Technical Writing and Speaking in English
Scientific article structure and research questions

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The IMRAD standard

- Widely accepted standard format for scientific writing
  - **I**ntroduction
  - **M**ethods
  - **R**esults and
  - **A**nalysis
  - **D**iscussion (and Conclusion)

Parts of a scientifc article

- Introduction
  - Establishes the context for the research
    - the area in which the research takes place
    - the research problem
    - the importance of the research
    - the guiding question or hypothesis
- Materials and Methods
  - Describes the research procedure
- Results
  - Reports the outcomes of the research procedure
- (And/Analysis)
- Discussion (Conclusion)
  - Interprets the results, explaining them and comparing them to the results of other experiments
  - Focuses the reader on what is important about the research, its contribution to the larger area of study

Exercise 1

Sections: Abstract, Introduction, Materials and Methods, Results, Discussion, Acknowledgments (optional), Literature cited, Appendices (optional)

Process	Section of paper
What is the problem?	
What did I do in a nutshell?	
Who helped/helps me out?	
What did/will I find out?	
How did/will I solve the problem?	
Whose work did/will I refer to?	
What do the results mean?	
Extra information	

Process	Section of paper
What is the problem?	Introduction
What did I do in a nutshell?	Abstract
Who helped/helps me out?	Acknowledgments (optional)
What did/will I find out?	Results
How did/will I solve the problem?	Materials and Methods
Whose work did/will I refer to?	Literature cited
What do the results mean?	Discussion
Extra information	Appendices (optional)

Exercise 2

1. Read the paper "Using Microcomputers in Teaching"
2. How many major sections does this experimental research report contain? Are all of these sections indicated by headings? Which major section does not have a heading?
3. What kind of information does each major section contain? Do any major sections have more than one kind of information? Which ones?

Answers (1 of 2)

- Sections and their ordering
  1. Introduction
  2. Method
  3. Results and
  4. Discussion
  5. References

Answers (2 of 2)

- **Introduction**
  - General background
  - Literature review
  - Statement of purpose
- **Method**
  - Human subjects (sample)
  - Procedure
  - Equipment and evaluation instrument
- **Results**
- **Discussion**
  - Reference to the original hypothesis
  - Conclusions
  - Implications of the study
  - Reasons of the findings obtained
  - Suggestions for further research

Formulating a research question

- The research question is the basis on which the study is planned and carried out.
- After researchers have focused on a specific topic of investigation, they formulate a question that addresses a specific aspect of the topic in which they are interested.
- Two types of questions:
  1. **Open question:** Example: What are the effects of increased concentrations of sulfuric acid in the atmosphere on production of grain sorghum?
  2. **Closed question:** Do increased concentrations of sulfuric acid in the atmosphere lead to significant decreases in the production of grain sorghum?
- **What is the difference?**

Formulating a hypothesis

- **Hypothesis:**
  - Statement of expected results
  - A possible response to the research question
  - Necessary in formal research work
  - **Example:** Abnormally high concentrations of sulfuric acid in the atmosphere have **no effect** on the production of grain sorghum.
- **Null hypothesis:**
  - A hypothesis stated in a negative way
  - The purpose of the experiment is to determine whether the hypothesis can be rejected or not
- Not always the (null) hypotheses are stated explicitly in scientific articles.

Exercise 3

- Look back at the report on microcomputers in teaching. Determine the research question and locate the hypotheses. Then write them out. Are the hypotheses stated as null hypotheses?

Some possible answers

- **Research question:** What is the effect of micro-computer-assisted instruction compared with traditional lecture discussion on the performance of graduate students enrolled in agricultural education?
- **Hypothesis 1:** there is no difference between the performance of students given micro-computer-assisted instruction and those given traditional instruction.
- **Hypothesis 2:** there is no relationship between the amount of time spent by students in micro-computer- assisted instruction and their test scores.

Checklist for scientific articles

- **Resarch report format**
  - Abstract
  - Introduction
  - Method
  - Results and
  - Discussion
  - References
- **Steps in beginning the research process**
  1. Select an area of interest
  2. Focus on one aspect of the area
  3. Write a research question
  4. Design the siudy

Exercise 4

On the topic of your research internship, write your own research question(s) – start with an open question, then formulate a yes and no question (closed question) and finally a hypothesis.