How to Write and Publish a Scientific Paper

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1. What is scientific writing

a) **Need of clarity** - clearly stated problem

- clearly stated conclusion

New knowledge “for the first time”

b) **Receiving the signals**

Scientific communication = two ways process

Need to be received – to be understood

c) **Understanding the signals**

- Purpose of Sci. Com. : to communicate new scientific findings
- As clear as possible
- Not literature nor poetry

- Publication = ultimate result of scientific research $\Rightarrow$ same effort as for the rest
- Best English = same sense in the fewest short words (no diversion, metaphors, ….)

1. Origins of Scientific Writing

- Experience over 100 past years ⇒ **IMRAD** (first sci. Journals :1665)
- **Introduction** **Methods** **Results** and **Discussion** :

  - Highly structured and Rigid (originality in the content not in the form
  - Requested by most editors because

    Simplest

    Most logical way to communicate research results

  - **Question** form :

    - What **question** (problem) was studied ? Answer = **Introduction**
    - How was the **problem** studied ? Answer = **Methods**
    - What were the **results** ? Answer = **Results**
    - What do the **findings** mean ? Answer = **Discussion**

- I**MRAD** = easy roadmap for authors – editors – referees – readers

1. What is a Scientific Paper

- Definition : Written and published report describing original research results

- Criteria(test) for **VALID** publication

- Must be published in the right place : Primary journals

  (not reports, conference proceedings,…)

- Council of Biology Editors :

*An <u>acceptable primary scientific publication</u> must be the **first disclosure** containing **sufficient information** to enable **peers***

- *to **asses observation**,*
- *to **repeat experiments**, and*
- *to **evaluate intellectual processes**;* (conclusion justified by the data)

*moreover it must be susceptible to **sensory perception*** (printed journal, computer data base, microfilms,…)*, essentially **permanent**, **available to the scientific community without restriction** , and available for **regular screening** by one or more of the major recognized **secondary services** (e.g. Institute for Scientific Information,…)*

- No newsletter, internal reports, proceedings of symposium (should be (re) published in Primary Journals when speculations matured to conclusions), …

- **Prepublication peer review (referee's evaluation procedure)**

- Organization : **IMRAD**
  - **M** : Materials and Methods
  - Sometimes : **Experimental section** : **M+R+D**

    (in notes or short communications)
  - **R**esult section different from **D**iscussion section : Highly desirable

- A scientific paper is **NOT** literature BUT communication of research results

- No dual publication

1. Title

- Importance : read by thousand of people (only few if any will read the full paper)
- Need to reach its **intended audience**
- **Title = Label** suitable for indexing by Abstracting / Indexing services
- choice of words
- order of words
- **Rule** : fewest possible words that adequately describe the content of the paper
  - Not to short : need for specific title (no general)
  - Not to long : not an abstract
  - no waste words (study on …, observations on …, verb)
  - no abbreviations, jargon,…
  - avoid series titles each paper = independent cohesive study

(chronology of appearance ?) better : **hanging title**

1. How to list the Authors

- **Orde**r of names? Origin of disputes and arguments

- **Authorship**?
  - takes the intellectual responsibility of the results being presented
  - should have made an important contribution to the study being reported

  (referring to original aspects)
  - intellectual input : not easy to measure

- More than one initial recommended

- Corresponding author (reprints address, proofs, …)

1. How to prepare the Abstract

- **Abstract = brief summary** (250 words) , Miniversion
- **Goal** : allows the reader to decide to read or not
- **IMRAD** structure :
    - state principal **objectives** and scope
    - describe the **methodology** employed
    - summarize the **results**
    - state the principal **conclusions**

      (conclusions : 3 times in Abstract, Introduction and Discussion)
- Past tense because refers to work done
- No references
- Self contained (published by it self)
- Economy of words (but no abbreviations)

1. How to write the Introduction

- Should state briefly and clearly your **purpose**
- Decide the **audience**
- Justify **why** did you **choose** that subject and **why** is it **important**
- Start writing the paper when the work is still in progress
- **From problem to solution** (even if some redundancy with Abstract)
- Suggested rules :

⇒ Present first the nature and scope of the work

⇒ Review the pertinent literature (most important background information, state of the art)

⇒ State the methods of investigation, so as the reasons for their choice

$\Rightarrow$ (State the principal results)

$\Rightarrow$ (State the principal conclusions suggested by the results)

- Present tense for the established knowledge
- Mention your previously published papers (abstracts, closely related papers, …)
- Avoid mistake : do not keep the reader in suspense (not a detective story)
- Define specialized terms and abbreviations

1. How to write the Materials and Methods Section

- **Purpose** : Describe and justify the experimental design so that the experiments could be **repeated** by others (peers)
- **Reproducibility = basis of Science**
- Must give the full details (if not $\Rightarrow$ rejection by the referee no matter the results)
- Past tense
- Chronological presentation (with sub headings)
- Similar to **cookbook recipes** :
    - How ?
    - How much?
- If new method (unpublished) : Provide all the needed details
- Rule : enough information must be given so that the experiments could be reproduced by a competent colleague

- Avoid **mistake** : No mixing some of the results

2. How to write the Results

- **Result section = Core of the paper**
- Presentation of the data but **predigested** : only representative data not all

  "The fool collects facts, the wise selects them"
- No more method description
- Not yet data interpretation : the discussion section is designed to tell what they mean
- No references
- **Crystal clarity** : the whole paper will stand or fall on the basis of the results
- **Avoid redundancy**

  Most common fault : repetition in the text of what is apparent in Figures or Tables
- No need to cite Figures and Tables

It is clearly shown in Figure X that … = ***verbiage***

- If n variables tested,
  - present in Table or Graphs only those which affect the reaction
  - For the others: state you did not find under the experimental conditions

  Absence of evidence is not evidence of absence
- Past tense

1. How to write the Discussion

- Harder part to define and to write ← Cause of rejection
- Often : many too long
- Show the relationships among observed facts
- Components :
  - Try to present the principles, relationships, generalization shown by the results not a recapitulation of the results
  - Point out any exceptions or any lack of correlation, define unsettled points
  - Show how your results and interpretations agree (or contrast)with previously published work
  - Don’t be timid. Discuss the theoretical implications of your work as well as any possible practical applications
  - State your **conclusions** as clear as possible

- Summarize your evidence for each conclusion

- End of discussion : Short summary or **Conclusion** regarding the **significance** of the work

  Bad, if the reader at end asks " So what ?"

- **Be modest** :

  Scientific truth ≠ whole truth

  Only spotlight shining on one particular area

  Don’t extrapolate to a bigger picture than that shown by your data

- Verb tense
  - Present for established knowledge
  - Past for the new (own) results

1. How to state the Acknowledgments

- Acknowledge

  - Technical help

  - Advisors, … (be specific, they are not responsible for the work)

  - Financial assistance (grants, fellowships, contractors, …)

- Be courteous

  We thank … NOT we wish to thank

1. References

- Avoid secondary materials (only significant, published references)
- Read carefully “the instruction to authors” of the journal
- Place it at the point of the sentence to whish it applies (not all at the end of sentences)

Outline

- What is scientific writing
- Origins of Scientific Writing
- What is a Scientific Paper
- Title
- How to list the Authors
- How to prepare the Abstract
- How to write the Introduction
- How to write the Materials and Methods Section
- How to write the Results
- How to write the Discussion
- How to state the Acknowledgments
- References