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 ⇒ 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**
• **IMRAD** = 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 **acceptable primary scientific publication** 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)*
  - Result section different from **Discussion section** : Highly desirable

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

• No dual publication
1. Title

- Importance: read by thousands 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

- **Order** 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 itself)
- 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
⇒ (State the principal results)
⇒ (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 ⇒ 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 which it applies (not all at the end of sentences)
Outline

- What is scientific writing
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- 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