raw Material

Now is a good time to look back at what you have done. Examine all your evidence again. Is it all relevant and vital to the paper? Do you still want to publish this paper? Do you really need all those tables? Could you boil down your data and combine or simplify tables? Could some tables be expressed more simply as figures or graphs? Would a line drawing be better than a blurry photograph you have? Consider these points now because the editor and referee will certainly do so later. Have you left anything out? Are you going into too much detail or not enough? Try to ask yourself the most difficult questions now so that you can change the structure of the paper before you are too involved in writing.

Starting On a long distance journey, the hardest thing is the first step. So, make the first step easy! Sometimes it is difficult to start. One-way around this is to begin with the easiest section, **Materials and Methods**, which is a simple description of what you used and what you did. Then, you could go on to the **Results**, again because you only have to describe exactly what happened. By then, you should be involved with the paper and ready to start on the difficult task of interpreting the results in the **Discussion**. Another way is to try to write the most difficult section first, the **Discussion**, which contains much interpretation and independent thought. Everything after that is easier.

Your approach should be to work on your writing whenever you have time. At this early stage, you should imagine each section of the paper to be a separate part of the complete paper. When you have the time, take out your master plan, and pick out one of the headings. Take this single heading and start thinking about what you want to say about it. Start making quick notes, pieces of sentences, and a plan of a paragraph. You may find that you need to subdivide the section even further. Go ahead and do it. Then when it is time for a break, you can put away your notes and start again whenever it is convenient. Doing this means that you do not have

to remember the whole plan of the article every time you want to start working. You deal only with individual sections, one at a time.

The first draft Once you have organized all your material, prepared the figures and made up the tables, written all your notes and assembled them in the order you want, you are ready to start writing. Once you start a section, you should write as fast as you can. Do not worry about language, grammar, style, or spelling. Try to write simply. Just write down as much as possible while the flow of whatever section you are working on is clear in your mind. In this way, you will have copy to work on later. It is always easier to come back to something than to start filling in a blank piece of paper. This first draft can be as untidy as you like. Only you will see it. Concentrate on scientific content and nothing else.

Most important at this stage is to turn your notes into sentences and paragraphs. Finish with each section before going on to the next one. Do not go back and start revising parts of what you have written until you have completed your writing.

Be practical as well. Do not be afraid to use paper. Leave wide margins and plenty of space between the lines. You are certain to revise what you are writing and you will need physical space on the page to include all the words. If you are writing by hand, it may be best to use lined paper to keep your handwriting under control. If you are keying in the manuscript, then double-space your printout so that you will have plenty of room to make corrections between the lines.

Revising the first draft Once your first draft is finished, you can start revising the paper. Remember that there are many steps in the publishing process, and the manuscript usually needs changes at every one of them. You should never think that what you have just written is perfect. You should always be prepared to revise what you have written.

Remember also that at this stage the scientific content of the paper is your main concern. Do not waste energy worrying too much about grammar and style yet. As you are reading what you have written in the paper, ask yourself questions like:

- are all the parts of the paper properly described?

- are there any major changes needed?
- is the logic of the paper sound?
- is the order of presentation satisfactory?
- is all the text needed?
- can any figure or table be eliminated or combined?
- is each piece of text in the correct section?
- is the sequence of paragraphs correct?
- are there enough or too many headings and subheadings?

The second draft

Once you have finished revising the first draft of your paper, it is time to tackle the second draft. Even professional writers usually prepare several drafts of any written document before it is polished enough to suit them. Do not worry if, even at this stage, the paper reads awkward. Time, patience, and persistence are required ingredients for good writing.

Once you are satisfied with the standard of your work and think you have a second draft, prepare the paper in a neat format, preferably the format of the journal. The next thing to do is to give the article to other workers in the same field and ask them to comment on the scientific content, pointing out errors of logic and interpretation, nothing where your writing is clumsy, and recommending further improvements. Also, and this is

an important note, you should put the article away for a few days or a week, then come back and reread it. You will be surprised at how many changes will be obvious if you do this. A short time away from the work gives you a perspective that will allow you to judge what you have written. This is particularly important for judging whether you have given the right amount of emphasis to the various points of your paper. This is the time to use the organization of your paper and your choice of words to highlight the most important points you want to make.

The third draft By now, you should be confident of the scientific content and structure of the article. Now you have to make sure that the paper can be read easily and your message understood. This is important, because to matter how good your results are, if the reader cannot understand what you are trying to say, you are wasting your time writing the article. Every section of the paper should be completely clear to the reader. This is one of the things that editors will be looking for. You should look for it as well.

Check the references At this stage, you must check that all the references in your reference list

are mentioned in the text. Then look at it the other way around and check that all the references cited in the text are included in the reference list. *Why?* Because you have been adding and deleting sections of the paper and you might have added or deleted references without changing the reference list.

Figures and tables Are all figures and tables present? and are they numbered correctly? You might have deleted or rearranged the figures and tables as you were writing the paper. Check that all the tables and figures with the paper are mentioned in the text, and that all the tables and figures mentioned in the text are included with the paper. Check also that the figure number on the original figure corresponds with its legend and its citation in the text.

Proofreading Make sure to edit carefully. Use a spell-checker if you have a computer. Strive to eliminate unnecessary or redundant sections. Add more to sections that clarify key points. (This is a normal part of the evolution of any paper). It often helps to proofread a manuscript printed on paper rather than one that is simply displayed on a computer monitor.

The final manuscript

Remember that the paper you send to the journal must be prepared according to the rules of publishing and the instruction of the journal, in the right format, using proper units, nomenclature, etc. You might not think this is very important, but the journal editor will. You have to worry about only your won article. The editor has to worry about the whole journal. The editor wants all units, abbreviations, etc., to be the same in every paper in the journal. The editor is looking for consistency throughout the journal. You should make sure that you prepare your final paper just as the editor wants to see it. Look again at the **"Instructions to authors."** Some of these are detailed. Note how wide the margins of the page must be, the line spacing, if headings should be on the left or in the middle of the page, how to indicate boldface and italic letters, and so on, and make sure that you and the person preparing the final text of the paper follow the guidelines.

Number all the pages. This is most important in case pages get out of order.

On the title page, make sure that you have given a title, the correct spelling of the authors' names, and accurate list of addresses for the authors, an abstract or summary, and keywords if required. In a multi-authored paper,

you should make clear on the manuscript to whom the proofs of the paper should be sent, who is responsible for the paper and is the contact for the editor or publisher.

Check that you are sending the required number of copies. Check if you should enclose a computer diskette or send an electronic version via the Internet as well, containing the file of your paper. Check on the requirements for the figures, original drawings, photographs, and so on and make sure you are following those instructions.

Wrap the whole package well, then look in the journal and find the correct address. You will often have to send the paper to an editor or editorial board at an address that is different from the publisher's address, so make sure you choose the right one. Some journals have different editors dealing with different subject areas. All this information is usually on the inside front cover of the journal; make sure you read it all carefully.

If you want to send the manuscript by airmail, a registered mail is recommended. If you do not receive a letter or e-mail from the publishers within in few weeks, you should write, asking them to confirm that they

received the package. Make sure that you have a good quality copy of the same version of the article you sent off. If the script is stored on a computer, make sure you have a backup copy in your computer, because if the paper is lost, you will have to send new, good quality copies to the publisher again.

For more elaboration, you must make sure the following requirements are fulfilled

- remember that your final manuscript is what the editor of the journal would like to see
- the importance of your manuscript is not decided by yourself, but the journal editor
- you worry about your manuscript and the editor worries about the whole journal
- make sure you prepared your final manuscript just as the editor wants—***Instruction to Authors***
- number all pages
- check if you are sending an attached file to your e-mail in the required format
- make sure you choose the correct address of the journal

Organizing a Manuscript

Time

YOU MIGHT ORGANIZE A PAPER on potato production trends during the 1980s and 90s based on TIME (chronology during a specified period).

Sequence

You would probably organize a how-to manual (for e.g. Potato Seed Production Manual) based on SEQUENCE (a series of steps in a prescribed order).

Space

You might organize a scientific article documenting the same set of experiments conducted in different national trails based on SPACE (trial sites or laboratory space).

Progression

You might organize a paper on modeling long-term soil erosion on the basis of progression (general to specific) first broadly defining the concepts of model and modeling, then presenting the various types of computer models appropriate to soil erosion, and finally naming a particular model to discuss in detail.

Importance

You might organize a scientific article on leaf disease of maize by discussing the various contributing factors (pathogens, genetics, environment, and so on) in order of their perceived importance; probably beginning with the most important and proceeding to the least. Some subjects dictate what the basis of organization will be. However, many require that the writer decide. For example, suppose you are planning an article on the role of missionaries operating in Ethiopia before the Italian invasion in introducing certain potato cultivars. Your basis could be TIME (chronology of events as they unfolded), SPACE (regions first exposed to potato cultivars), IMPORTANCE (relative impact of the cultivars), or CONCEPT (social or political ambition of the NGOs). Begin by breaking the whole of the

information into smaller and more manageable chunks. Then, observe which ones group together naturally.

Rank

Rank information according to its relative importance. Typically, the main points form the major divisions preceded by first-order headings. The subsidiary points form the subdivisions preceded by lesser-order headings.

Sequence

The ranked information; the divisions, and then the subdivisions; by deciding which one is the natural opener, which should logically follow the opener, which should come next, and so on. Once a satisfactory listing is achieved, notice how rough or refined it is. Is the outline a broad one from which a raw or big chunk of text could be generated? Alternatively, is it so detailed that it is essentially a filling in the blanks? No one type of outline is best: try to see what works for you.

Dynamics

In writing, relative position dictates importance. Placing an idea at the beginning or end of a sentence, paragraph, chapter, or section elevates its importance (makes it

louder). Placing the same idea in the middle diminishes it (makes it softer) and can effectively burry it.

Do not try to tell readers everything you know about a given subject, just what they need to know (the louder) points. Some of the more peripheral (softer) points, though of interest to you, may not be relevant to the intended audience. Do not become blindly enamored your material; it is not precious.

In organizing your message, watch for the following points

Continuity

Sometimes, while you are in the heat of composing, CONTINUITY—the coherence of the whole—goes haywire. On the other hand, you might unintentionally position text where it does not belong, perhaps in the wrong paragraph or under the wrong heading.

To foster CONTINUITY, it is an excellent practice to read over what you wrote during your last writing session just before beginning your next session. This helps to re-orient you within the document as a whole, remind you of what you said last, and prompt you about what you will say next.

Looking back will also help you detect other subtler problems of CONTINUITY. Hastily moving forward, the writer forgets to look back.

Parallelism

PAPRALLELISM is a fundamental aspect of order that it ramifies through writing on three levels

- structure of an entire document
- structure of the internal parts of a document
- structure within individual sentences

Structure of an entire document: A good example of this level of parallelism is a book's skeleton through a display of headings. Most books have several levels of headings. First-order headings precede the main points, lesser order headings the subsidiary headings. Because all headings of the same order function alike, they should be constructed alike, i.e., they should be parallel.

Structure of the internal parts of a document: Good example of this level of PARALLELISM is lists and descriptions. Lists are simple arrays of items either embedded in the text or displayed, i.e., broken out of text. Because items in each array function alike, they should be constructed alike, i.e., they should be parallel.

Structure within individual sentences: At this most localized structural level, PARALLELISM operates through individual words and phrases to ensure that functionally similar elements are aligned.

For example, Vitevar grass will be planted to stabilize irrigation canals, to provide forage for sheep, and to improve aesthetics in Werer Research Center.

Consistency

Once your writing is well constructed down deep, you can put the final changes on order being uniform, i.e., CONSISTENT in your format and terminology.

Format

Structurally parallel elements should be formatted consistently:

HEADINGS of the same order should look the same (ALL CAPITAL LETTERS? **Bold face,** *Italic*, Underlined, and so on

ERTRIES IN A DISPLAYED LISTING should look the same (each entry preceded by a number, letter, bullet First word of each entry capitalized or lowercase' The end of each entry punctuated. If so, with comma,

semicolon, period, or a question mark, spacing between entries, spacing between the main body of the text and the listing, and so on

TABLES should look the same. Table heading centered over the table or flush left, headings in all capitals and lowercase, headings pithy, with details in footnotes, or comprehensive to avoid footnotes, horizontal lines above and below table body, if so, how many, vertical lines allowed within table, rules or white space used to separate groupings with the table, units of measurement spelled out or abbreviated, and so on.

Format is usually specified by the person or organization or a professional society you are writing for.

Terminology

Using inconsistent terminology is one of the worst traps in agro-writing; and one of the easiest to avoid once you are sensitized to it. You should minimize the number of different technical terms you use to refer to the same thing.

For example, do not refer to your experimental materials varieties, genotypes, accessions, lines, or cultivars. Your

reader will be forced to guess whether these terms all refer to the same thing, whether some are the same and others are different (perhaps subunits), or whether all are different. You as a writer know because it is your study. However, your readers can only divine.

Remember to crosscheck text, including headings and captions, with tables, charts, graphs, and illustrations, if you have any, to ensure consistency of terms among all aspects of your paper.

An effective writer

- is clear in his message
- anticipates potential questions from reviewers and readers and answers those questions in the paper
- correctly interprets their data and delivers an accurate message
- uses efficient formatting and writing to save the reader time.

Reporting statistics

The following are main considerations in reporting and presenting your data or statistics

- are your data normally distributed? If so, you can talk about mean and standard deviation. If not, mean and

standard deviation from the mean are not appropriate calculations to use

- when you decide to represent data graphically, make sure that you know whether your data are continuous or categorical. Do not plot categorical data as a line. If you decide to break continuous data into categories, make sure you have a rationale for the categories, and make sure, you include your rationale in your figure legend or results section
- when plotting a linear regression analysis, be sure that the line is generated from the equation and is not plotted point-to-point
- ask yourself whether a graphical depiction of the data is necessary. Does your graph point out a trend in the data? If there were no trend or pattern to illustrate, would your data be just as meaningfully displayed in a table or talked about in the text?
- when you create a figure, can the reader get the take-home message by reading the figure legend and looking at the figure, or, does the reader need to read your discussion section three times over to understand your figure, do not make your readers work too hard to understand your data, especially editors, reviewers, and dissertation committee members. Also, the more convoluted your presentation of the data is, the more likely you are to make a mistake
- Finally, be consistent. If you give a ratio as 1:10, use the same nomenclature throughout the document. Do not

change from 1:10 to “1 in 10” to 1/10, to 0.1, etc. You will only confuse your reader.

Review Articles

REVIEW ARTICLES ARE DETAILED SUMMARIES of the work published on a specific topic. They either evaluate published work on the topic and provide an up-to-date synthesis of it or summarize the work without evaluating it.

A good review, like other research articles, starts with a well-defined question and either answers that question by a systematic search of the literature or produces new questions for further research. Unpublished work by the author should not be included in a review.

Before you write a review, look at the journal's instructions to authors and at reviews in the current issue to see what kind of review you are expected to produce. The editor's letter of invitation may define the

exact scope of the required article. If not, ask for a definition and discuss whether unpublished material that is not easily available (gray literature, personal communications) should be cited. Such material may be extensive.

Topics for review articles may also be proposed by authors who noticed the information gap. If you have such an idea:

- discuss it with an editor before getting down to a serious work
- describe the scope of the intended review and list the subtopics you plan to cover
- make it clear that you know what kind of review the journal usually publishes and that you plan to match the journal's requirements
- give the editor a realistic estimate of when your review will be ready.

Whenever the idea for the review article originates, you must be clear whether you are writing a critical review assessing a selection of published work or providing an annotated list of all the relevant works published during a given period.

Kinds of reviews

Reviews are categorized as based on their coverage (content) and time (chronology).

In terms of their coverage, Critical reviews, authoritative evaluations of published works, Bibliographic reviews, designed to compile and annotate but not necessarily to evaluate are included in this category.

In terms of the timeframe they consider, reviews are also classified as historical reviews, organized in chronological order (less common today), state of the art reviews, that provide a new understanding of a rapidly moving field by referring to recent literature.

Literature search

You will obviously have to do a lot of reading before starting to write a review article. When the scope of the article has been agreed with the editor:

- decide on the main headings under which you will tackle the subject
- make an outline of the article and plan your reading strategy
- start with background publications, such as research reports and earlier general reviews, before turning to the specialized work that is your subject

- make notes on your procedures, on the selections you make, on the criteria you use, and on everything you read
- keep notes and bibliographic details on paper or computer
- do not forget that you have to report quantitatively on all the references published during a given period and on the references you comment on in detail in the review
- guard the notes and bibliographic information carefully—prevent disaster by keeping a second set somewhere other than your regular place of work
- make photocopies or back-up copies of new or altered material at regular intervals.

As you read, your reading ideas on the topic will almost certainly change and broaden, your reading may then have to be extended beyond the original limits, and the original question may have to be widened or narrowed.

Writing a review article

Review articles, like other articles, should be written with their intended readership in mind. Even if you are writing for a specialist journal, some readers will be non-specialists needing an overview. Orientate such readers by providing a clear and simple introduction and by stating your conclusions clearly. If you are writing for a general journal, the readers are even more

likely to need a comprehensible and comprehensive survey.

Review articles do not usually have the standard headings—materials and methods, results, discussion—used in many research articles. After the introduction, they continue with a description of the literature review and end with conclusions and recommendations for future work. The headings in the middle of this sandwich (equivalent to the results section) depend on the aspects of the main topic.

In the introduction, describe the background as clearly as possible and state the question you set out to examine. In the literature review (or scope and methods) section, say whether you used conventional or computer-based searching methods, or both. Name the bibliographic databases earliest and latest dates covered. Mention how you assessed the reliability of the studies covered and their publication bias (the tendency to exclude studies with negative results).

In the main part of the text, summarize or evaluate the selected articles as objectively as possible. Indicate the limitation of the articles. Analyze variations in the findings critically. Set out your conclusions and

recommendations for further work clearly. Do not hide treatment of a controversy under the plain heading. Present both sides of a controversy as objectively as you can, and state your position.

In your conclusion, summarize your main findings and recommend directions for new research.

Make the reference list—likely to be a long one—as accurate as possible, always taking the details from the original publication. Reference lists in review articles are valuable sources for many researchers; mistakes are unprofessional and will waste a lot of people's time.

Follow the journal's recommended style for references. Check that each citation in the text is linked to an entry in the reference list and that every entry in the reference list has a corresponding citation in the text. If you want to include extra references that are not referred to in the text, put them in a separate list of 'Further reading'.

Include an informative abstract that is as complete as possible. State the purpose of the review, say what search methods you used, summarize your main findings, and indicate your main conclusions and recommendation.

Handling negative results

Like mentioned earlier, publishing a good paper is not a straightforward path; it is a time and resource consuming process, i.e., observations (problem identification), writing a proposal, designing the experiment, doing the experiment, analyzing data, writing up the manuscript, surviving the revision process and getting it published .

Behind a good paper, there is often a body of work based on the experience of negative results that could be forgotten. Some authors suggest that it might be a good practice to describe and write up results of experiments that failed or produced a negative result in a supplementary material. On the one hand, it is also suggested that it is not worthy to invest such a big effort preparing a paper just on a negative result, because it might happen that the underlying hypothesis is right but the experimental design, or the person conducting the experiment did it wrong. That is the reason why nobody can rely on negative results, unless obtained under highly restrictive conditions and controls. On the other hand, a place to upload simple reports on negative results might help other researches to design experiments that are more powerful or save them time.

Another thought worth mentioning is the fact that when research is planned on some issues, it is expected that some positive result though our aim has a null hypothesis. If always positive, results are to be appreciated then what is the need to do a research project. In research, there should be no prejudice and the results shall be published as they are with honesty. These negative results may contribute a lot for future research.

There are also more opinions that as long as negative results are accompanied with a good analysis they could be published.

Why Papers Reject Early?

OFTEN RESEARCH PAPERS ARE REJECTED for the issue not important, not appropriate for journal, data old, and now irrelevant, and ethical issues. The most common ones are

Relevance: If the paper is of limited interest to the publisher and it covers, local issues only for example, sample type, geography, and specific product

Novelty: If it does not offer anything new and if its significance is not immediately evident

Format/ Style/ Language: If the paper fails to meet submission requirements of the publisher or has language deficiencies

Scientific: There could be a number of reasons for rejecting a paper; however, the most common scientific grounds are

- unclear hypotheses
- poor or weak design
- sample biased or too small
- statistics inappropriate or misapplied
- conclusions unjustified
- references outdated

Presentation: The following are considered as affecting your paper to be rejected

- poorly organized
- badly written
- careless errors
- terrible tables
- needless figures
- outdated or improperly cited references

Research design: This is also very critical. The following are some of the common examples for rejecting papers:

- comparison group not clearly identified
- insufficient or inappropriate timing or strength of intervention
- questionable randomization

Sample and Sampling: Any unqualified approach in sampling has a cost too

- sample size too small or biased
- subjects insufficiently described
- sampling method inappropriate or insufficiently described
- population not identified
- sample too heterogeneous

Statistics: make sure you are taking care of statistical issues such as the following in your writing.

- analysis insufficiently described
- inappropriate analysis done
- analysis not specified
- *p* values not reported

Results: In results section of your paper the following are very critical a, thus, need utmost care:

- failure to provide all the data critical to answering the research question
- adding interpretations to results
- failure to adequately address statistical methods
- tables and figures inappropriate

Tables and figures: special attention should be given to tables and figures including the following:

- do not include identical information in a table and graph
- do not repeat the information from table or graph in the text
- the text just amplifies or explains the data

Graphs and illustrations: the following warrants attention to avoid rejection due to improper handling of graphs and illustrations

- unlike a table, show trends, frequencies, relationships
- bar graphs compare groups; line graphs used for variations in trends or trends over time; flow charts for summarizing steps
- should be stand-alone; use text to interpret, explain graph

Discussion: due attention should be given to the following issues pertaini9ng discussion:

- failure to summarize
- unwarranted review of literature
- no mention of limitations
- unwarranted conclusions not supported by the data

Style and Language

PUBLISHING IS A HIGHLY COMPETITIVE FIELD, and journals receive many more good papers than they can publish. An editor will select a well-written and well-presented paper before one that is clumsily written and presented, if the scientific quality is similar. Language and style are like packaging. Good packaging can never make up for poor content, but attractive packaging enhances good content. Clear, concise writing gives the impression of confidence and knowledge, credibility and authority. Much of the advice on writing scientific papers applies to writing in general.

The following points can help you in scientific writing.

Simple and direct language

Always choose the simplest way of saying something. Choose a simple word rather than a difficult one, a concrete work in preference to an abstract one, a familiar word instead of a rare one. Complex, hard-to-understand sentences are rarely good sentences. Good scientific writing communicates in simple terms, even though the subject may be complicated. Repeated use of unnecessarily difficult, abstract words and phrases makes the subject hard to understand.

Unnecessary and difficult words

`Verbosity' means to say a thing in a complicated way, with lots of words, usually to make it sound more important, this is poor style. For example, you might say "*The efficacy of the pesticide utilized was undeniable.*" This is verbose. Much better if you write exactly what you mean in a direct and simple way, as "*The pesticide used was effective.*"

Always try to use simple expressions. Avoid 'buzz words' and phrases that are suddenly popular but are not well defined, for example, 'sustainability', 'participatory approach', 'gender sensitive'. Concentrate on what you want to say and try to say it in the simplest, most direct way.

Double negatives

In English, you can use two negatives or negative words to make a positive statement. For example, '*It is not unlikely*'. '*Not*' is a negative, and so is '*unlikely*'. So they cancel each other out and mean '*It is likely*'. Although this sort of construction is common, it is convoluted and often gets in the way of plain speech. There is sometimes a fine difference in meaning between a positive statement and a double negative one, but if your first language is not English, it is better to avoid using the construction. Examples are

The total yield was not unimpressive. [The yield was impressive.]

Here the reader might miss the word '*not*' and misunderstand the meaning.

At no time was the disease absent. [It was always present.]

This is verbose; it uses extra words to say a simple thing in a more complicated, less direct way.

No decrease in numbers of species...

This is vague and ambiguous. Does it mean '*numbers stayed the same...?* 'or '*numbers increased...?*

Spelling

Check to see if the journal you have selected uses British, American English, or Canadian English, which is a mix of both. Then use that style of spelling consistently. Consistency is part of the packaging and helps give a paper a finished look.

Spell-check applications or programs are wonderful things. They are great at pointing out missed "opportunities." However, these programs cannot replace a thorough proofreading. For instance, they will not distinguish between duel (a fight) and dual (two). Nor will they catch misuse of homonyms like: "their, there and they're" or "your and you're". A spell-check program will not understand the difference between "serial dilution" (a series of solutions, each one more dilute by a specific amount) and "cereal dilution" (too much milk). Therefore, use spell-check programs because they eliminate many errors, but do not rely on spell-check to catch every error. Nothing replaces thorough review and proofreading.

Nouns from verbs

Nouns made from verbs, dominate scientific writing. Some writers call them "Nominalizations." They are often associated with awkward passive constructions.

Looking at the nominalizations in a sentence and "rescuing" the verbs can do a lot to make writing more understandable on a first-read. Nominalizations are abstract nouns.

This can be done quite easily: '*to measure*' gives '*measurement*', a common English word. Nevertheless, because it is a noun, you have to put a verb with it, for example, '*the measurement was done [or carried out]*'. Often, it is much easier to use a verb and say that something was measured. So instead of '*Measurements were carried out on the variation*', write '*The variation was measured*'.

Alternatively, if the subject is important: '*Bedada (1999) measured the variation*'. Other common examples of this are '*production*' from '*produce*', '*interpretation*' from '*interpret*', or '*observation*' from '*observe*'. Using such abstract nouns, too often produces long sentences and dull prose. The extra length comes in part from the length of the '*-iton*' nouns and in part from the need to use extra words as verbs. The dullness results from the abstractness of these nouns and the usually passive, weak verbs that must go with them. Replacing an abstract noun with a verb gives you more chance to

bring the subject into the sentence and make it more alive and specific.

In science writing today, abstract nouns are extremely common, but it is better to avoid using too many of them. When you review your manuscript, look for the nouns ending in **-tion, -ance, -sion, -ment, -ness, -cy.** Usually, you can replace them by rewriting the sentence using the verb. These changes may also shorten a sentence and put its elements into a clearer sequence.

For example:

Not: '*It is possible that the pattern of weeds now found at the site is a reflection of past disturbances*'.

Better and fewer words: *The pattern of the weeds now found at the site may reflect past disturbances.*

Noun clusters

In English, nouns can be used as adjectives and strings of them can be put together to form phrases. To some, these clusters sound impressive. However, in fact they hide the meaning of what you are trying to say and make the message unclear or ambiguous, leaving your meaning open to interpretation. Although these noun clusters are used frequently, your writing will be clearer if you avoid them. Note that nouns in a cluster are

usually abstract nouns. Sometimes, you can go back to the verbs and make a good sentence, with a clear meaning. Look at the way a noun cluster can build up.

You can start with:

Research

Which leads to:

Research dissemination

then:

Research results dissemination

then:

Research results dissemination improvement

and finally:

Research results dissemination improvement methods

This final phrase has become hard to understand. It is much clearer if you break it up:

Methods of improving dissemination of research results

Unfortunately, noun clusters are common today, especially in science writing. Two nouns together are easy enough to understand; when more are strung together, the meaning can be lost. As you look through your text, mark the places where more than two nouns

occur together. Then, go back and try to rephrase the sentences using verbs instead of nouns.

Errors of meaning and form

Make sure you understand the meaning of all the words you are using. Do not use a long word that you think sounds impressive unless you are certain of what it means. If you have used it wrongly, you will hide what you are really trying to say. Much better to use several simple words that give the correct meaning and are easily understood.

You may consider the following example for more elaboration

The use of “affect” and “effect” is often confused. The word "affect" is usually a verb meaning "to influence." Here are some examples of how the word "affect" can be used:

The pesticide affected the crop due to an overdose application

The word "effect" is usually a noun meaning "result." The following sentences show how "effect" can be used:

The fungicide may have serious side effects if applied at early growth stage of the plant.

If you do not know with certainty the exact meaning and connotation of a word, do not use it.

Jargon and buzzwords

According to the Oxford dictionary, jargon is "a mode of speech familiar only to a group or profession." All scientific disciplines have their own special language of technical words, which you should be careful not to use them in your manuscript without defining them. English has become the universal language of science because so many people understand it. However, if the reader cannot understand the specialized terms you are using, you are not communicating. Remember that researchers outside your own field or discipline may not understand the terms. Review your manuscript to make sure you have defined all the 'jargon' that you might have included. For example;

not: *Kubssa bread wheat yields less than other highland varieties*
but: *Kubssa, a highland variety of bread wheat, yields less than other varieties.*

not: *Samples were 5-cm augered from depths of 2 and 3 meters.*
but: *Samples from depths of 2 and 3 meters were taken with an auger 5 cm in diameter.*

The term jargon has other negative connotations. Jargon can seem like gibberish to most people. When a special

term arises because it describes or categorizes something in a helpful way, it is acceptable. However, when jargon becomes a way of making something sound more scientific, technical, or complex than it really is, it should be avoided. Jargon is sometimes merely doublespeak, and it is often responsible for wordy, heavy-handed sentences.

Buzzwords are terms that have spread beyond their original field, and people outside the occupation often use the words imprecisely or pretentiously, for example: *downsize cutting edge, holistic, benchmarking, paradigm, synergy, tipping point, next generation, sustainability, mainstream, state-of-the-art, and participatory,.*

In conclusion, jargons and buzzwords can have distinct meanings within a field; if you borrow them to describe other phenomena, you may be making a mistake. At the very least, you may confuse the reader.

Sentence structure

Avoid long sentences. How long is a long sentence? Any sentence that is more than two lines may be too long. However, remember that a mixture of short and long sentences adds variety and improves the rhythm of your

writing. There are several different types of sentences that are too long. Below are two common examples.

Hiding the subject under conditions

Often, you may have a list of conditions that describe the main topic of the sentence, but by including them, all you bury the main statement. Sometimes you can make a series of sentences, but at other times, it may be better to take the conditions out of the way. Either start a new sentence after you have said the most important thing, or make a list.

For example, here is a long sentence with a list of conditions hiding the main subject.

If the cooperative is to provide farmers with a fertilizer-supply service and help them produce more, and wash their coffee and help market it, and provide a ploughing and harrowing service, and market farmers' chat, it is meeting its objectives.

This can be understood much easier if the subject and verb are first identified and brought to the beginning of the sentence. A short list can follow:

The cooperative can meet its objectives if it provides member farmers with:

- fertilizer supply and marketing service

- a drying and marketing service for coffee
- ploughing and harrowing services
- a chat-marketing service

Parallel structures

Parallel construction signals to the reader that two ideas are of equal importance. If two or more ideas or items are connected by a coordinating conjunction such as "and," "but" or "or," then those ideas should be expressed in parallel or equivalent grammatical constructs. Items and ideas of equal importance should be presented using equivalent grammatical structures. Items in a list should be parallel: all verbal phrases, all nouns, etc. Parallel construction guides your reader and helps your reader organize concepts on a first read of your text.

Verb forms

Tense

Most of the time, the past tense is used in scientific papers because whatever is described in the paper has already happened. The **Introduction** describes work that has already been done. The **Material and Methods** section describes how the current work was done, and the **Results** section describes what happened. However, in the **Discussion** section the present tense might be

used for something that has already been demonstrated. For example

There are [present already known] *only 4 different amino acids in DNA, but we found* [past] *that...*

Where you are making predictions or describing current work, you might use the future tense: *These results mean that less fertilizer will be needed.*

Voices

Many books on English style and grammar checks in word processing software recommend that you avoid the passive voice because it makes text boring and dull, add words, reduce impact, and may confuse. This is true, but the passive voice is often used in scientific style. In the sentence '*We measured the variation*' (active), it is clear that the subject (we) did something (measured) to an object (the variation).

In the passive voice, the object comes first and has something done to it by the subject*: 'The variation was measured by us*'. In the passive voice, you can also leave the subject out and say '*The variation was measured*'. Most of the time, the subject is you, the writer, and the subject is not important in what you have to say. Readers do not

need to be told that 'you' measured the variation. However, you should try to use the active voice where it fits, because it adds variety and interest to your writing.

Some advices on voices

Avoid a passive voice in your writing. Use of passive verbs (is, was, has, etc...) represents an outdated, bland style of scientific writing. Active verbs convey information concisely and with greater impact. Thus, strive for an "active voice" when writing scientific papers.

As has been said earlier in this section most science journals expect the use of an active voice.

For example "Real life" examples of a "passive" voice (passive verbs in *italics*) with the same ideas rewritten in an "active" voice below (active verb underlined).

a) "There *were* no bees concentrated at the top three air holes as previously observed rather they *were* clustered around the air-hole screens between the upper and middle honeycomb". (29 words)

a') "In contrast to their previous concentration near the upper three air holes, honeybees clustered around the screened vents between the upper and middle honeycomb." (23 words)

b) "The objective of this observational trip *was* to determine the methods one *would* use to quantify the patterns of dispersion and association among animals in

nature." (26 words)

b') "We sought to develop methods that quantified natural patterns of animal dispersion and association." (14 words)

Personal pronouns

If you did the work, or if you think, something is right, then you should say it. Do not say, '*It is felt by us that... 'or* '*One of us...*' Take responsibility for your ideas or work. Classical science writing encouraged the use of impersonal language at the expense of readability and clarity. The contemporary trend is to use personal pronouns sometimes, to make a more lively style and easier reading.

Lists

Lists are often good to present material clearly and concisely. However, all items in a list should be grammatically parallel in their construction. They are in the list on the preceding page. Sometimes, however, an author starts a list one-way and then switches to a different construction halfway though. It would be *wrong*, for example, to write:

The objectives of the cooperative can be met if it provides member farmers with

- a fertilizer supply and marketing service

- to dry their coffee and market it
- ploughing and harrowing services for members
- marketing their chat for them

A good way to check if your series is parallel is to see if each item correctly completes the introductory part of the list. The rule of parallel construction applies even if the list is in straight text, without 'bullets' or items on separate lines.

Qualification

'Hedging' or qualifying a statement, is done when you are not certain of the truth of what you are writing. You use conditional verbs and qualify what you want to say. It is good to say 'perhaps' when you are not sure of something, but it can be taken to extremes: You can still stop short of being too definite by using a single conditional:

not: *within the limits of experimental error, and taking into account the variation in the statistical treatment, it may be likely that the drug produced a favorable response to the sample of patients.*
but: *The drug appears to have produced a favorable response...*

The latter says the same thing and is a lot more effective in delivering its message.

Unbiased language

Watch carefully to make sure that your paper does not include hidden biases in its language. To say '*the farmer and his wife*', is not only biased it is likely inaccurate, as a high percentage of farmers are women.

'Man' as a verb

Do not use '*man*' as a verb. '*Work*', '*staff*', '*serve*', '*operate'*, and other alternatives can be used instead

not: *The emergency room must be manned at all times*
but: *The emergency room must be staffed at all times.*

'Man' as a prefix

Speakers and writers often use '*man*' prefixed compounds in context where '*man*' represents males alone or both males and females. Alternatives for '*man*' are '*humanity*' and '*human beings*'. With a little thought, sentences can be rewritten:

not: *Will mankind murder Mother Earth or will he rescue it?*
but: *Will human beings murder the Earth or will they rescue it?*

'*Manpower*' is usually replaceable with '*personnel*', '*staff*', '*work force*', '*available workers*', '*human resources*'.

'Man' as a Suffix

not: *The spokesman of EIAR will meet with the farmers' representatives of Benishangul Gumuz at 4 pm*

but: *The representative of EIAR will meet with the farmers' representatives of Benishangul Gumuz at 4 pm*

not: *The Oromomen are said to prefer coffee.*
but: *The Oromos are said to prefer coffee.*

Pronoun problems

It has been common in English to use the pronouns 'he', 'his', and 'him' to refer to any unspecified or hypothetical person. Using 'he or she' or 'his or her' is clumsy. It becomes especially awkward when repeated. A writer can often recast the material in the plural, for example

not: *Each farmer received his share.*
but: *All farmers received their share.*

not: *The learner should not be cut off from his roots; his own culture and traditions should be respected.*
but: *Learners should not be cut off from their roots; their own cultures and traditions should be respected.*

Pronouns may also be eliminated by repeating the noun they refer to, but again this can sound clumsy. A synonym or substitute for the word may also be used.

not: *The farmer may have to do all the fieldwork himself.*
but: *The farmer may have to do all the fieldwork alone*
not: *With this variety, the farmer makes best use of his farmyard manure and his green manure.*

but: *With this variety, the farmers use farmyard manure and green manure to the best advantage.*

Rhythm and follow

The rhythm and flow of language is important in scientific writing. One of the best ways to ensure understanding of a complicated topic on a first read is to edit for rhythm and flow.

Some writers seem to have an innate sense of rhythm and flow, and the words that they type simply work really well together. Other writers must work a little harder. All writers, though, can improve the rhythm and flow of their writing.

One of the easiest tricks for improving the rhythm and flow is to read aloud. If you stumble over a sentence, stop. What caused you to stumble? If you can fix a sentence so that you do not stumble over it when you read it aloud, you have improved its flow.

Reading aloud also allows you to listen for things like the lack of parallel construction (with good parallel construction, items of equal importance are expressed in equivalent grammatical constructs), poor word choice, too often repeated words, incomplete thoughts and

sentences, and lengthy sentences that do not allow you time to breathe (much less think) as you are reading.

You may also try one of the tricks by reading the piece aloud while another person reads a printed copy. Some people cannot read exactly what is on the written page even when they edit as they read. If you are reading aloud and substituting words or making minor phrasing changes as you read, your listener can keep track of those changes for you on the printed copy. Quite often, those minor words and phrase changes can be incorporated, and they will dramatically improve the rhythm and flow of your writing.

Another trick to writing with rhythm and flow is to make sure that when you write, you are away from distractions, interruptions and constant starts and stops. If you can, find a place to hide out when you are writing.

Over the long term, the more you practice writing and the more you read well written writing, in or out of your field of expertise, the more your writing will improve.

Miscellaneous points

I, we, the present writer

'I think' is preferable to 'in the present writer's opinion' or 'we think', though an impersonal form may be necessary in a multi-author work.

A or an

Some authors still write 'an historical', 'a hotel'; publishers usually retain this where the author has it, but do not introduce it yourself. With abbreviations, it is sometimes difficult to know whether to use 'a' or 'an'; abbreviations can be pronounced as though they were spelt out (a Mr Brown), or as a word (an AAU faculty), or as separate letters (an MP): and there are borderline cases.

Singular or plural verb

'None' may be followed by a singular verb, but 'neither' as an adjective or pronoun should be followed by a singular verb; for number after 'neither . . . nor'

'A number of . . . are/is'. It is recommended you use the number . . . is' and 'A number . . . are'

'Data', 'errata', 'media' and 'strata' are plural nouns and should normally be treated as such; but in data-

processing 'data' is now treated as a singular collective noun.

Position of neither and both

See that these are correctly placed, e.g. 'which neither suits him nor I' should be 'which suits neither him nor me'; 'which both suited him and me' should be 'which suited both him and me'. Watch out for 'neither . . . or': authors slip up, especially where there is a long clause between 'neither' and 'nor'.

Position of 'only'

If there is any possibility of uncertainty, 'only' must be placed in the correct position; otherwise place it in the most natural-sounding position

For example does:

Weeds only cleaned on Saturday

mean

- only weeds are cleaned
- only weeds are cleaned on Saturdays
- weeds are cleaned, but not burned, on Saturdays

'Due to'

'Due to' is often used when there is no noun for it to refer back to

For example; Due to bad weather, planting the new tef variety of tef was cancelled

That and which

'That' should be used for defining clauses (restrictive element— is just part of a sentence you cannot get rid of because it specifically restricts the noun) and 'which' for non-defining (non-restrictive element):

For example, Hammers that do not have noise-dampening technology are on sale.

You cannot get rid of the words "that don't have noise-dampening technology" because then we would be saying all jackhammers are on sale, not just the special ones; so that means the clause is restrictive.

For example Jackhammers, which are useful for breaking up concrete, are on sale.

You could throw out the words "which are useful for breaking up concrete" and the meaning of the sentence would not change. Those words are just extra, meaning

they are non-restrictive, surrounded by commas, and "which" is the right word choice.

The simplest rule is to choose the relative pronoun "that" when you cannot get rid of the clause and the relative pronoun "which" when you can get rid of the clause.

'Of which 'and whose'

Some classical thoughts suggest that 'whose' should be used only when it refers to a person, but the use of 'whose' instead of 'of which' can save a very clumsy sentence.

For example, the pastoralists managed to retain their practice in range management of which was not based on the local law

Is not as clear as
The pastoralists managed to retain their practice in range management whose jurisdiction was not based on the local laws

Position of descriptive phrase

Such a phrase at the beginning of a sentence continues in force until the subject changes or it restated. In the sentence: 'In 2012 he went to Dessie and married a dressmaker in 2013', the date 2012 applies to both verbs, and the sentence should be turned round to read 'He

went to Dessie in 2012 and . . .' Or one could say 'In 2012 he went to Dessie, and he married. . .

Split infinitives

Each of these three sentences conveys a different meaning.

I want to live simply. The thought is that the speaker wants to live without the trappings of affluence. The speaker prefers a simple life.

I simply want to live. Here the thought seems to be that the speaker wants to live as opposed to dying.

I want to simply live. The speaker is tired of going to work, worrying about responsibility.

If the split infinitive coveys your intended thought and sounds idiomatic, leave it. If the split infinitive sounds awkward or muddies your thought, rewrite the sentence.

Ditto marks

Ditto is a mark used to indicate the word above it should be repeated. Ditto marks, 'ditto', and 'do' should be avoided in printed matter, except in a quotation. Sometimes it is possible to tabulate the material so that

no repetition is necessary; otherwise, the word or phrase should be repeated.

Avoid excessive quotation

Many researchers avoid quotes altogether. Instead, write others' ideas and findings in your own words... just be sure to cite the sources every time you do!

Avoid moody writing

Avoid touchy, feely, and moody writing that relies too much on your personal experiences or denotes feeling to the study organism.

For example "Chilada baboons seem to be attracted to other baboons and when the ecological conditions allow, they prefer being in large social groups."

Better: "When ecological conditions permit, Chilada baboons typically occur in large social groups."

Make the paper readable

If you have a computer with a choice of typefaces (fonts), please choose one that is large enough (at least 12 point) and easy to read (e.g. Times).

Use section headings and subheadings to orient the reader

Do not be afraid to repeat these in subsequent sections of a paper. Italics and indentations can help.

Do not use many words where few would do better

Writing is a very important part of science; it is used to document and communicate ideas, activities, and findings to others.

Words can comfort when we are feeling sad, inspire us to take action, acknowledge us for a job well done, humiliate us, and make us laugh, stimulate our thoughts, educate us, or incite violence. Our words are so much more powerful than we realize. We take our words for granted, because we say so many in a day.

Science communication through writing is a more powerful medium for sharing opinions than speaking; because it facilitates communication and collaboration. Eventually communication and collaboration contributes to advancement of the discipline or profession. Therefore, your values and ideas as a researcher are unique and important to the discipline or profession.

In science communication, you cannot miss the option of using professional vocabulary. Therefore, you have to acquire and learn to use the unabridged dictionary as an invaluable aid. A researcher should be able to broaden and deepen his word power in daily conversations, writing, and presentations.

The secret of good writing is to strip every sentence to its cleanest components. Every word that serves no function, every long word that could be a short word, every adverb that carries the same meaning that is already in the verb, every passive construction that leaves the reader unsure of who is doing what—these are the thousand and one adulterants that weaken a sentence.

Here are some examples to choose and apply comfortable and productive words in your writing.

Wordy	Better
…in establishments of a workshop rather than factory character	*…in workshops…*
…proved fatal in most cases	*… killed most of them.*
A maximum depth of ten meters	*Ten meters deep*
An account of the methods used and the results obtained has been given by….	*The methods and results are described by*
An increased appetite was manifested by all rats	*All rats ate more*
An oral presentation	*A talk*
At the other end of the educational spectrum	*In primary schools*
At the pre-school level	*The under-fives*
By any actual person in particular	*By anyone in particular*
Degree courses are in the process of development.	*Degree courses are being planned*
During the month of April	*In April*
Even when the class is engaged in reading and writing activities…	*Even when the children are reading and writing…*
Experiments are in progress to assess the possibility of using	*We are trying to use*
For a further period of fifteen years	*For another fifteen years*
How we speak depends on what speech communities we are actually operating	*How we speak depends on the people we are with.*
I myself would hope	*I hope*
I would have said	*I think*
If at all possible	*If possible*
In black and white only	*In black and white*
In no case did any of the seedlings develop disease symptom	*None of the seedlings developed disease symptom*
In no case did any of the seedlings develop disease symptom	*None of the seedlings developed disease symptom*
In the school environment	*In schools*
In virtually all sectors of the environment	Almost everywhere
It consists essentially of two parts	*It has two parts.*
It was observed in the course of the demonstration that…	*We observed…*
Maintain a high degree of activity	*Move about a great deal*
Measures on purely local terms	*Local actions*
Mechanisms of a physiological nature	*Physiological mechanisms*
No longer that 20 000 to 25 0000 words in length	*No more than 25 000 word*
On a dawn to dusk basis	*From dawn to dusk*
On a regular basis	*Regularly*

Wordy	Better
On a theoretical level	*In theory*
On an experimental basis	*By experiment*
On the educational front	*In education*
Outside the kidney itself	*Outside the kidney*
Over a period of the order of a decade	*For about ten years*
Peer groups	*Equals*
Several… are known to influence	*Several…influence*
Such is by no means the case.	*This is not so.*
Ten meters in length	*Ten meters long*
The committee was obviously cognizant of the problem.	*The committee was aware of the problem*
The reading and learning process	*Reading an learning*
The roads were limited in mileage	*There were few roads*
There is really somewhat of an obligation upon us…	*We should….*
They are without any sanitary arrangements whatsoever	*There is no sanitation*
They utilize for sustenance	*They eat*
To show the same high level of application	*To keep trying*
We are in process of making	*We are making*
Working towards an unanimous situation	*Trying to agree*
You are in fact quite correct	*You are right*
In view of the fact that	*Because*
A great deal of	*Much*
A greater length of time	*Longer*
A large number of	*Many*
A number of	*Several*
A proportion of	*Some*
A small number of	*Few*
A sufficient number of	*Enough*
After this has been done	*Then*
Aimed at	*For*
Are found to be in agreement	*Agree*
At a later date	*Later*
At an early date	*Soon*
At that point in time	*Then*
At the present time	*Now*
Bring to a conclusion	*Finish/conclude*
Carry out experiments	*Experiment*
Check on	*Check*

Wordy	Better
For the purpose of	*For*
Have been shown to be	*Are*
If it is assumed that	*If*
In all cases	*Always*
In all other cases	*Otherwise*
In as much as	*Because*
In between	*Between*
In conjunction with	*With*
In connection with	*About*
In most cases	*Usually*
In order that	*To*
In regard to	*About*
In spite of the fact that	*Although*
In the event that	*If*
In the vicinity of	*Near*
It is apparent therefore that	*Hence*
Later on	*Later*
Make an adjustment to	*Adjust*
Make an examination of	*Examine*
Not infrequently	*Often*
On a regular basis	*Regularly*
On two separate occasions	*Twice*
Prior to	*Before*
Proved to be	*Were*
Take into consideration	*Consider*
The question as to whether	*Whether*
Undertake a study of	*Study*
Using a combination of	*From*
Which goes under the name of	*Called*
With the exception of	*Except*
With the result that	*So*

Some common non-English words you may wish to use

Non-English word	English equivalent
a priori	from cause to effect
ab inition	from the beginning
ad hoc	for this particular purpose
de facto	in fact, actually
de novo	newly, again
in situ	in position
in toto	entirely, completely
inter alia	amongst other things
per annum	each year
per diem	daily
per se	of it self
rationale	reasoning

Watch out plural forms of non-English words

Singular	*Plural*
Criterion	Criteria
Datum	Data
Medium	Media
Phenomenon	Phenomena

Abbreviation of Latin expressions

Abbreviations of Latin should not be over used

Abbreviation	Full name	English equivalent
cf	*confer*	compare
et al.	*et alii*	and other people
etc.	*et cetera*	and the rest, and so forth
e.g.	*exmpli gratia*	for example
i.e.	*id est*	that is
NB	*note nene*	note well
per cent	*per centum*	by the hundred
q.v	*quod vide*	which see

Punctuations

Full stop

The **full stop** (**.**), also called the **period**, presents few problems. It is chiefly used to mark the end of a sentence expressing a statement, as in the following examples:

Getachew's latest book is not yet out in paperback.
I asked Almaz whether she could tell me the way to Bahirdar.

Question mark

A **question mark** (**?**) is placed at the end of a sentence, which is a direct question. Here are some examples

What is the capital of Tigray?
Who told you that?

Exclamation mark

The **exclamation mark** (**!**), known informally as a *bang* or a *shriek*, is used at the end of a sentence or a short phrase, which expresses very strong feeling. Here are some examples:

> *What a yield advantage over the old varieties of tef!*
> *That is fantastic!*

Comma

The **comma** (**,**) is very frequently used and very frequently used wrongly. In fact, the rules for using commas are really rather simple, though complicated by the fact that the comma has four distinct uses. The four uses of the comma are called the **listing comma**, the **joining comma**, the **gapping comma** and **bracketing commas**. Each use has its own rules, but note that a comma is never preceded by a white space and always followed by a white space.

Listing comma is used as a kind of substitute for the word *and*, or sometimes for *or*. It occurs in two slightly different circumstances. First, it is used in a list when three or more words, phrases, or even complete sentences are joined by the word *and* or; we might call this construction an *X, Y and Z list*:

Joining comma is only slightly different from the listing comma. It is used to join two complete sentences into a single sentence, and it **must** be followed by a suitable connecting word. The connecting words which can be used in this way are *and*, *or*, *but*, *while* and *yet*. Here are some examples:

Ethiopia has applied to join the WTO, and Kenya is expected to do the same.

You must hand in your research report by Friday, or you will receive a delay in refunding.

Gapping comma is very easy. We use a gapping comma to show that one or more words have been left out when the missing words would simply repeat the words already used earlier in the same sentence. Here is an example:

Ethiopia is famous for her coffee and spices, Kenya, for her flowers and fruits, and Uganda, for her beef and sugar.

Bracketing comma (also called **isolating commas**) do a very different job from the other three types. These are the most frequently used type of comma, and they cause more problems than the other types put together. The rule is this: a **pair** of bracketing commas is used to mark

off a weak interruption of the sentence — that is, an interruption, which does not disturb the smooth flow of the sentence. Note that word `pair': bracketing commas, in principle at least, always occur in pairs, though sometimes one of them is not written, as explained below. Look carefully at these examples of bracketing commas:

These findings, we would suggest, cast doubt upon his hypothesis.

Darwin's Origin of Species, published in 1859, revolutionized biological thinking.

Colon

The **colon** (**:**) seems to bewilder many people, though it is really rather easy to use correctly, since it has only one major use. But first please note the following: the colon is **never** preceded by a white space; it is **always** followed by a single white space in normal use, and it is **never**, **never**, **never** followed by a hyphen or a dash — in spite of what you might have been taught in school. One of the commonest of all punctuation mistakes is following a colon with a completely pointless hyphen.

The situation is clear: if you have unprotected sex with a stranger, you risk AIDS.

We found the place easily: your directions were perfect.

Semicolon

The **semicolon** (;) has only one major use. It is used to join two **complete** sentences into a single written sentence when all of the following conditions are met:

- the two sentences are felt to be too closely related to be separated by a full stop
- there is no connecting word which would require a comma, such as *and* or *but*
- the special conditions requiring a colon are absent.

In 1985, Ethiopia was shaken by a tragic event; the drought and famine.

There is one special circumstance in which a semicolon may be used to separate sequences, which are not complete sentences. This occurs when a sentence has become so long and so full of commas that the reader can hardly be expected to follow it without some special marking. In this case, we sometimes find semicolons used instead of commas to mark the most important breaks in the sentence: such semicolons are effectively being used to mark places where the reader can pause to catch his breath. Consider the following example:

> *In Somalia, where the civil war still rages, aid workers, in spite of their efforts, are unable to operate, and the people, starving,*

terrified and desperate, are flooding into neighboring Ethiopia and Kenya.

This sentence is perfectly punctuated, but the number of commas is somewhat alarming. In such a case, the comma marking the major break in the sentence may be replaced by a semicolon:

In Somalia, where the civil war still rages, aid workers, in spite of their efforts, are unable to operate; and the people, starving, terrified and desperate, are flooding into neighboring Ethiopia and Kenya.

Summary of colons and semicolons:

- use a colon to separate a general statement from following specifics
- use a semicolon to connect two complete sentences not joined by *and*, *or*, *but* or *while*.

Contractions

The apostrophe is used in writing **contractions** — that is, shortened forms of words from which one or more letters have been omitted. In Standard English, this generally happens only with a small number of conventional items, mostly involving verbs. Here are some of the commonest examples, with their un-contracted equivalents:

it's
: it is *or* it has

we'll
: we will *or* we shall

they've
: they have

can't
: cannot

he'd
: he would *or* he had

aren't
: are not

she'd've
: she would have

won't
: will not

Unusual plurals

As a rule, we **never** use an apostrophe in writing plural forms. (A plural form is one that denotes more than one of something.)

In British usage, we do not use an apostrophe in pluralizing dates:

> *This research was carried out in the 1980s.*

American usage, however, does put an apostrophe here:

This research was carried out in the 1980's.

Possessives

An apostrophe is used in a possessive form, like *Esther's family* or *Janet's cigarettes*, and this is the use of the apostrophe, which causes most of the trouble. The basic rule is simple enough: a possessive form is spelled with "'s" at the end. Hence:

Lemma's publication
my brother's flower farm

There are three types of exception.

First, a plural noun, which already ends in s, takes only a following apostrophe:

the farmers' excitement
my parents' shop

Second, a name ending in *s* takes only an apostrophe if the possessive form is not pronounced with an extra *s*. Hence:

Meles' philosophy
Abas' farm tools

The final class of exceptions is pronouns. Note the following:

He lost his book.
Which seats are ours?
The donkey lowered its ear.
Whose are these houses?

Note: *in particular the spelling of possessive its. This word never takes an apostrophe:*

The hyphen

The **hyphen** (**-**) is the small bar found on every keyboard. It has several related uses; in every case, it is used to show that what it is attached to do not make up a complete word by itself. The hyphen must **never** be used with white spaces at both ends, though in some uses it may have a white space at one end.

Most obviously, a hyphen is used to indicate that a long word has been broken off at the end of a line.

The hyphen is also used in writing compound words, which, without the hyphen, would be ambiguous, hard to read or overly long.

The dash

The **dash** (—), also called the **em dash**, is the long horizontal bar, much longer than a hyphen. Few keyboards have a dash, but a word processor can usually produce one in one way or another.

There are two slightly different conventions for using a dash. The more modern one is to put white spaces at both ends of a dash, while the older style uses no white spaces at all, but writes the dash solid next to whatever precedes and follows it. Both conventions are in use, and hence you may see either of the following:

Vegetable farmers in Gojam need organic fertilizer — or so they say.

The dash has only one use: a **pair** of dashes separates a strong interruption from the rest of the sentence. (A strong interruption is one, which violently disrupts the flow of the sentence.)

For example: A farmer — if there is one in the locality — would never agree to such a plan.

Capital letters and abbreviations

Capital letters

Capital letters are not really an aspect of punctuation, but it is convenient to deal with them here. The rules for using them are mostly very simple.

- the first word of a sentence, or of a fragment, begins with a capital letter
- the names of the days of the week, and of the months of the year, are written with a capital letter
- the names of languages are always written with a capital letter. Be careful about this; it's a very common mistake
- words that express a connection with a particular place must be capitalized when they have their literal meanings. So, for example, *Ethiopian* must be capitalized when it means `having to do with Ethiopia'

Abbreviations

An **abbreviation** is a short way of writing a word or a phrase that could also be written out in full. Therefore, for example, you might write *Dr Kebede* instead of *Doctor Kebede*. Here *Dr* is an abbreviation for the word *Doctor*.

Many large and well-known organizations and companies have very long names, which are commonly abbreviated to a set of initials written in capital letters,

usually with no full stops. Here are a few familiar examples

ETV
Ethiopian Television
ECA
Economic Commission for Africa

EIAR
Ethiopian Institute of Agricultural Research

AAU
Addis Ababa University

SNNPR
South Nations Nationalities and Peoples Regional State

Parentheses

Parentheses (**( )**), also called **round brackets**, always occur in pairs. Most commonly, a pair of parentheses is used to set off a strong or weak interruption, rather like a pair of dashes or a pair of bracketing commas. In the case of a strong interruption, very often it is possible to use either dashes or parentheses:

The destruction of our forest – and there is no doubt that the destruction was deliberate – horrified the world.

The destruction of Guernica (and there is no doubt that the destruction was deliberate) horrified the world.

We also use parentheses to set off an interruption, which merely provides additional information or a brief explanation of an unfamiliar term:

The number of tree species (currently about 6000, by most estimates) is decreasing rapidly

It is possible to put an entire sentence into parentheses, or even a series of sentences, if they constitute an interruption of an appropriate type:

It appears that 33% of cooperatives export 16–18 thousands of metric tons of coffee every month. (These figures are provided by a recent Central Statistical Authority survey.)

Parentheses may also be used to represent options:

The referees who decide whether an abstract should be accepted will not know the name(s) of the author(s).

Finally, parentheses are used to enclose numerals or letters in an enumeration included in the body of a text:

General style

Specific editorial requirements for submission of a manuscript will always require instructions to authors by publishers. However, the following general guidelines are applicable to make a paper readable

- print or type using a 12-point standard font, such as Times, Geneva, Bookman, Helvetica, etc.
- text should be double spaced on A4 size paper with 2.5 cm margins, single sided
- number pages consecutively
- start each new section on a new page
- adhere to recommended page limits

Mistakes to avoid

- placing a heading at the bottom of a page with the following text on the next page or insert a page break
- dividing a table or figure - confine each figure/table to a single page
- submitting a paper with pages out of order

In all sections of your paper

- use normal prose including articles ("a," "the," etc.)
- stay focused on the research topic of the paper
- use paragraphs to separate each important point (except for the abstract)
- keep a white space at the end of the paragraph or indent the first line of each paragraph and close space between paragraphs
- present your points in logical order
- use present tense to report well accepted facts; *for example, 'the grass is green'*
- use past tense to describe specific results; for example, 'When herbicide was applied, the weeds were brown'

- avoid informal wording, do not address the reader directly, and do not use jargon, slang terms, or superlatives
- avoid use of superfluous pictures - include only those figures necessary to presenting results

Numbers, Date, and Abbreviations

Numbers and Statistics

IN GENERAL, follow the following when using numbers and statistics in scientific writing

- use tilde (~) to mean *approximately equal to.*
- Numbers beginning a sentence must be spelled. Rewrite a sentence so you do not start it with numbers greater than ninety-nine
- Note one, two, three, … nine, 10, 11, 12… Exceptions: a 2-m tape measure; 3 million
- Put a space between numbers and units: for example, 75 kg. Exception: 75%
- 0.32, not .32

- 143, 2,461 or 2461, 21,278, 1,409,000…
- when you quote numbers, make sure you use the minimum number of significant digits or decimal places. For example, 23 ± 7 years is easier to read than 23.4 ± 6.6 years, and the loss of accuracy is not important in most situations
- use the appropriate number of digits: two significant digits for standard deviations (one digit if the standard deviation is for a descriptive statistic like height or weight, or if precision is not important); two decimal places for correlations, two significant digits for percentages. Examples: 73 ± 5; r = 0.45; r = 0.08; 16%; 1.3%; 0.013%
- if it is more convenient to show p values than confidence limits, show the exact p value to one significant digit (for $p < 0.1$) or two decimal places (for $p > 0.10$). Do not use $p < 0.05$ or $p > 0.05$. Examples: p = 0.03; p = 0.007; p = 0.09; p = 0.74. (The exact p value is important for anyone using your data to calculate confidence limits or using your data in a meta-analysis)
- make sure the significant digits of the mean and standard deviation are consistent. Examples: 20 ± 13; 0.020 ± 0.013; 156 ± 7; 1.56 ± 0.07; 15600 ± 700
- use the standard deviation as a measure of spread. Do not use the standard error of the mean
- show 95% confidence intervals for effect statistics like a correlation coefficient or the difference between means.

Dates

It is would be best to write dates using a word (in full or abbreviated) for the month: 12 November 2014 or 12 Nov 2014 or 12 Nov 14. The abbreviated forms are commonly used in tables. Using all numbers can cause confusion; the date 12/11/14 would be read as the 12th of November in much of the world, but in North America it would mean the 11th of December.

When writing out a date in text, no punctuation is needed if you write day-month-year. 'The trial began on 5 December 2013 and continued until 4 December 2010.' Nor is it necessary (or even desirable) to write '5th December', '4th December'. If you write month-day-year, you must use a comma both before and after the year. 'The trial began on December 5, 2013, and continued until December 4, 2014.' If you use just month and year, you do not need a comma between them: July 2012, not July, 2012.

Day-month-year is a logical, ascending order of the elements in a date. Also logical is the descending order that ISO recommends, in all-numeric date method of expression:

20140602 or
2014-06-02 or
2014 06 02

The order can be continued by adding hour, minute, second, if that degree of precision is required: 2010 04 18 1330 26.

In using Ethiopian calendar the year should be followed by EC for Ethiopian Calendar (for example; 2006 EC)

Units

Units should be expressed in metric or SI measures. If you are using traditional or local units or a unit that may be well known in only in Ethiopia, include an SI equivalent so that other researchers can fully understand the quantity you are referring.

Abbreviations

Abbreviations, or shortened forms of words or terms, are common in science today. Many scientific, technical, and industrial bodies have adopted standard forms of abbreviation. The object of using shortened forms is to save space and make reading easier. For example, it is much more difficult to read glycerolphosphorylglycerol than GPG. First spell out the whole word or term and

follow it with the abbreviation in parentheses: (GPG). After that, you can use GPG and the reader will know what it is. However, abbreviations are not usually used in a title or an abstract.

Spelling out a term before you abbreviate it avoids a common danger: what is obvious to you and familiar in your specific field may be completely unknown to workers outside that area. What might be obvious to all researchers in one field or one country may not be so easily understood by scientist in another country or discipline.

It is often impossible for a reader to work out what an unrecognized abbreviation stands for. However, you do not need to spell out, even the first time, abbreviations common throughout science, such as SI units.

Especially for a longer work, such as a proceedings or a book, you may want to include a list of the abbreviation you use so that readers can look them up easily.

Different journals have different policies about abbreviations. Rules on the use of abbreviations and symbols are included in almost every 'Instructions to authors'.

Currency

ISO has designated a 2-letter code for every country in the world, and a 3rd letter for the currency of the country. This system avoids having to use currency symbols-often not on keyboards or hard to get at on extended character sets. Thus instead of € $, £, ¥, Pt, the system advocates, USD (US dollar), euro, GBP (pound sterling), JPY (yen), and so on. Ethiopian currency is written as Birr (not Ethiopian birr)

Contractions

A contraction is an abbreviation in which letters are removed from the middle of the word so that the last letter is the same as the full word, for example, Dr = doctor; concn = concentration. In the British style of punctuation, contractions usually do not have a full stop (period) at the end, whereas abbreviations will, for example; temp. = temperature. However, the American style of punctuation uses a period after both abbreviations and contractions. Therefore, you should be sure to check the journal for which you are writing to determine which style it uses.

Acronyms

Words made up out of initial letters or parts of a name are called acronyms, for example

EIAR for Ethiopian Institute of Agricultural Research,
EPA Environment Protection Authority
AAU for Addis Ababa University
UNESCO for the United Nations Educational, Scientific, and Cultural Organization

An acronym can be made for any long-term, but all should be defined the first time they are used.

Symbols

Symbols are similar to abbreviations or acronyms, but they are usually shorter, for example, A_{260nm} for absorbency at 260 nm, P_i for inorganic phosphate, Ω for ohm, % for percentage. Many symbols are widely accepted and do not need definition, but you should be careful to define any new or uncommon symbol.

Converting non-SI units to acceptable units

Non-SI units	Multiply by	Acceptable units to obtain
acer	0.405×10^{-3}	Square meter, m^2
acre	4.05	hectare, ha (10^4 m^2)
acre	4.05×10^{-3}	square kilometer, km2 (106 m2
calorie	4.19	joule, J
cubic feet	0.028	cubic meter, m^3
cubic feet	28.3	liter, 1 ($10^{-3}m^3$)
cubic inch	1.64×10^{-5}	cubic meter, m^3
foot	0.305	meter, m
gallon	3.78	liter, 1 (10^{-3} m^3)
gallon per acre	9.35	liter per hectare, 1 ha^{-1}
gram per cubic centimeter	1.00	megagram per cubic meter, Mg m^{-3}
gram per square decimeter hour (transpiration)	27.8	milligram per square meter second, mg m^{-2} s^{-1} (10^{-3} g m^{-2} s^{-1})
micromole (H_2O) per square centimeter second (transpiration)	180	milligram (H_2O) per square meter second, mg m^{-2} s^{-1} (10^{-3} g m^{-2} s^{-1}
micron	1.00	micrometer, m(10^{-6} m)
mile	1.61	kilometer, km (10^3 m)
mile per hour	0.477	meter per second, m s^{-1}
milligram per square decimeter hour (apparent photosynthesis)	0.0278	milligram per square meter second, mg m^{-2} s^{-1} (10^{-3} g m^{-2} s^{-1})
ounce	28.4	gram, g (10^{-3} kg)
ounce (fluid)	2.96×10^{-2}	liter, 1 (10^{-3} m^3)
pound	454	gram, g (10^{-3} kg)
quintal (metric)	10^2	kilogram, kg
square centimeter per gram	0.1	square meter per kilogram, m^2 kg^-
square feet	9.29×10^{-2}	square meter, m^2
square inch	645	square millimeter, mm^2 (10^{-6} m^2)
square mile	2.59	square kilometer, km^2
square millimeter per gram	10^{-3}	square meter per kilogram, m^2kg^{-1}
temperature (^{0}F – 32)	0.556	temperature, ^{0}C
temperature (^{0}C + 273)	1	temperature, K
tone (metric)	10^3	kilogram, kg
ton (2000 lb)	907	kilogram, kg
ton (2000 lb) per acre	2.24	megagram per hectare, Mg ha^{-1}

Publishing Ethics

YOU SHOULD ALWAYS KEEP IN MIND the way things are done and the strict code of ethics that exists in scientific publishing.

Using other people's words or data (plagiarism)

It seems unnecessary to discuss the ethical problems associated with "stealing" someone's property, but such theft is common. Stealing data is a more serious matter. This kind of theft can never be done unconsciously; the perpetrator always realizes (or, at least, he/she should) that what he/she is doing is wrong. The consequences of this act should be the same as the consequences for making up data.

If you use someone's work without paying attention to the copyright, you are stealing—plain and simple.

Whether you can get away with it or nor is irrelevant. It is still theft, and it is still unethical.

Not reporting others work

Failing to cite the work of others that is related and complementary to your own is a bad form; it is depriving others of their reward.

Working in a popular field, there may be several previous papers on the topic. It may be impossible to cite them all. There is no set formula for this decision; you simply decide which are most important to the case you wish to make. Those whose work you miss may have their feelings hurt. Perhaps a statement that there is other work un-cited will suffice. For any scientific paper, there are certain earlier works that *must* be cited.

These are the papers that any honest researcher would be ashamed to omit from his/her references--and that any careful referee would insist on. Clearly, there is another group of earlier works whose importance to the paper may be debated by different referees.

Putting your name on work you did not do

There are strong pressures for a researcher's name to appear on as many publications as possible. These have led to an explosion of author lists on papers and to inclusion in such lists of people who made no substantial contribution to the work or know nothing about it. It is not always clear whose name should be put on a paper. There are certainly people who have a legitimate claim to authorship, but there are many who do not.

Double publishing and multiple submissions

Using the same body of data to produce two papers that are published in two different places is double publishing. This is strictly forbidden in scientific publishing. In addition, never submit the same article to several journals at the same time. If you are found out, it could be very embarrassing for you.

Many international journals are becoming ruthless in their treatment of what they consider dishonest authors. Double publishing and multiple submissions are looked upon as cheating. Most journals make it a condition when they accept a paper for consideration that it is not being considered for publication anywhere else. Submit one paper to one journal at a time. Never try to make

two different papers out of the same block of data. The exception to this rule is writing for a general audience in a popular publication. After your research paper has been published in a scientific journal, you may then rewrite the material for a lay audience and publish it in the media. This is and thus need to be encouraged. It is often only in the way that, the public knows what scientists are doing. Even funding of project proposals can come about through popular write-ups of research.

If an article has already been published in your own language, you should not expect to translate it, send it off to an English-language journal, and publish it there. This may be seen as unethical. If you intend to do this, you should tell the editor of the English-language journal what you have done as you submit the paper. If your research has already been published in another language, then you might be able to translate and adapt the material for another journal, but it is best to check with the journal first. Remember also that you will probably need the original journal's permission to use the material in that way.

If an article or a body of research has already been published as a preliminary communication, read at a major symposium, or published in a proceeding, this

should be pointed out to the editor. Publication like this may not mean that your paper is automatically rejected, but telling the editor is common courtesy and will protect you from later misunderstanding.

You should also contact the conference organizers if you are doing this, if they hold the copyright to published proceedings.

Publishing the same results many times

This problem shows up in several different ways.

First, some authors have published exactly the same paper in two different journals. Whereas this practice is not as common as it once was, it does happen, and one occurrence is too many.

Another form of this problem is the publication in a journal and then in multiple review articles of identical data. Albeit there is no rule against this, it does get a bit dull reading the same thing multiple times.

The third form of this problem is series of articles in which the data are published piecemeal instead of all together. Some authors publish the report of a project on the installment plan. They report the results of a small

group of subjects, then, those of a larger group and finally the entire study. Still others do a study, parcel it into small units, and then publish each small part as a separate paper. Again, this is not prohibited, but it is not a good practice to pad one's curriculum vita while forcing the reader to synthesize what the author should have done.

Failing to obtain approval from authors

Every author whose name will appear on a published paper has the right and the responsibility to review the paper before it is submitted. He should know what the paper is about, understand the rationale for the experiments, understand the methods used, know the results obtained, and know the conclusions drawn. Furthermore, he should agree *completely* with *everything in the paper*. Anyone who has not done all of these, should not appear in the author list.

It may be surprising, but there are authors who did not know their names were included on a paper until they encountered the paper while browsing in the journal. Sometimes they have been very shocked by the viewpoints appearing in print under their names, viewpoints with which they could not agree. Just as it is unethical to leave a deserving coauthor out of the author

list, it is unethical to include an undeserving or uninformed coauthor.

Another reason for the low number of failures to confirm hypotheses is that the hypothesis stated in the paper is the converse of the one actually tested. In other words, the investigator claims that he obtained results supporting one hypothesis when actually he obtained results inconsistent with the original, opposite hypothesis! What, you ask, is wrong with that? *It is a clear violation of the rules of evidence*. An investigator may not use data that suggested a hypothesis (in this case the converse of the one actually tested) to support that hypothesis. Only data *collected to test* a hypothesis may be used to support it. In this situation, *another experiment* must be done to obtain data supporting or refuting the converse hypothesis.

One rarely is able to apprehend the reason for a deviant value. What should be done? There are a number of approaches that could be taken. The first is to include the value with all of the others. If the results are insignificant because of that value, then a larger sample will have to be drawn. The statistical evaluations could also be made with *and* without that value and the results of both analyses presented along with an argument as to

why the deviant value should be disregarded. In this case, it is left to the reader to decide whether he believes the value belongs in the sample or not. Either approach would be valid; the latter makes thorough use of data.

Authorship

Another consideration is authorship. Who holds the rights to the data? Who did the research? Are you entitled to write up and publish the work? Whose names should be on the paper? If you did some research in another country, perhaps for an MSC or a PhD, you are entitled to use that material, but you should always clear it with the supervising body of the university or institute in which you worked.

If you intend to name other people as co-authors, you must check with them to ensure that they have no objections.

The names at the top of the paper should be those of the scientists who did the research, and nobody else. Some journals allow special mentions like "with the technical assistance of..." on the title page, but these are rare. Journals do not want director's names first or anywhere at all, if they did nothing in the experiment or in helping

to write the paper. Do not load up your paper with a long string of names.

Authorship is a dangerous area. Journal managers are just as sensitive about disputed authorship and allegations of stolen results as they are about double publishing, so be very careful that every author you mention fully agrees with the publication of the paper in the form that you present it.

For inclusion as an author, they must make a substantial contribution in one (or all) of the following areas:

- conception of the ideas or experimental design
- execution of the study
- analysis or interpretation of data
- the person who writes the bulk of the manuscript tends to be first author
- do not load up your paper with a long string of names
- every author mentioned should agree with the publication of the paper

Who is not an author?

The following are not enough to be an author

- editing of the paper
- providing funding, equipment or lab space

- being an advisor; but, advisors often do contribute in other ways, too
- laboratory or field technicians or assistants: While they often do the bulk of the labor, they normally do not have intellectual input into the project.

The acknowledgements section is where you thank the people who contributions in these ways.

Copyright

People who write anything, however long or short, automatically possess, in most countries, certain rights to their work. This is based on the idea that if you have spent your time writing something, and then if someone else uses it, you should expect to be rewarded for that use. You wrote it so you should be able to choose and control where and how it is published. This is known as copyright. You hold the copyright to your work.

If a written work is to be published, the authors will usually transfer some or all of these rights, by formal agreement, to the publisher. Two of these rights are the right to make copies of the work and the right to distribute these copies. This is international practice. Most journals will publish a copyright notice where they claim the copyright. This is made up of the copyright symbol ©, sometimes the word '***copyright***', the year of

publication, and the name of the copyright holder. Sometimes the phrase '*all* rights reserved' also appears.

Data fabrication

- never fabricate data
- never falsify data. For example, d*o not throw out data points that "do not look right"*
- do not plagiarize
- do not reword (and even then attribute the source)
- direct quotes are rarely used, but make sure you use quotation marks and properly cite the source.

Fraud or error

There is no doubt, as everyone else; researchers make mistakes. It is easy to transpose two digits in recording data or press the wrong key on a computer keyboard. However, is not there a difference between this kind of mistake and fraud? According to the dictionary, fraud is an "intentional deception to cause a person to give up property or some lawful right." The difference between fraud and an honest mistake seems to be a matter of "intention." Fraud is done intentionally; a mistake is done by accident.

"Of all the violations, fraud is the gravest. As with error, fraud breaks the vital link between human

understanding and the empirical world, a link that is science's greatest strength. However, fraud goes beyond error to erode the foundation of trust on which science is built" (Committee on the Conduct of Science, 1989).

"The only ethical principle, which has made science possible, is that the truth shall be told all the time. If we do not penalize false statements made in error, we open up the way for false statements by intention. A false statement of fact made deliberately, is the most serious crime a researcher can commit." (Snow, 1959)

Permission to reproduce material

If you want to include in your publication a figure or a table of other matter from a published work that is under copyright, you must get permission from the copyright holder. It is your responsibility as an author to do this. Take care to include in the legend of the copied item a full credit to the source, including author, publication, date, and publisher. A typical credit line in a figure legend would read as follows:

Guarantee of material

In submitting a paper to a journal, author guarantee that

- the work is original

- the author owns it
- no part of it has been published previously
- no other agreement to publish all or part of it is outstanding

If you have published a significant part of the material elsewhere, you must obtain written permission to reprint the material from the copyright holder and send a copy to the publisher. You must also mention this matter of copyright in your paper.

Conference and journal publishing

If you read a paper at a conference, the proceedings of that meeting may be published later. If you submit the same paper to a journal, you are in danger of committing two offences: double publishing and breaching copyright.

If the journal article is published first, you will need that publisher's permission to print the paper in a conference proceedings, even though you read the paper at the conference before sending it to the journal, if the paper is to be published by a journal and the conference proceedings are already published, you will need the permission of the conference publishers to print the paper in the journal. Either way, you will be publishing

the same research results twice; that makes journal editors nervous.

How you resolve this problem? Simple. Do not do it. Withdraw the article from the conference proceedings before you submit it to the journal, or do not submit it to the journal. Do not wait to see if the journal accepts it before you withdraw it.

Many papers read at conferences are preliminary, or parts of a larger work. In this case, you may submit the whole work later to a journal, but again, you may need copyright permission parts of it. You should tell the journal editor, from the very start, what you are doing.

Should you acknowledge sponsor in a publication?

Unless, for some special reason, your sponsor does not want its support acknowledged, your paper should include acknowledgements, usually including the project code

Steps in Science Writing

AS HAS BEEN DISCUSSED IN DIFFERENT PARTS OF THIS PUBLICATION, researchers need to develop the skills of writing in science if they are to communicate clearly the full extent of their ideas, knowledge, and understanding and so achieve highly. Decide which of these ten steps you need to take to enable researchers to succeed in producing better writing in science.

Before you start writing your manuscript, try to develop some habits as a science writer. Writing ability will probably compound if you just continue to maintain these habits, even if you are not a natural writer. You may already do one or two of the following habits. However, maintaining all the habits all at the same time will have more substantial snowball effect over the long haul.

Keep dictionaries at hand and use them on a regular basis. This is a simple yet powerful way to improve your writing. Using dictionaries will also help you to clarify your thinking processes and to choose the right word.

The reason why you should use a thesaurus is that you can find short, familiar words. Do not try to impress others by using unfamiliar words. Unfamiliar words are powerless. In addition, you can reduce phrases or words you unconsciously use repeatedly by replacing them by others.

Watch the spelling. If you try to memorize the spelling of a word by associating it with the pronunciation, you may misspell. If you know words, you often misspell, pick up these words, and store them in flash cards. Watch them from time to time, and try to visualize them in your metal mind.

Here are the most common steps in science writing.

Step	Title
1	What is the right time to publish?
2	What question has been asked, and what are the conclusions?
3	What is the most suitable journal?
4	How are the findings related to the existing body of knowledge?
5	Write the title and synopsis
6	Reread the "Purpose and Scope" in the chosen journal
7	Read the Instructions to Authors
8	Decide on the basic form of the article
9	Stock the section reservoirs
10	Construct the tables and figures
11	Construct the sentence outline
12	Construct the sentence outline
13	Think of the article as a unit; write the first draft continuously from beginning to end
14	The Introduction: keep it short
15	Construct the list of references as you go along
16	Materials and Methods section(s): include the right amount of detail
17	Results section: allow the data to speak for themselves
18	Discussion section: watch for symptoms of megalomania
19	Are major alterations necessary?
20	Polishing the style
21	Give drawings to Illustration Department
22	Write title and abstract in final from
23	Reread the journal's instructions to authors before having the manuscript typed
24	Departmental review
25	Shelve the manuscript for a while

Checklist of Information on a Journal

THE FOLLOWING INFORMATION is presented in almost all scientific journals.

Information	Cite
Title	Front cover, spine, heading of contents list
ISSN	Front cover, heading of contents list
Volume and number	Front cover, spine
Date of issue	Font cover, spine, heading of contents list
Publishers address	Inside front cover
Editorial board	Front cover, inside or out
Editorial address	With notes to contributors
Scope of journal	Inside front cover
Frequency and month of publication	Inside front cover
Price and acceptable method of payment	Inside front cover
Copyright notice	Inside front cover
Contents list	Back cover, front cover
Permissions statement	Inside front cover
Note for contributors	Inside cover
Mailing notice	Inside front cover

Peer Reviewing

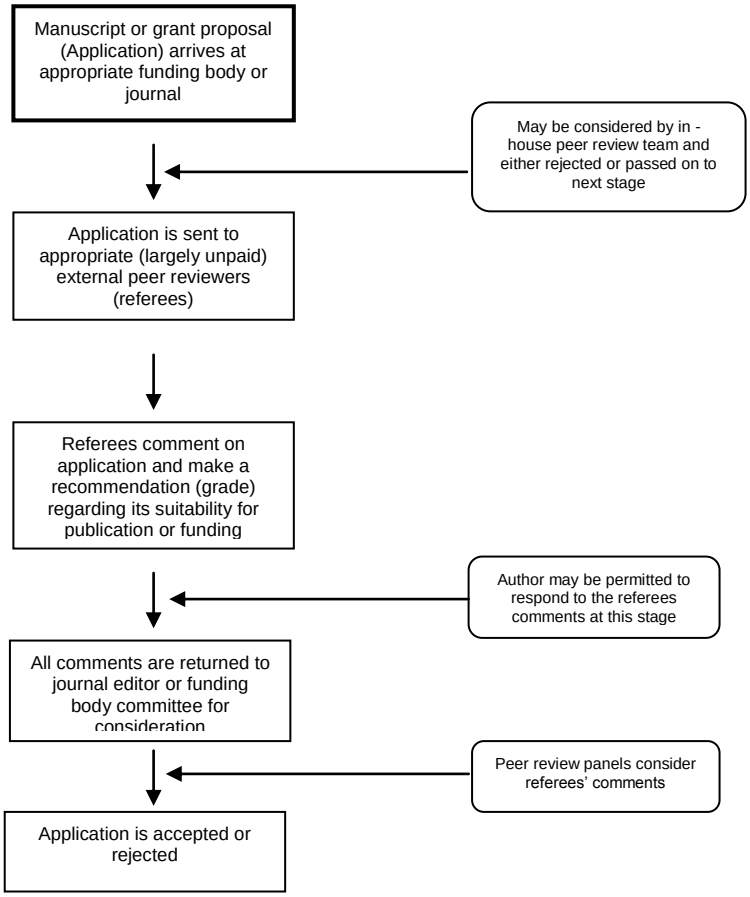
AFTER ATTAINING AUTHORSHIP STATUS AND RECOGNIZED IN THAT REGARD, you may be invited to be a peer reviewer to evaluate work by others in your field for a journal papers being considered for publication. Peer review helps editors decide what to publish, and it helps authors improve their work. It can help you keep up in your field and maintain your critical skills

What is peer review?

Peer review is a system whereby research – or a research proposal - is scrutinized by independent experts (peers). In general, the process serves a technical (ensuring that the science is sound) and a subjective function (is the science interesting, important and/or groundbreaking).

Your main task as a peer reviewer is to evaluate the content of the paper. Is the research of high quality? If not, what are the problems? Has all the appropriate content been provided? Should any content be deleted? In answering the last two questions, you may find it useful to review the sections of this book on the respective sections of a scientific paper.

The flowchart below gives a brief overview of how the process works to select science for funding and publication, although in practice, there is considerable variation in peer review processes between publishers and journals.



Peer review is used for three main purposes:

- Publication of research in scientific journals. Peer review is used to assess the quality of research submitted for publication and to assess its importance. The process thus influences what science enters the public domain, where it is published and what impact it will have (the more prestigious the journal, the greater the likely influence of the publication)

- Assess the research rating. Peer review has been used to judge the quality of research conducted by each department
- Allocation of research funding. The main funding bodies all use peer review for advice on which research projects should be funded in the first place and to assess the progress of funded projects.

In addition to the above, peer reviewed science is playing an increasingly influential role in the formulation of policy and decision-making. The following sections analyze the issues arising from the use of peer review.

Issues

Peer review is designed to improve the quality of research writing and prevent poor research from taking place. It is generally regarded as having the confidence of the research community.

The accuracy and readability of research manuscripts is improved between submission and publication, due to peer review, and technical editing. There is also some evidence that peer review is effective at weeding out poor quality research at publications level. In general, peer review is held to be beneficial to the scientific

community and has become central to the process by which science is conducted and communicated.

There are a number of issues raised by peer review are discussed below.

Fraudulent research

Peer review relies on mutual trust and honesty

Researchers must entrust their data/ideas to referees while referees must trust that researchers are telling the truth. Because of this reliance on trust, the peer review system is open to abuse. Recent years have seen a small number of high profile cases where the system has failed to detect fraudulent research, although these cases are thought to account for only a tiny proportion of peer reviewed research. Fraudulent research can take a number of forms including:

Fabrication: where data or cases in manuscripts submitted for publication are simply invented.

Falsification: where data in manuscripts submitted for publication are distorted or manipulated in some way. This can include ignoring 'inconvenient' results and analyzing data in inappropriate ways.

Plagiarism: copying of data, papers, or ideas. This can occur in manuscripts submitted for publication and in research proposals for which funding is sought.

Failure to disclose conflicts of interest: The increasingly close links between science and industry have led to concerns that commercial interests may bias the scientific literature.

Other forms of scientific misconduct: These can include (undisclosed) redundant publication (where authors publish the same paper in a number of different journals) and gift authorship (where senior members of staff lend their names to papers with which they have had little or no involvement.

Preserving the status quo

Peer review is an inherently conservative process that encourages the emergence of self-serving cliques of reviewers, who are more likely to review each other's grant proposals and publications favorably than those submitted by researchers from outside the group. This could have a number of consequences. For instance, it may:

- discourage researchers from moving into new fields in which they have no record of accomplishment
- make it difficult for junior researchers to obtain grants or publish their research
- present difficulties for multidisciplinary work, since peer review committees that do not contain individuals qualified to judge all aspects of a proposal may be less likely to approve the funding
- result in the funding/publication of 'safe' research that fits neatly into the conventional wisdom and work against innovative, 'risky' or unconventional ideas.

Inefficiency

Peer review can be relatively slow and inefficient for both funding and publication. Reasons for this may include:

- failure of referees to keep to deadlines -reviewers are commonly given 3-4 weeks to complete and submit reviews, but typically only 50% keep to this deadline
- inconsistency between referees often means that must be sought, thus slowing the process
- recruiting and retaining referees is increasingly difficult (acceptance rates are typically as low as 50%)
- the lengthy time taken for editors and funding bodies to reach a decision regarding the fate of an application (sometimes up to six months)

Anonymity

The majority of peer review is conducted anonymously. That is, the authors do not know the identity of the referees. This practice has traditionally been based on the assumption that anonymity increases objectivity and honesty. However, some scientists believe that anonymity provides an opportunity for settling old scores and burying rival research. An alternative to the traditional system is open peer review where referees' identities are disclosed to researchers. The relative merits of each system are a topic of lively debate. Arguments against an open system include

- junior researchers may be unwilling to give an unfavorable review to a senior scientist
- referees are less likely to provide critical reviews
- it may be difficult to recruit referees to an open system

Arguments supporting an open system include

- reduces abuses of the system
- renders referees more accountable for their comments
- increases the credit given to referees

In summary

- peer review is important – it is the process by which researchers and editors seek to ensure that only high quality research is funded and published
- peer review thus has a role to play in maintaining public confidence in scientific research; peer reviewed science also informs an increasingly wide range of policy decisions
- although it is the best available system for assessing the quality of science, it is not perfect; nevertheless, increased efforts are being made to improve the efficiency and transparency of the peer review process
- a peer reviewer is not expected to comment in detail on the writing. The task does not include identifying every punctuation error and misspelling; if the paper is accepted, a copyeditor can correct such problems
- it is worthwhile to comment in general on the clarity, conciseness, and correctness of the writing; to note passages that are ambiguous; to suggest any reorganization that could improve the paper; and to remark on the design of figures and table

Revolution in Scientific Communications

THE CURRENT EVOLUTION IN SCIENTIFIC COMMUNICATION is revolutionized by the Internet. The Internet is obviously and tremendously desirable. It is producing a much more efficient system that is serving the scholarly community and the public.

.

Publishers and information managers are stepping up the evolution by approaches that require researchers to make preprints of their papers freely available on the Web. However, such steps are in some ways construed as interfering with the workings of the market. Hence, publishers are forced to adjust much faster than they are doing publishing business now.

Digitization of older material has also become a common practice to make it available widely. This approach is facilitating the order of the day in promoting scientific and technical publications as public goods by way of lowering costs of maintaining information centers such as libraries, and most importantly, by making available information and communication resources that would otherwise become neglected.

References

American Society of Agronomy, Crop Science Society of America, Soil Science Society of America.1988. Editors' handbook

American Society of Agronomy, Crop Science Society of America, Soil Science Society of America.1988. Publication Handbook and style manual

Amin S Bredan and Frans van Roy. 2006. Writing readable prose. MBO reports 7, 846 - 849

Anderson PV. 1991. Technical Writing, a reader-centered approach, 2nd edition, Harcourt Brace Jovanovich.

Australian Government Publishing Service .1988. Style Manual for Authors, Editors and Printers, 4th edn, AGPS, Canberra.

Barrass R. 1978. Scientists Must Write. John Wiley and Sons, New York.

Barrie JM. 1860-1937. Sir James M. Barrie's challenge to youth: being his inaugural address as Lord Rector of St. Andrews, Scotland's oldest university

Bolshakova EI. 2000. Towards computer-aided editing of scientific and technical texts. International Journal "Information Theories & Applications" Vol.10. Pp 204-210

Brooke Crutchley. 1970. Preparation of manuscripts and correction of proofs. Cambridge University Press.

Burbidge PG. 1969. Prelims and end-pages. 2nd edition. Cambridge University Press.

CBE.1986. Scientific writing for graduate students. 4th edition.

Council of Biological Editors (CBE). 1983. CBE Style Manual: a guide for authors, editors and publishers in the biological science. 5th edn. Council of Biology Editors Inc., Bethesda, MD, U.S.A.

David Clearwater. 2010. Citation Guide: Footnotes and Bibliographic Entries (Turabian/Chicago Citation Style). University of Lethbridge. USA.

De Sola R. 1985. Abbreviations Dictionary. 7th edn, Elsevier, Amsterdam. The Netherlands.

Ernest Gowers. 1968. Fowler's ***Modern English usage*** 2nd edition.

Ernest Gowers.1976. The Complete Plain Words (1976), Penguin Books, Middlesex, U.K.

Eugene Garfield. 1983. Citation Indexing-Its Theory and Application in Science, Technology, and Humanities. Institute for Scientific Information. ISI Press. Philadelphia

Farr. AD.1985. Science writing for beginners. Blackwell Scientific Publications. Oxford, UK

Fowler HW. 1965. Modern English Usage. Clarendon Press, Oxford, U.K.

George D. Gopen and Judith A. Swan. 1990. The Science of Scientific Writing. American Scientist (Nov-Dec 1990), Volume 78, 550-558

Gopen, George D., and Judith A. Swan. 1990. The Science of Scientific Writing. *American Scientist*, November-December.

Hans Friedrich Ebel, Claus Bliefert, William E. Russey. 2004. The art of scientific writing: from student reports to professional publications in chemistry and related fields. Wiley-VCH

Hath EJ. 1990. How ta Write and Publish Papers in the Medical Science, 2nd ed. Williams & Wilkms; Baltimore.

James DL, JD Lester.2010. Writing research papers. A complete guide. 13th edition.

Jean-Luc Lebrun. 2007. Scientific writing: a reader and writer's guide.

World Scientific Publishing.

Jennifer Peat. 2008. Scientific writing: easy when you know how. BMJ Books

Judith Butcher. 1981. Copy–editing. The Cambridge handbook. 2nd edition.

Julia Ann Kelly. 1998. Scientific meeting abstracts: significance, access, and trends. Bull Med Libr Assoc 86 (1). University of Minnesota, USA.

Julia Johns, Tom Fox, and Ronald Silvia. 2004. APA writing style. SourceAid, LLC.

Larry Trask. 1997. Guide to Punctuation**.** University of Sussex

Loban CS and M Schefter 1992. Successful Lab Reports: A Manual for ScienceStudents. Cambridge University Press.

Maeve O'Connor. 1978. Editing Scientific Books and Journals. Pitman Medical, kent, U.K.

Maeve O'Connor. Writing Successfully in Science. Harper Collins Academic. UK

McLaren S.2006. Easy Writer. Student's guide to writing eaasays and reports.

McMillan VE. 1988. Writing Papers in the Biological Sciences. St Martin's Press, New York.

McMillan VE. 2001. *Writing papers in the biological sciences.* Boston: Bedford/St. Martin's

Meadows AJ. 1991. The evolution of graphics in scientific articles. Publishing Research Quarterly, 1991, Volume 7, Number 1, Pages 23-32

Michael Alexander Kirkwood Hallidayand JR MArtin.1993. **Writing science:** literacy and discursive power. The Falmer Press, UK.

Michael Alley. 1996. The Craft of Scientifc Writing. 3rd edition. Springer Science+Business Media.

Michael JZ. 2009. From Research to manusctipt. A guide to scientific writing. 2nd edition.

Odlyzko AM. 1997. The slow evolution of electronic publishing, pp. 4–18 in Electronic Publishing. ***In:*** Meadows J and F Rowland (eds.) New Models and Opportunities. ICCC Press

Pechenik JA. 1997. A Short Guide to Writing About Biology. Addison-Wesley Pub Co.

Perry CR.1991. The fine art of technical writing. Blue Heron Publishing Inc. USA

Ralf Berry. 1986. How to write a research paper. 2nd edition. Pergamon Press.

Reynolds L and D Simmonds, and Martinus N. 1982. Presentation of Data Science. The Hague, The Netherlands.

Robert A Day. 1983. How to Write and Publish a Scientific Paper. 2nd edn, ISI Press, Philadelphia, PA, U.S.A.

Robert AD, C Barbara. 2006. How to write and publish a scientific paper. 6th edition.Cambridge University Press.

Robert De Blasi, Paramus Public Schools. 1982. Writing science: specific techniques for developing writing skills and enhancing comprehension in the content of science. Educational Development Center, UK

Snow, CF. 1959. The **two cultures** and the scientific evolution: Volume 1959, Part 1

Sonia Jennings (ed). 1994. Essay and Report Preparation Suggestions Styleguide. School of Information Technology & Computer Science

Stepalon P, Youdeowei A, Mukayange J and Kelen VH. 1995. Scientific writing for agricultural research scientists. A training manual. WARDA/CTA.

The International System of Units (SI). 2001 National Institute of Standards and Technology (NIST) Special Publication 330.

The Parliamentary Office of Science and Technology. 2002. Peer Review**.** Number 182. 7 Millbank, London.

Thomas Allen Lang and Michelle Secic.2006.How to report statistics in medicine: annotated guidelines for authors, editors, and reviewers. Philadelphia

University of Chicago Press. 1982. The Chicago Manual of Style. The 13th edition of A Manual of Style Revised and Expanded. University of Chicago Press, Chicago. IL, U.S.A.

William Strunk, Elwyn Brooks White.2000. The elements of style. 4th edition. Longman, UK

Indexes

S

T

U

W