From Structure to Style

Structure, Content, and Style of a Scientific Paper

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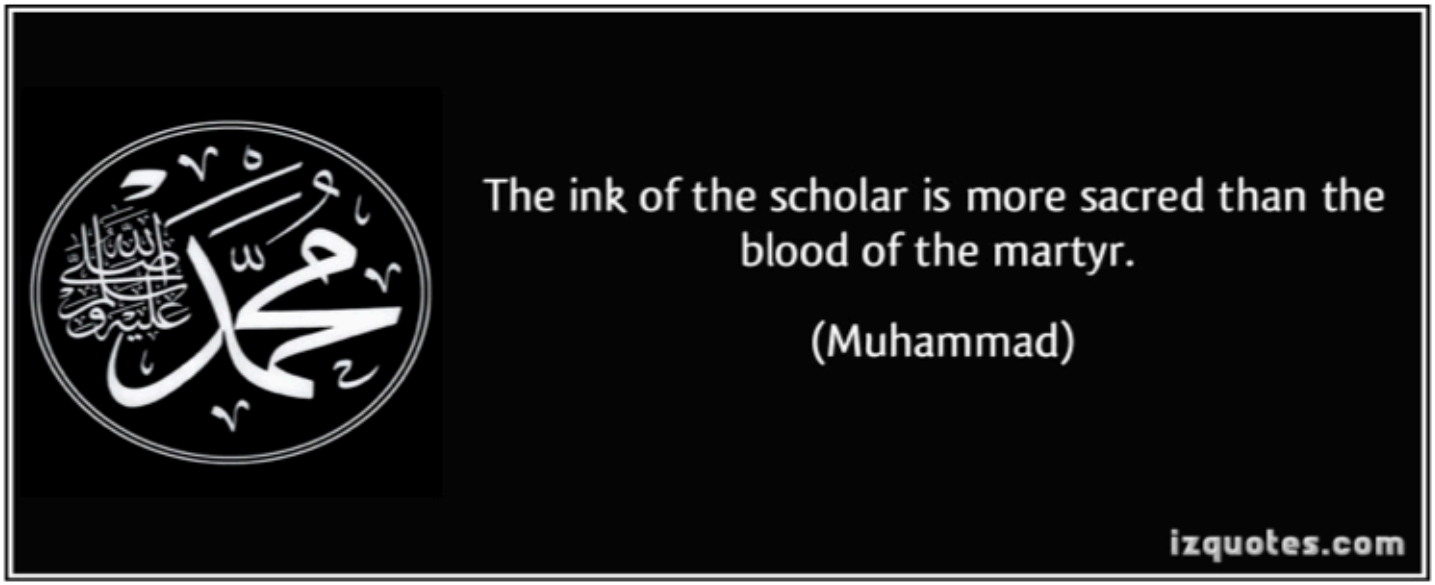
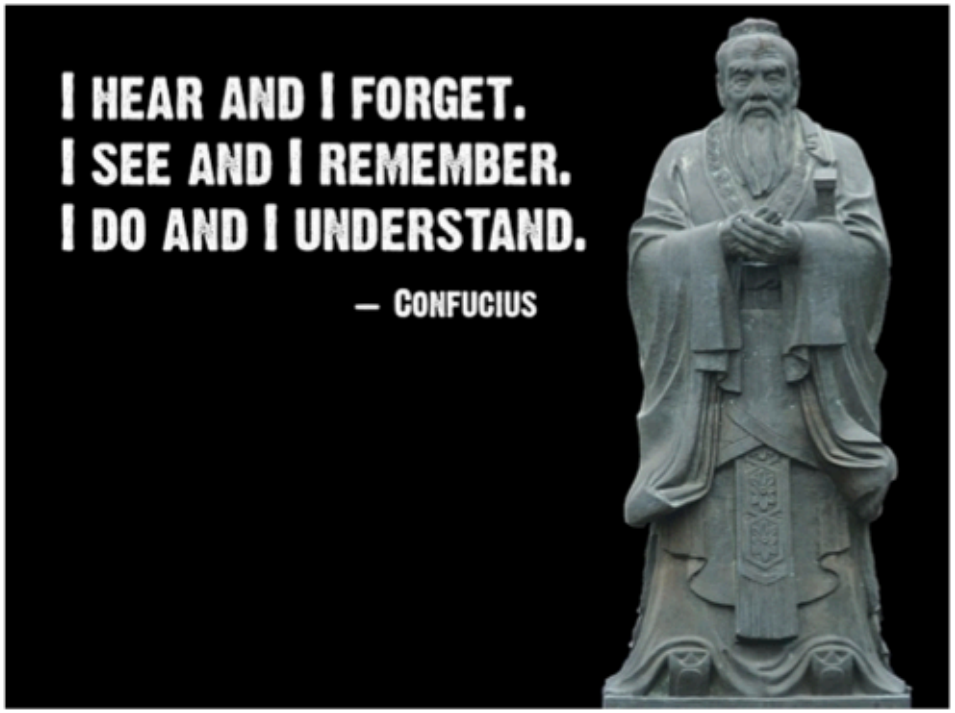


而易忘,
见而易记,
做而易懂



Outline

Experimental process	Section of Paper
What did I do in a nutshell?	Abstract
What is the problem?	Introduction
How did I solve the problem?	Materials and Methods
What did I find out?	Results
What does it mean?	Discussion
Who helped me out?	Acknowledgments (optional)
Whose work did I refer to?	Literature Cited
Extra Information	Appendices (optional)

TITLE

What is the paper broadly about?

- Your opportunity to **attract the reader's attention**. Remember: readers are the potential authors who will cite your article
- Reviewers will **check whether the title is specific and whether it reflects the content of the manuscript**. Editors hate titles that make no sense or fail to represent the subject matter adequately;
- So, keep it **informative and concise**;
- **Avoid technical jargon** and abbreviations if possible. You wish to have a readership as large as possible, right?
- **Discuss with your co-authors**.

KEYWORDS

Mainly used for indexing and searching

- It is the label of your manuscript.
  - Avoid words with a broad meaning, but do neither use too narrow terms (get into the Google groove…)
- Only abbreviations firmly established in the field are eligible
  - e.g. XML, TVET
- Check the Guide for Authors!
  - Number, label, definition, thesaurus, range, and other special requests

Abstract

1. Function:

An abstract summarizes, in one paragraph (usually), the major aspects of the entire paper in the following prescribed sequence:

the **question(s) you investigated** (or purpose), (from Introduction)

state the purpose very clearly in the first or second sentence.

the **experimental design** and **methods** used, (from Methods)

Clearly express the basic design of the study.

Name or briefly describe the basic methodology used without going into excessive detail-be sure to indicate the key techniques used.

the **major findings** including **key quantitative results**, or **trends** (from Results)

report those results which answer the questions you were asking

identify trends, relative change or differences, etc.

a brief summary of your **interpretations** and **conclusions**. (from Discussion)

clearly state the implications of the answers your results gave you.

Abstract

2. Style:

The Abstract is ONLY text. Use the active voice when possible, but much of it may require passive constructions. Write your Abstract using concise, but complete, sentences, and get to the point quickly. **Use past tense**. Maximum length should be 200-300 words, usually in a single paragraph.

Abstract

3. Strategy:

Although it is the first section of your paper, the Abstract, by definition, must be written last since it will summarize the paper. To begin composing your Abstract, take whole sentences or key phrases from each section and put them in a sequence which summarizes the paper. Then set about revising or adding words to make it all cohesive and clear.

Abstract

The Abstract SHOULD NOT contain:

- lengthy background information,
- references to other literature,
- elliptical (i.e., ending with …) or incomplete sentences,
- abbreviations or terms that may be confusing to readers,
- any sort of illustration, figure, or table, or references to them.

Abstract

The abstract should work like a marketing tool. It should help the reader decide "whether there is something in the body of the paper worth reading" by providing a quick and accurate summary of the entire paper, explaining why the research was conducted, what the aims were, how these were met, and what the main findings were.

Types of abstracts

Generally between 100 and 300 words in length, abstracts are of different types: descriptive, informative, and structured.

- **Descriptive abstracts**, usually used in the social sciences and humanities, do not give specific information about methods and results.
- **Informative abstracts** are commonly used in the sciences and present information on the background, aim, methods, results, and conclusions.
- **Structured abstracts** are essentially informative abstracts divided into a series of headings (e.g., Objective, Method, Results, Conclusion) and are typically found in medical literature and clinical trial reports.

Introduction

1. Function:

The function of the Introduction is to:

- Establish the context of the work being reported. This is accomplished by discussing the relevant primary research literature (with citations) and summarizing our current understanding of the problem you are investigating;

- State the purpose of the work in the form of the hypothesis, question, or problem you investigated; and,

- Briefly explain your rationale and approach and, whenever possible, the possible outcomes your study can reveal.

Quite literally, the Introduction must answer the questions, "What was I studying? Why was it an important question? What did we know about it before I did this study? How will this study advance our knowledge?", This is to judge the novelty of the research (whenever required)

Introduction

2. Style:

Use the active voice as much as possible. Some use of first person is okay, but do not overdo it.

Introduction

3. Structure:

The structure of the Introduction can be thought of as an inverted triangle - the broadest part at the top representing the most general information and focusing down to the specific problem you studied.

Organize the information to present the more general aspects of the topic early in the Introduction, then narrow toward the more specific topical information that provides context, finally arriving at your statement of purpose and rationale.

A good way to get on track is to sketch out the Introduction backwards; start with the specific purpose and then decide what is the scientific context in which you are asking the question(s) your study addresses.

Once the scientific context is decided, then you'll have a good sense of what level and type of general information with which the Introduction should begin.

Introduction

Here is the information should flow in your Introduction:

Begin your Introduction by clearly identifying the subject area of interest.

Do this by using key words from your Title in the first few sentences of the Introduction to get it focused directly on topic at the appropriate level. This insures that you get to the primary subject matter quickly without **losing focus**, or discussing information that is **too general**.

Introduction

Establish the context by providing a brief and balanced review of the pertinent published literature that is available on the subject.

The key is to summarize (for the reader) what we knew about the specific problem before you did your experiments or studies. This is accomplished with a general review of the primary research literature (with citations) **but should not include very specific**, lengthy explanations that you will probably discuss in greater detail later in the Discussion.

The judgment of what is general or specific is difficult at first, but with practice and reading of the scientific literature you will develop e firmer sense of your audience.

Lead the reader to your statement of purpose/hypothesis by focusing your literature review from the more general context to the more specific topic of interest to you.

Introduction

What literature should you look for in your review of what we know about the problem?

Focus your efforts on the primary research journals - the journals that publish original research articles. Although you may read some general background references (encyclopedias, textbooks, lab manuals, style manuals, etc.) to get yourself acquianted with the subject area, **do not cite these**, becasue they contain information that is considered **fundamental** or "**common**" knowledge within the discipline.

Cite, instead, articles that reported specific results relevant to your study. Learn, as soon as possible, how to find the primary literature (research journals) and review articles rather than depending on reference books. The articles listed in the Literature Cited of relevant papers you find are a **good starting point** to move backwards in a line of inquiry.

Most academic libraries support the Citation Index - an index which is useful for tracking a line of inquiry forward in time. Some of the newer search engines will actually send you alerts of new papers that cite particular articles of interest to you. Review articles are particularly useful because they summarize all the research done on a narrow subject area over a brief period of time (a year to a few years in most cases).

Introduction

Be sure to clearly state the purpose and /or hypothesis that you investigated.

When you are first learning to write in this format it is okay, and actually preferable, to use a pat statement like, "The purpose of this study was to…." or "We investigated three possible mechanisms to explain the … (1) blah, blah..(2) etc.

It is most usual to place the statement of purpose near the end of the Introduction, often as the topic sentence of the final paragraph. It is not necessary (or even desirable) to use the words "hypothesis" or "null hypothesis", since these are usually implicit if you clearly state your **purpose and expectations**.

Introduction

Provide a clear statement of the rationale for your approach to the problem studied.

For example: State briefly how you approached the problem (e.g., you studied oxidative respiration pathways in isolated mitochondria of cauliflower). This will usually follow your statement of purpose in the last paragraph of the Introduction.

Why did you choose this kind of experiment or experimental design? What are the scientific merits of this particular model system? What advantages does it confer in answering the particular question(s) you are posing?

Do not discuss here the **actual techniques** or **protocols** used in your study (this will be done in the Materials and Methods); your readers will be quite familiar with the usual techniques and approaches used in your field.

If you are using a novel (new, revolutionary, never used before) technique or methodology, the merits of the new technique/method versus the previously used methods should be presented in the Introduction.

Methods

1. Function:

In this section you explain clearly how you carried out your study in the following general structure and organization (details follow below):

- the organism(s) studied (plant, animal, human, etc.) and their pre-experiment handling and care, and when and where the study was carried out (only if location and time are important factors); note that the term "subject" is used ONLY for human studies.
- if a field study, a description of the study site, including the significant physical and biological features, and precise location (latitude and longitude, map, etc);
- the experimental OR sampling design (i.e., how the experiment or study was structured. For example, controls, treatments, the variable(s) measured, how many samples were collected, replication, etc.);
- the protocol for collecting data, i.e., how the experimental procedures were carried out, and,
- how the data were analyzed (qualitative analyses and/or statistical procedures used).

Methods

Organize your presentation so your reader will understand the logical flow of the experiment(s); subheadings work well for this purpose. Each experiment or procedure should be presented as a unit, even if it was broken up over time. The experimental design and procedure are sometimes most efficiently presented as an integrated unit, because otherwise it would be difficult to split them up.

In general, provide enough quantitative detail (how much, how long, when, etc.) about your experimental protocol such that other scientists could reproduce your experiments. You should also indicate the statistical procedures used to analyze your results, including the probability level at which you determined significance (usually at 0.05 probability).

Methods

2. Style:

The style in this section should read **as if** you were verbally describing the conduct of the experiment. You may use the active voice to a certain extent, although this section requires more use of third person, passive constructions than others.

Avoid use of the first person in this section. Remember to use the past tense throughout - the work being reported is **done**, and was performed in the **past**, not the future. The Methods section **is not a step-by-step, directive, protocol** as you might see in your lab manual.

Methods (FAQs)

Describe the organism(s) used in the study.

This includes giving the source (supplier or where and how collected), size (weight, length, etc.), how they were handled before the experiment, what they were fed, etc. In genetics studies include the strains or genetic stocks used. For some studies like **education**, age, gender, geographic zone are important.

Methods (FAQs)

Describe the site where your field study was conducted. The description must include both physical and biological characteristics of the site pertinent to the study aims.

Include the date(s) of the study (e.g., 10-15 May 2020) and the exact location of the study area. Location data must be as precise as possible: ”SMK Negeri 1, Bangkala Jeneponto” rather than ”SMK Negeri 1 Jeneponto".

When possible, give the actual latitude and longitude position of the site (the WWW has sites which provide this service). It is most often a good idea to include a map (labeled as a Figure) showing the location in relation to some larger more recognizable geographic area. Someone else should be able to go to the exact location of your study if they want to repeat or check your work, or just visit your study area.

Methods (FAQs)

NOTE:

For laboratory studies you need **not report** the date and location of the study UNLESS it is relevant. Most often it is not. If you have performed experiments at a particular location or lab because it is **the only place to do it**, then you should note that in your methods and identify the lab or facility.

Methods (FAQs)

Describe your experimental design clearly.

Be sure to include the hypotheses you tested, controls, treatments, variables measured, how many replicates you had, what you actually measured, what form the data take, etc.

Always identify treatments by the variable or **treatment name**, NOT by an ambiguous, generic name or number (e.g., use "2.5% NaCl" rather than "test 1"; use "regular or mainstream class" rather than "class A")

When your paper includes more than one experiment, use **subheadings** to help organize your presentation by experiment. A general experimental design worksheet is available to help plan your experiments in the core courses.

Methods (FAQs)

Describe the protocol for your study in sufficient detail that other scientists could repeat your work to verify your findings.

Foremost in your description should be the "**quantitative**" aspects of your study - the masses, volumes, incubation times, concentrations, etc., that another scientist needs in order to duplicate your experiment.

When using standard lab or field methods and instrumentation, it is not always necessary to explain the procedures (e.g., serial dilution) or equipment used (e.g., auto pipetter) since other scientists will likely be familiar with them already. You may want to identify certain types of equipment by vendor name and brand or category (e.g., ultracentrifuge vs. prep centrifuge), particularly if they are not commonly found in most labs.

It is appropriate to report, parenthetically, the source (vendor) and catalog number for reagents used, e.g., "….poly-L-lysine (Sigma #1309)." When using a method described in another published source, you can save time and words by providing the relevant citation to the source. **Always make sure to describe any modifications you have made of a standard or published method**.

Methods (FAQs)

Describe how the data were summarized and analyzed. Here you will indicate what types of data summaries and analyses were employed to answer each of the questions or hypotheses tested.

The information should include:

- how the data were **summarized** (Means, percent, etc) and how you are reporting measures of variability (SD, SEM, etc.)

  this lets you avoid having to repeatedly indicate you are using mean ± SD.

- **data transformation** (e.g., to normalize or equalize variances)

- **statistical tests** used with reference to the particular questions they address, e.g., t-test, ANOVA, MANOVA, etc.

- any other **numerical** or **graphical techniques** used to analyze the data

Result

1. Function:

The function of the Results section is to objectively present your **key results**, without interpretation, in an orderly and logical sequence using both text and illustrative materials (Tables and Figures).

The results section always begins with text, reporting the key results and referring to your figures and tables as you proceed.

Summaries of the statistical analyses may appear either in the text (usually parenthetically) or in the relevant Tables or Figures (in the legend or as footnotes to the Table or Figure).

The Results section should be organized around Tables and/or Figures that should be sequenced to present your key findings in a logical order. The text of the Results section should be crafted to follow this sequence and highlight the evidence needed to answer the questions/hypotheses you investigated. **Important negative results should be reported, too**.

Authors usually write the text of the results section based upon the sequence of Tables and Figures.

Result

2. Style:

Write the text of the Results section concisely and objectively. The passive voice will likely dominate here, but use the active voice as much as possible. Use the past tense. Avoid repetitive paragraph structures. **Do not interpret** the data here. The transition into interpretive language can be a slippery slope.

Result (FAQs)

Organize the results section based on the sequence of Table and Figures you'll include.

Prepare the Tables and Figures as soon as all the data are analyzed and arrange them in the sequence that best presents your findings in a logical way. A good strategy is to note, on a draft of each Table or Figure, the one or two key results you want to address in the text portion of the Results. Simple rules to follow related to Tables and Figures:

- Tables and Figures are assigned numbers separately and in the sequence that you will refer to them from the text.

  The first Table you refer to is Table 1, the next Table 2 and so forth.

  Similarly, the first Figure is Figure 1, the next Figure 2, etc.

- Each Table or Figure must include a brief description of the results being presented and other necessary information in a legend.

  Table legends go above the Table; tables are read from top to bottom.

  Figure legends go below the figure; figures are usually viewed from bottom to top.

- When referring to a Figure from the text, "Figure" is abbreviated as Fig., for example, Fig. 1. Table is never abbreviated, e.g., Table 1.

Result (FAQs)

The body of the Results section is a text-based presentation of the key findings which includes references to each of the Tables and Figures.

The text should guide the reader through your results stressing the key results which provide the answers to the question(s) investigated. A major function of the text is to provide clarifying information. You must refer to each Table and/or Figure individually and in sequence (see numbering sequence), and clearly indicate for the reader the key results that each conveys.

Key results depend on your questions, they might include obvious trends, important differences, similarities, correlations, maximums, minimums, etc.

Result (FAQs)

Report negative results - they are important!

If you did not get the anticipated results, it may mean your hypothesis was incorrect and needs to be reformulated, or perhaps you have stumbled onto something unexpected that warrants further study. Moreover, the absence of an effect may be very telling in many situations. In any case, your results may be of importance to others even though they did not support your hypothesis.

Do not fall into the trap of thinking that results contrary to what you expected are necessarily "bad data". If you carried out the **work well**, they are simply your results and need interpretation. Many important discoveries can be traced to "bad data".

Appearance counts !

- **Un-crowded plots**: 3 or 4 data sets per figure; well-selected scales; appropriate axis label size; symbols clear to see and data sets easy to discriminate.
- Each **photograph must have a scale marker** of professional quality on one corner.
- **Use color ONLY when necessary.** If different line styles can clarify the meaning, never use colors or other thrilling effects.
- **Color needs to be visible and distinguishable** when printed out in black & white.
- **Do not include long boring tables** ! (e.g., chemical compositions of emulsion systems).

Discussion

1. Function:

The function of the Discussion is to **interpret your results** in light of what was already known about **the subject** of the investigation, and to explain our new understanding of the problem after taking your results into consideration.

The Discussion will always connect to the **Introduction** by way of the question(s) or hypotheses you posed and the **literature** you cited, but it does not simply repeat or rearrange the Introduction. Instead, it tells how your study has moved us forward from the place you left us at the end of the Introduction.

Discussion

- Fundamental questions to answer here include:
  - Do your results provide answers to your testable hypotheses? If so, how do you interpret your findings?
  - Do your findings agree with what others have shown? If not, do they suggest an alternative explanation or perhaps a unforseen design flaw in your experiment (or theirs?)
  - Given your conclusions, what is our new understanding of the problem you investigated and outlined in the Introduction?
  - If warranted, what would be the next step in your study, e.g., what experiments would you do next?

Discussion

2. Style:

Use the active voice whenever possible in this section. Watch out for wordy phrases; be **concise** and make your points **clearly**. Use of the first person is okay, but too much use of the first person may actually distract the reader from the main points.

Discussion

3. Approach:

Organize the Discussion to address each of the experiments or studies for which you presented results;

Discuss each in the same sequence as presented in the Results, providing your interpretation of what they mean in the larger context of the problem.

Do not waste entire sentences restating your results; if you need to remind the reader of the result to be discussed, use "bridge sentences" that relate the result to the interpretation.

You will necessarily make **reference** (new or taken from literature review) to the findings of others in order to support your interpretations.

Discussion

You must relate your work to the findings of other studies - including previous studies you may have done and those of other investigators.

As stated previously, you may find crucial information in someone else's study that helps you interpret your own data, or perhaps you will be able to reinterpret others' findings **in light of yours**.

In either case you should discuss reasons for **similarities** and **differences** between yours and others' findings.

Consider how the results of other studies may be **combined** with yours to derive a new or perhaps **better substantiated** understanding of the problem.

Be sure to state the conclusions that can be drawn from your results in light of these considerations.

You may also choose to **briefly mention further studies** you would do to clarify your working hypotheses.

Make sure to reference any outside sources as shown in the Introduction section.

Discussion

Do not introduce new results in the Discussion.

Although you might occasionally include in this section tables and figures which help explain something you are discussing, they must not contain new data (from your study) that should have been presented earlier. They might be flow diagrams, accumulation of data from the literature, or something that shows how one type of data leads to or correlates with another, etc.

CONCLUSIONS

How the work advances the field from the present state of knowledge

- Without a clear conclusion section reviewers and readers will find it difficult to judge the work, and whether or not it merits publication in the journal.

- DON’T REPEAT THE ABSTRACT, or just list experimental results. Trivial statements of your results are unacceptable in this section.

- You should provide a clear scientific justification for your work in this section, and indicate uses and extensions if appropriate. Moreover, you can suggest future experiments and point out those that are underway.

Acknowledgment

If, in your experiment, you received any significant help in thinking up, designing, or carrying out the work, or received materials from someone who did you a favor by supplying them, you must acknowledge their assistance and the service or material provided.

Authors always acknowledge outside reviewers of their drafts and any sources of funding that supported the research. Although usual style requirements (e.g., 1st person, objectivity) are relaxed somewhat here, Acknowledgments are always brief and never flowery.

Place the Acknowledgments between the Discussion and the Literature Cited.

Literature Cited

1. Function:

The Literature Cited section gives an alphabetical listing (by first author's last name) of the references that you actually cited in the body of your paper. Instructions for writing full citations for various sources are given in on separate page.

NOTE: Do not label this section "**Bibliography**". A bibliography contains references that you may have read but have not specifically cited in the text. Bibliography sections are found in books and other literary writing, but not scientific journal-style papers.

REFERENCES

- Typically, there are more mistakes in the references than any other part of the manuscript.

- It is one of the most annoying problems, and causes great headaches among editors…
  - Cite the **main scientific publications** on which your work is based
  - Do not over-inflate the manuscript with **too many references** – it doesn't make it a better manuscript! (10-15 items recommended);
  - Avoid **excessive self-citations**
  - Avoid excessive citations of **publications from the same region**
  - **Check correspondence** between text and reference list;

Appendices

- **Function:** An Appendix contains information that is non-essential to understanding of the paper, but may present information that further clarifies a point without burdening the body of the presentation. An appendix is an optional part of the paper, and is only rarely found in published papers.
- **Headings:** Each Appendix should be identified by a Roman numeral in sequence, e.g., Appendix I, Appendix II, etc. Each appendix should contain different material.

Appendices

Some examples of material that might be put in an appendix (not an exhaustive list):

- **raw data**
- maps (foldout type especially)
- extra photographs
- explanation of formulas, either already known ones, or especially if you have "invented" some
- statistical or other mathematical procedures for data analysis.
- specialized computer programs for a particular procedure
- full generic names of chemicals or compounds that you have referred to in somewhat
- abbreviated fashion or by some common name in the text of your paper.
- diagrams of specialized apparati.

Appendices

Figures and Tables in Appendices

Figures and Tables are often found in an appendix. These should be formatted as discussed previously (see Tables and Figures), but are numbered in a separate sequence from those found in the body of the paper. So, the first Figure in the appendix would be Figure 1, the first Table would be Table 1, and so forth.

Terima Kasih