

# HOW TO WRITE A SCIENTIFIC PAPER

J. A. Esfahani  
Ferdowsi university of Mashhad



# Scientific Writing

**In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs.**

**- Sir Francis Darwin**

# What is a Scientific Paper ?

**A scientific paper is a written and published report describing original research results**

# Presentation Objectives

*Importance of  
Scientific Writing*



*Key Principles*

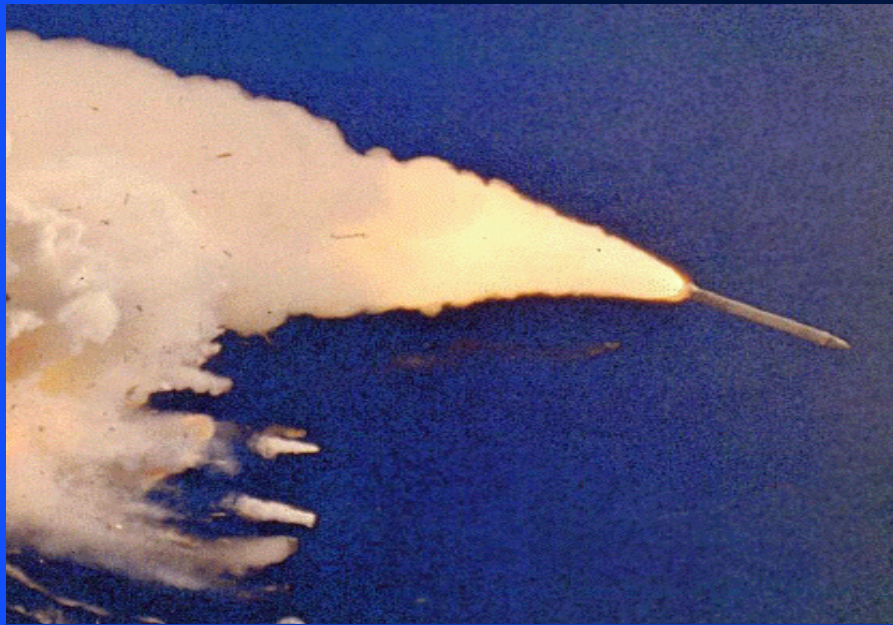
*audience*



*occasion*

*purpose*

# Impact on Others

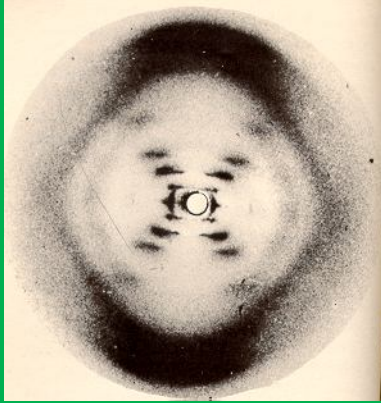


*Space Shuttle  
Challenger  
(January 28, 1986)*

- Explosion was caused by failure of O-rings in the solid rocket boosters
- Engineers knew of O-ring problems well before fatal launch
- Engineers failed to communicate seriousness of problem

# A Matter of Difference

## 1. Subject Matter



## 2. Writing Constraints

*audience*

*purpose*



*occasion*

## 3. Purpose of Writing

*To inform*

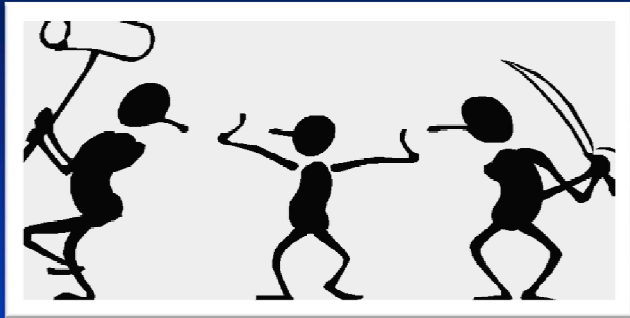
*To persuade*

## 4. Writing Style



# Writing Stages

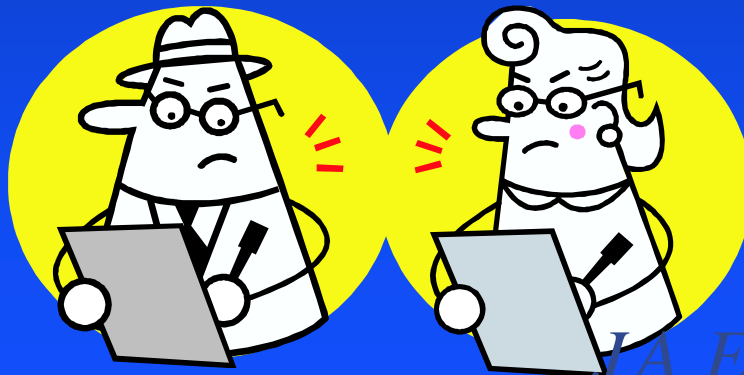
## 1. Getting in the Mood



## 2. Writing the First Draft



## 3. Revising, Revising, Revising



## 4. Finishing



# In the Beginning

- **Begin by analyzing your constraints**
  - **Audience**
    - » Who they are
    - » What they know
    - » Why they will read
    - » How they will read
  - **Occasion**
    - » Format
    - » Formality
    - » Politics and ethics
    - » Process and deadline
  - **Purpose**
    - » To inform
    - » To persuade



# Aspects Affecting Reader

*Content*



*Style*



*Form*



# Overview

- Report purpose and planning
- Report format and organization
- Headings and language
- Visual design
- Source documentation
- Finishing touches

# Report Purpose

- **Describe research**
  - Explain problem or issue studied
  - Discuss research method
  - Describe data collected
  - Describe research findings
  - Explain implications

# Report Purpose

- **Inform readers of research results precisely, concisely, and specifically**
  - They shouldn't have to read whole report to get essential points

# Report Planning

- **Before writing, consider:**
  - Why you are writing
  - What you hope to achieve
  - Who you are writing for

*These considerations will determine your report's content, organization, textual and visual design*

# Organizational Considerations

- **Your audience, purpose, and contents should influence your report organization and format**
  - Example: your professor may have very specific guideline
  - Author's guideline of journal
- **Carefully consider your decisions**

# Report Format and Organization

- Reports generally include these sections in this order:
  - Title
  - Abstract
  - Introduction
  - Literature Review
  - Physical Model
  - Methodology
  - Results
  - Discussion
  - Conclusion

# Report Format and Organization

- But be aware that order is flexible in that sections can be combined
  - Some journals combine introduction and literature review
  - Others have the results and discussion combined



# Title

- **Max info in least words**
- **<12 words**
- **<100 characters**
- **The title is a label**
- **Should almost never contain abbreviations**
- **Easier to understand, more impact**
- **State results**

# Report Format and Organization

- **Abstract**

- Always comes first , 80-200 words
- Microcosm of entire paper – contains key info from each section
  - » Contains essential information only – it is brief!
  - » Covers research highlights
  - » Gives the research problem and/or main objective of the research
  - » Indicates the methodology used
  - » Presents the main findings and conclusions

# Abstract

- **Précis writing**
- **Informative, not descriptive**
- **Some numbers, but not in excess**
- **Determines if paper will be read**
- **Is distributed freely in databases**

# Report Format and Organization

- **Background/Introduction**

- Explains the research problem and its context

- » Explains importance of the problem (Why does it matter? Why is more information needed?)

- » Application

- » **Literature Review**

- » Explains reason and goals for study

- » Explains the limitations of the research performed

*You want your reader to fully understand the significance of your research*

# Introduction

**2-3 paragraphs, <450 words**

- **First paragraph**
  - Introduce broad area
- **Second paragraph**
  - Explicit rationale
- **Last paragraph**
  - Hypothesis

# Report Format and Organization

- **Literature Review**

- Summarizes and evaluates the literature that you have used in your study by considering:

- » How that literature has contributed to your area of research

- » The strengths and weaknesses of previous studies How that literature informs your own research and understanding of the research problem

# Report Format and Organization

- **Physical Model**

- Define your problem with details
- Explains dimensions, properties, and working conditions
- Assumptions and justification
- **Assumes reader understands material**
  - » **Does not include explanatory material**
- **Is in past tense and passive voice**
  - » **“A 1” piece of coil was cut”**
    - **The research has been carried out**

# Report Format and Organization

- **Methodology**

- Explains how data was gathered/generated
- Explains how data was analyzed
  - » Accuracy and CPU time
- It is the research, and not your activities, that are of interest
- **Assumes reader understands material**
  - » Does not include explanatory material
- **Is in past tense and passive voice**



# Report Format and Organization

- **Results**

- **Visually and textually represents research findings**

- » **Visual representation of results:**

- **Graphs, tables, diagrams, charts**

- » **Explanatory text:**

- **Text points out the most significant portions of research findings**

- **Indicates key trends or relationships**

- **Highlights expected and/or unexpected findings**

# Results Section

- Refer to data (Fig. X, Table Y)
- Don't repeat numbers in Tables
- Can state numbers from Figures if precision is required
- A lot of numbers, make Table

# Report Format and Organization

- **Discussion**

- **Assesses and comments on research results**

- **Includes:**

- » **Explanation for Results**

- **Comments on unexpected results, offering hypothesis for them**

- » **Comparison to literature**

- **Does your research confirm previous studies? Deviate from them?**

- » **Explanation for how info can be applied in broader context**

# Discussion Section

- **First paragraph**
  - State major findings
  - Paraphrase abstract
- **Last paragraph**
  - “In summary...” (2-3 sentences)
  - “In conclusion...” (biggest message, return to Intro, avoid speculation, avoid “need more work”)

# Discussion Section

- **Middle paragraphs**
  - Base each on a major result
- **Always focus on your results**
- **Never discuss prior work without reference to your work**
- **Refer Tables and Figures**

# Report Format and Organization

- **Summary**

- **Discusses:**

- » **What was learned through research**
    - » **What remains to be learned**
    - » **Weaknesses and shortcomings of study**
    - » **Strengths of study**
    - » **Possible applications of study (how it can be used)**
    - » **Recommendations**

# **Key Point Considerations**

# Headings and Subheadings

- **Headings and subheadings guide readers' attention**
- **Can be used to keep track of various parts of project:**
  - For example: “Making Components,” “Assembling Components,” and “Testing Assembly”
- **They should be:**
  - Specific and helpful
  - Used to break up text and “chunk” information
  - Used to guide readers' attention



# Headings and Subheadings

- **Example of vague heading:**
  - “The use of some computing technologies in certain engineering classrooms”
- **Example of specific heading:**
  - “Using Matlab in the Freshman engineering classroom”

# Language and Vocabulary

- **Reports should be easily accessible**
  - Be straightforward and concise
  - Use simple terms, not jargon and technical terms
  - Keep sentences short and simple (20 words max)
  - Be specific and not general
    - » Use concrete numbers and metaphors or similes

# Visual Design

- **A report's visual design can make or break its communication success**
- **Visual Design includes:**
  - Use of graphs and other graphics
  - Use of white space

# Visual Design

- **Graphics:**
  - Should be used to illustrate specific points
  - Should be incorporated in a way that is natural to report's content/context
  - Should be explained fully in text using references such as “Fig. 1 shows...”
  - Should be cited if taken from a source

# Visual Design

- **Graphics – a caveat**
  - Graphics do not speak for themselves!
  - For this reason, textual information should come before graphics.
- **General layout should focus readers on key information**
  - Use white space to guide readers' attention
    - » Created through use of headings, subheadings, and visuals

# Figures

- **Do before writing**
- **Redraw, redraw, prune clutter**
- **Least non-data-ink**
- **Max 4 lines, all solid**
- **No caption**
- **Reduce to 1 column in journal**
  - **Reduced xerox copy to check out**
  - **Original should be <3x final**

# Figures

- **Axes**
  - Minimize tick marks
  - Don't number each tick
- **Lettering**
  - Uniform, lower case
  - Minimize, avoid bold
  - After reduction, 2-3 mm high
- **Legend**
  - Gives message

# Tables

- **Single unit, understood without text**
- **Prune, prune: columns, lines**
- **Exceed 1 sheet: redraw**
- **Avoid narrow/broad; rotate all 90°**
- **No added vertical/horizontal lines**
- **If small: move data to text**



# First Draft

- Write as quickly as possible
- As if thinking out loud
- Get everything down
- Ignore spelling, grammar, style
- Skip troublesome words
- Correct and rewrite only when the whole text is on paper
- Do not split the manuscript among the co-authors

# Good Writing

- **Content, accuracy**
- **Clarity**
- **Precision**
- **Logic**
- **Order of presentation**

# Clarity

- **Clear**
- **Exact**
  - **Ambiguity, inconsistency**
  - **Wooly words**
- **Concise**
  - **Least words**
  - **Short words**
  - **One word vs many**

# Simplify

**a majority of = most**

**at the present time = now**

**give rise to = cause**

**in some cases = sometimes**

**is defined as = is**

**it is believed that = I think**

**on the basis of = by**

**pooled together = pooled**

**subsequent to = after**

**with the result that = so that**

# Use and Misuse of English

- **Tense**
  - Previously published work: past tense
  - Your own work: present tense
- **Voice**
  - Active more precise and less wordy than passive
  - Name the agent, even “I” or “we”
- **Singulars and plurals**

# Bad Writing

- **Words don't do justice to your ideas**
- **If multiple mistakes in spelling and syntax, reviewer suspects similar sloppiness in the lab**

# Source Documentation

- **Cite sources whenever you are quoting, paraphrasing, or summarizing work that is not your own**
  - Quoting directly is discouraged
  - Cite sources you saw
- **Sources include:**
  - Books, Lectures
  - Journal, magazine, or newspaper articles
  - Interviews
  - Conference Proceedings
  - Internet

# Source Documentation

- **Citing:**
  - Shows your credibility as a researcher
  - Gives proper credit to authors and researchers
  - Protects you from accusations of plagiarism



# Source Documentation

- Use specified format for documentation
- Check online for style guides
- Check our department website
- Check journals for format info

# Finishing Touches

- **Usability Testing**
  - Have a colleague read your report for clarity, organization, and visual design
- **Check your sources for proper citations**
- **Proofread carefully – or better yet, ask someone to do it for you**

# **Broad Content Issues**

- **Check your use of supporting evidence.**
- **Check your use of sources.**
- **Check to see that you achieve your purpose.**
- **Check your attention to audience.**
- **Check for overall impression.**

# Organization & Presentation

- Check the overall organization.
- Check sentence structure and style.
- Check paragraph structure.
- Check format.
- Check documentation.

**Tanks your attention**

**Welcome any question**