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 assess 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 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

- **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
2. How to write the Results

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