

# **Writing Research Papers**

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# General Principle

- Gather data
  - Introduce the experiment: Why are you doing this?
  - Describe the result/finding: What next important question is raised?
- Put together figures and tables
  - Give each figure/table a simple, declarative title in the form of a sentence
- Decide if you have a story and a bottom line (selling point)
  - A strong paper/complete story needs:
    - a discovery
    - some mechanism
    - broader implications

# General Principle

- Write a provisional title to express the bottom line
  - Include key components in the title
- Outline result section
  - Based on the order of Figures and Tables
  - Logical order: telling a story
- Keep focused on the bottom line
  - Exclude everything that does not contribute to that bottom line
- Keep the logic flowing. Leave no gaps
  - Bullet main ideas
  - Convert main ideas into topic (or summary) sentences

# Submitting Principle

- The journal's scope and goals: read instructions to authors
- Target audience: broad or specialized?
- Ways of presentation:
  - Simple or complex take-home message?
  - How many figures and tables?
  - Should Results/Discussion be combined?
- Where were similar papers published? (Journal Citation Reports)
- Who will manage the review?
- Ask others to help assess the degree of novelty in your work; Ask them to be critical
- Start from journals with higher rank/impact factor

# General Structure

- An objective of organizing a research paper is to allow people to read your work selectively
  - Do NOT read from the first word to the last word
- Sections of a research paper
  - Title (Cover page)
  - Abstract
  - Introduction
  - Materials & Methods
  - Results
  - Discussion
  - References

# Writing Order

- Figures (Figure legends) and Tables
  - Title (Cover page)
  - Materials & Methods
  - Results
  - Introduction
  - Discussion
  - References
  - Abstract
- Put the draft in drawer several days. Revise from beginning to end
    - Acknowledgments
    - Cover letter
    - Rebuttal letter

# Figures and Tables

- Fig. and Tables are backbone of a manuscript
- Every Figure and Table should have a clear point
  - Use the clear point as the first sentence of the Figure legend and Table caption (legend)
  - Any Table or Figure must be able to stand alone and be interpretable
    - sufficiently clear, well-labeled, and described by its legend to be understood by audience without reading the results section
- Place of the legend
  - Table legends go above the body of the Table and are left justified
  - Figure legends go below the graph
- Tables and Figures are put on separate pages from text material and at the end of manuscript

# Things to be noticed in making Tables

- Figure and Table number consistent with text
- The presence of a period after “Table #.”
- Arabic numbers are easier to read than Roman numbers (1,2,3... vs. I. II. III....)
- Upper-lower case type is easier to read than all upper case letters (Tables vs. TABLES)
- Arrange comparisons vertically
- the numbers you want to compare are close to each other
- Units are specified in column headings wherever appropriate



# Things to be noticed in making Tables

- Lines of demarcation are used to set (1) legend, (2) headers, (3) data, and (4) footnotes apart from one another
- Avoid vertical lines between columns
- Make the contents concise
  - Round data to simplify: use common units
  - Avoid repetitive information
- Footnotes are used to
  - Clarify points in the Table
  - Convey repetitive information about entries
  - Denote statistical differences among groups
- Self-contained, to stand alone

# The Anatomy of a Table

Table legend

**Table 1. Control of a first-planting corn stand as influenced by herbicide treatment and corn growth stage.**

Column titles

<i>Treatment</i>	<i>Rate</i>	<i>% control<sup>a</sup></i>	
		<i>V1 at time of application</i>	<i>V2-V3 at time of application</i>
Liberty	32 fl oz	50	75
Gramoxone Inteon	2.25 pt	27	48
Gramoxone Inteon	2.50 pt	— <sup>b</sup>	40
Gramoxone Inteon + Sencor	2.25 pt + 3 oz	65	—
Gramoxone Inteon + Sencor	2.50 pt + 3 oz	—	70
Balance Pro + atrazine	3 fl oz + 1 lb	—	25
SelectMax	1 fl oz	12	33
SelectMax	2 fl oz	58	68
SelectMax	3 fl oz	—	75
SelectMax	4 fl oz	98	94

Table body

Footnotes

Data averaged over experiments conducted in 2006 and 2007.

<sup>a</sup>Control ratings taken 14 days after herbicide application.

<sup>b</sup>Not all treatments were applied at each corn growth stage.

# Things to be noticed in making Figures

- Consistent scale, boldness, and font (Adjust in Illustrator)
  - a good rule of thumb in Fig. size: about one-half of a page
- Avoid “busy” figures and “white space”
- Avoid using a title for Figures
- Avoid using unnecessary boxes (especially with heavy lines) to enclose graphs or images
- Most often black and white is preferred
  - Photocopy or fax your paper, any information conveyed by colors will be lost
  - Very expensive in publishing color figures
- Always include error bars (SD or SEM) when plotting means
- Understood independently, to stand alone
  - Figure legend goes below the figure and conveys all the necessary information

# Title

- Title must reflect the central theme: selling point
  - Including key components
- Attractive and easy to understand
- Concise and Informatiive: avoid no noninformative words like “A study of---”
- Avoid acronyms

# Materials and Methods

- Buy materials before doing experiments → materials, then methods
- Only describe methods used
- Include enough information, but not more than necessary  
→ Rule of thumb: the research can be repeated
- Keep it extremely brief unless describing an unusual technique
  - e.g., ... according to the manufacturers' instructions
- Include rationale for why an experiment was done a particular way

# Results

- Tell a story. Follow your story line
  - Lead with important result, follow with controls and secondary findings
  - Chronologically
- Topic sentence: Lead each paragraph with the experimental aim and primary result. Then elaborate it.
- One paragraph = one thought
- Describe why you are moving from one experiment to another
- Don NOT interpret the data or draw major conclusions

# Introduction

- Funnel from the broad background (the big picture, significance of the field), to specific gaps (still unknown) , to questions answered by bottom line (selling point)
- Previous studies: General background information to the key components in the title; What has been done
  - Think of the terms in which you would justify your work to your parents
  - NOT a literature review. You are setting up the question
  - State what has NOT been done
- “Therefore” → State objectives, hypothesis, and approach
- Finish with a very brief summary of the results and why they are important

# Discussion

- Start with bottom line with a very brief (1-3 sentence) summary
- Do not just copy and paste results!
- Subsequent points go from most important / most related to bottom line to least important / least related
- Interpret results and support conclusions with evidence from the literature
- One paragraph = one thought



# Discussion

- Be Specific and Precise
  - Don't just cite references, but describe
  - Watch out for lazy thoughts and stock phrases
    - Not “gives insight into...” but “shows that process X uses mechanism Y.”
    - Not “opens up new ways of tackling disease X” but “suggests that approach Y will work against disease X.”
- Distinguish between confirmatory and new, and established and speculated
  - Make all links. A link that is obvious to you will not occur to many of your readers
- Discuss different levels of significance
- Describe limitations of your research

# References

- Use software: e.g., EndNote
- Follow the instructions of journal
- Should correspond to the text
- Updated; don't miss the most relevant ones
- Consistent format

# Abstract

- First impression to the readers and editors
- Write it last, following the logic of the paper
- Summarize key points in the paper:
  - 1-2 sentences:
    - Give essential background
  - 2-3 sentences:
    - State results
  - 1-2 sentences:
    - State conclusion, and significance /implications of findings
- Check character/word limits on Abstracts: often <150-200 words

# Acknowledgments

- General acknowledgments:
  - Institution or lab
  - Research project
  - Source of funds
- Specific acknowledgments:
  - Colleagues & technicians
- Examples:
  - We thank Drs. Xxx (institute), and xxx for support in ... [for critical reading of the manuscript.]
  - The project was financially supported by xxx
  - We are grateful to xxx for ...
  - XXX was supported by ...
  - This work was supported by ... to xxx