Technical reports have several features that are consistent between various fields of study. Below is a list of sections typically found in a technical report. They may exist with slightly different names in different fields. You should examine journals in your own field to determine exactly which sections apply. The order in which these are presented may also vary.

Abstract

Introduction

Theory

Equations

Procedure

Results

Tables

Figures and Plots

Discussion

Conclusion

References

The following pages include a more detailed description of each of the sections. Be aware that this is a living document. If some portion of it is inconsistent with your experience, please relay that information. Moreover, if some portion is unclear to you let me know and I will edit the text.

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ABSTRACT
The abstract may be the hardest section of a paper to write. Although it appears at the beginning of an article and is usually the first thing the reader looks at, the abstract should be written last, after the article is complete.

In professional journals, the abstract is often used to identify key features for indexing and so it should contain words that other professionals would use in a literature search. The abstract may appear by itself in a separate publication, and so it must be self-contained. On the other hand, because other professionals read the abstract to get a quick feel if the rest of the article will be of interest to them, it must be concise.

The abstract should contain a brief statement of the problem or purpose of the research. It should indicate the experimental or theoretical plan, summarize the principal findings, and state the major conclusions. It should not add to, evaluate, or comment on conclusions in the text.

The abstract should not cite tables, figures, or sections of the paper. Abbreviations and acronyms should be used sparingly, and should be defined at their first use.

INTRODUCTION

The opening sentence of a paper should state the problem or the purpose of the experiment. Subsequent sentences should provide a concise background and identify the scope and limit of the work.

In professional journals the introduction should also contain the background and/or history of the research project should be presented. This background should include the citation of pertinent literature, and identify how this work is different or related to the cited literature.

THEORY

Constructing a theory section requires identifying all of the key components of the theory. The concepts and their related equations must be developed from an accepted starting point. This means that terms must be defined early in the section, and that the concepts are presented in a logical order such that--when appropriate--they build on each other.

When equations are presented they should be offset in some manner and numbered. Discussion between equations should connect the equations conceptually. Completeness and clear thought are required in this section. The reader should be convinced that the author(s) know and understand the principles of the experiment.

Finally, this section should provide a connection between the theory and what must be measured. This will provide a connection between theory and experimental procedure.

Direct copying from a reference source is not acceptable. Indicate all references used with a number in parentheses corresponding to a reference number in the Reference Section.

EQUATIONS
Equations should be offset from the text in some manner, either by indentation or by centering. Equations should be numbered sequentially in order of initial appearance; this makes it easy to refer to them at some later point in the text. The terms of equations should be defined the first time those terms appear. It is not necessary to redefine a term every time it appears in an equation. It is not appropriate to use the same notation for different terms in different parts of the text, nor is it correct to different notation for the same term in different parts of the text.

EXPERIMENTAL PROCEDURE

This section of a report should have sufficient detail about the materials and methods that the audience could repeat the work and obtain comparable results. Identify the materials used, giving information about the purity. Give the chemical names of all compounds and the chemical formulas of compounds that are new or uncommon. Describe your apparatus if it is not standard or commercially available. If it is commercially available, provide a company name and model number. Describe the procedures you used.

RESULTS

Summarize the data collected. Include only relevant data, but give sufficient detail to justify your conclusions. Use equations, table, and figures for clarity and conciseness. It is often convenient to connect various pieces of information with some discussion. In this case, this section would be called RESULTS AND DISCUSSION.

TABLES

One of the most efficient methods used to communicate technical information is by means of a data table. While you have all seen examples of well-organized, legible data tables, few of you have had a great deal of practice constructing one from scratch. The construction of a good data table requires knowing what the important features are.

I. When to use Tables

Tables are to be used when the data are precise numbers, when there are too many to be presented clearly in the narrative, or when relationships between datum can be more clearly conveyed in a table than in the narrative. Tables should supplement, not duplicate, text and figures. If data is not treated theoretically in the report or if the material is not a major topic of discussion, do not present it in tables.

II. How to Construct Tables

There are two kinds of tables: informal and formal. An informal table is one that consists of three to five lines and is no more than four columns wide. Informal tables may be placed in text following an introductory sentence. They are not given titles or numbers.

A formal table should consist of at least three columns, and the center and right columns must refer back to the left column. If there are only two columns, the material should be written as
narrative. If there are three columns, but they do not relate to each other, perhaps the material is really a list of items and not a table at all.

Tables should be simple and concise, but many small tables may be more cumbersome and less informative than one large one. Combining is usually possible when the same column is repeated in separate tables. Use symbols and abbreviations that are consistent among tables and between tables and text.

**Numbering Tables.** Number formal tables sequentially with Roman numerals, in order of discussion in the text. Every table must be cited in the text.

**Title.** Every table must have a brief title that describes its contents. The title should be complete enough to be understood without referring to the text, and it should not contain new information that is not in the text. Put details in footnotes, not in the title.

**Column Headings.** Every column must have a heading that describes the material below it. Keep headings to two lines, use abbreviations and symbols. Name the parameter being measured and indicate the unit of measure after a comma. A unit of measure is not an acceptable column heading.

**Columns.** The leftmost column is called the stub column. All other columns refer back to it. Main stub entries may also have subentries that should be indented. Be sure that all columns are really necessary. If there are no data in most of the entries of a column, it probably should be deleted. If the entries are all the same, the column should be replaced with a footnote that says "in all cases, the value was . . . " Do not use ditto marks or the word ditto. Define nonstandard abbreviations in footnotes.

**Footnotes.** Explanatory material that refers to the whole table and to specific entries belongs in footnotes. Footnotes should be written as narrative, in paragraph form, using standard punctuation. Material that refers to the whole table might be: units of measure, explanations of abbreviations and symbols, sources of data or other citations. Material that refers to specific entries might be: units of measure that are too long to fit in the column heading, explanations of abbreviations and symbols used with one or two entries, statistical significance of entries.

*This information has been paraphrased from "The ACS Style Guide", Janet S. Dodd, ed., 1986.

**FIGURES AND PLOTS**

"A picture is worth a thousand words."

Often the most concise and precise way to present data is to plot it. The challenge is knowing what to plot on which axis. An understanding of the theory behind the experiment should provide clues so that the author can determine how to design a plot. Some general rules apply regardless of the content of the report.
The figure, graph or plot should have an appropriate title. Restating the axis labels is not an appropriate title.

All axes should be labeled with the parameter being plotted and the units of that parameter. The number of values on the axis and the number of tic marks should be sufficient to make it easy for the reader to identify the x and y values of each data point.

The x-axis is always the independent axis and the y-axis is the dependent axis; that is, the value of the y variable depends on or changes because of a change in the x variable. For example, the concentration of reactants changes because time has passed. It is not true that time has passed because of a change in the concentration of reactants. Consequently, time will be on the x-axis and concentration of reactants will be on the y-axis. By convention, a plot of A versus B means that A is on the y axis and B is on the x-axis.

The plot should not have a legend if there is only one set of data being plotted.

Individual data points should be obvious.

DO NOT CONNECT THE DOTS!!! It is not appropriate to connect the dots with straight lines because this implies that, between the points for which you took a measurement, the function follows the straight line that you've drawn. This is usually not true. It is appropriate and good to draw a curve on your plot if the curve is theoretically predicted. It is appropriate and good to draw a curve on your plot that is the best fit of your data to the functional form that theory predicts. It is appropriate to try to determine the functional form of the data you've presented, however if the theory provides a functional form, use it.

There should be a minimum of emptiness on a plot. If your data covers only a small portion of the plot, expand the axis so that the data fills the plot. There is one exception to this. If part of the purpose of the plot is to identify the value of the y-intercept, the y-intercept should be on the plot.

Plots should be as large as is feasible. I recommend that plots fill at least half a page. For this class, I prefer that every plot fill an entire page. I prefer landscape orientation, which is the default for Excel. The reason plots should be large is because if you make a plot small enough, all data points will fall on a line. Everything appears linear; even really bad data can be made to look artificially good.

DISCUSSION

After clearly presenting results of your experiments, either as tables or figures, it is necessary to discuss the meaning of those results. The discussion section of a report should be objective. The results of the experiment should be interpreted and (where appropriate) compared with each other. They should be related to the original purpose of the project. In the discussion section, it should be clearly stated whether or not the problem has been resolved. The logical implications of the results should be stated and further study or applications may be suggested. Conclusions should be based on the evidence presented.

CONCLUSION

The conclusion should begin with a restatement of the results. The results should be compared with literature values whenever possible. Any error in the results should be addressed, for
example why a plot that--according to theory--should be linear isn't linear. Any possible sources of error should be identified.

REFERENCES

Reference citations should follow the acceptable format for the editor (professor) to which the report is being submitted. It is extremely important that whatever style is used should be used consistently.