WRITING SCIENCE FOR THE GRADUATE SCHOOL

Robert Roseberry

Some of the common documents that graduate science and engineering students write include the following: (Please click on the desired link.)

Dissertation (Thesis)

This is a major paper, usually written after all course work and relevant examinations are completed. It may vary in length from around 50 pages to several hundred pages. The Ph.D. dissertation is expected to be longer and more detailed than the M.Sc. dissertation. The dissertation describes original work, usually of an experimental nature.

Journal Article

This is a short paper, usually between 5 and 25 pages in length, that is intended for publication in a refereed journal and often available on the Internet. It may focus on the results of an experiment. It is described in an objective manner that should enable a skilled scientific reader to replicate the experiment and find the same or similar results.

Grant Application

This may be a form or other structured document making a case for funding for a particular process or experiment. The focus is on the benefits to the funding agency, and all necessary information is given that will enable the funding agency to track the progress of the work.

Engineering Design Report

This is a report on an engineering project. It is often the result of a collaboration between a university research group and a corporation. It focuses on the practical outcomes of an engineering project.

Research Proposal

This is a document that makes a case for a process of research, possibly involving experimentation, and often leading to a dissertation or other research text.

Consulting Report

This type of report, also called a management report, is written to the management of a company. It reports on the management of a project from the point of view of a consultant.

Recommendation Report

This type of report is based on the study of a problem and contains recommendations designed to solve the problem.

Thesis Proposal

A thesis proposal combines some elements of a research proposal and a thesis. Since the proposed work has not been accomplished yet, the procedural steps are given in the future tense.

1. DISSERTATION (THESIS)

A dissertation, also called a thesis, may have some or all of the following parts:

TITLE PAGE

ABSTRACT

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Symbols And Abbreviations

INTRODUCTION

MATERIALS

METHODS

RESULTS

Discussion

Recommendations

- The parts usually appear in the order shown in the box on the left.
- The parts named in capital letters are usually included.
- The other parts are included only if required by the topic.
- MATERIALS and METHODS are often combined into one section called MATERIALS AND METHODS or PROCEDURE.
- RESULTS and DISCUSSION are sometimes combined into one section. Recommendations are sometimes added to this section.
- DISCUSSION is sometimes called CONCLUSIONS or CONCLUSIONS AND RECOMMENDATIONS.
- Recommendations may be contained in a final section called Conclusion. (Do not confuse this with "Conclusions".

Click on a link on the left for more information about that part.

Other pages or inserts, such as Appendices, a statement giving Permission to Use, a Declaration of Ownership, etc., may be required. Check with your supervisor.

Return to Top

1.1. Abstract

An abstract is a brief summary of the main sections of the text. It consists of some or all of the following pieces of information, called *moves*. The moves usually appear in the order given below. The following information is based on research by Salagar-Meyer (1991).

Move	Contents	Language
Background and/or Context of the Study	Give background or provide a context for the study	Language patterns and examples
Objective or Purpose of the Study	State the purpose of the study. Answer the question, "Why was this study conducted?".	Language patterns and examples
Subjects or Materials	Explain precisely and briefly who the subjects were or what materials were used and how or why they were chosen.	Language patterns and examples
Method or Design	Briefly summarize the main steps in the procedure.	Language patterns and examples
Statistical Treatment of Data	Briefly summarize the statistical/ mathematical methods used in the procedure.	Language patterns and examples
Results (Findings)	State the main results of the procedure and statistical/mathematical treatment. State what was found or observed. Do not interpret the results.	Language patterns and examples
Conclusions	Briefly interpret the results, indicating what was learned from the study.	Language patterns and examples

To see some examples of Salagar-Meyer's method of writing abstracts, click here.

Examples of Abstracts: Biology   Chemistry   Engineering   Medicine   Physics

Return to Top

Language Patterns: Abstract

1.1.1. Background and/or Context of the Study

The first move of the abstract, *the background and/or context of the study*, usually begins with one or more statements giving a background to the study. These may be of the following kinds: Statement of Fact, Definition, Statement of Intention, and/or Action Taken.

1.1.1.1. Statement of fact:

The subject of the sentence is usually part of the background or context of the study. This may be a chemical, a species, a theory, etc.

Common patterns:

> ...undergo...
> ...evolve...
> ...is (un)clear.
> ...has emerged
> ...vary considerably/significantly in...

[Click here for examples.](#)

[Return to Abstract](#)   [Return to Top](#)

1.1.1.2. Definition

A concept, theory, object, etc. is introduced. The class that it belongs to (e.g. tool, method, substance, disease, etc.) is named, and its purpose is mentioned briefly.

Common patterns:

> X is a Y that is...
> X is a Y to [VERB (showing purpose of X]

[Click here for examples.](#)

[Return to Abstract](#)   [Return to Top](#)

1.1.1.3. Statement of Intention

The authors indicate what they intend to do in their paper.

Common patterns:

> ...would allow...
> we demonstrate
> we show

Click here for examples.

Return to Abstract   Return to Top

1.1.1.4. Action taken

The authors explain what they have done.

Common patterns:

> This paper examines...
> We determined...
> We explored...
> element (form, aspect, generation, cause, effect, ...) of...

Click here for examples.

Return to Abstract   Return to Top

1.1.2. Abstract: Objective or Purpose of the Study

In this move, the authors give the reason(s) why they have undertaken the study.

Common Patterns:

We report (determine, describe, present, etc.)...
...this paper (study, investigation, etc.)
a method for...
...how to determine the...
We present a method for...

Click here for examples.

Return to Abstract   Return to Top

1.1.3 Abstract: Subjects or Materials

In this move, the authors briefly indicate the subjects or materials being studied.

Common Patterns:

[numbers / percentages]

Click here for examples.

Return to Abstract   Return to Top

1.1.4 Abstract: Method or Design

In this move, the authors briefly describe the method used in the study.

Common Patterns:

simulation
our method
demonstrate a method
present a method
apply a method
the general method

Click here for examples.

Return to Abstract   Return to Top

1.1.5 Abstract: Statistical Treatment of Data

In this move, the authors briefly indicate any statistical procedures that were used in the study.

Common Patterns:

varied from ... to ...
correlation between
a large number of statistics

Click here for examples.

Return to Abstract   Return to Top

1.1.6 Abstract: Results (Findings)

In this move, the authors briefly list the main findings of the study.

<u>Common Patterns:</u>

The results enabled...
Our data demonstrate...
with 95% confidence...
the presence of...
at least one...
patients receiving...
We find that...
the generation of...
the likelihood that
the mean incidence...
the probability of...
the risk of...
those receiving placebos...

<u>Click here for examples.</u>

<u>Return to Abstract</u>   <u>Return to Top</u>

1.1.7 Abstract: Conclusions

In this move, the authors briefly discuss their main findings and briefly indicate their relevance and importance.

Common Patterns:

information
provide
models
determine
outcomes
were presented
has been
we discuss
different types
(distinct/fundamental) concepts
we have presented
incidence (data/rates)
(the) estimates (for)
in terms of
(the) centrality (of)
(the) use (of)
(statistical) analysis (of)
(iterative) approach (for)
(two) distinct (concepts)
varying (levels of)
(appropriate) mechanisms (for)
(local) problem (solving)
(central) problem (of)
(the) estimates (for)
(the) mean (values of)
we have presented (a)
(reproducible) results (can be obtained)
(as/were) demonstrated (by/for)
(it is) (further) shown (that)
(these/clinical) findings/results (suggest that/demonstrate that)

Click here for examples.

Return to Abstract   Return to Top

1.1.1.1. Examples: Abstract: Context: Statement of Fact

Mitochondrial (mt) genomes from diverse phylogenetic groups vary considerably in size, structure, and organization (Hikosaka et al., 2009, p. 3).

Clostridium difficile has rapidly emerged as the leading cause of antibiotic-associated diarrheal disease, with the transcontinental spread of various PCR ribotypes, including 001, 017, 027 and 078 (He et al., 2010, p. 7527).

However, the genetic basis for the emergence of C. difficile as a human pathogen is unclear (He et al., 2010, p. 7527).

The rate of genome evolution varies significantly between species (Thomas et al, 2010, p. 1).

Interacting proteins evolve at correlated rates, possibly as the result of evolutionary pressures shared by functional groups and/or coevolution between interacting proteins (Clark & Aquadro, 2010, p. 2).

On activation, T cells undergo distinct developmental pathways, attaining specialized properties and effector functions (Bettelli et al, 2006, p. 235).

Since its original release, the popular crystal structure visualization program Mercury has undergone continuous further development (Macrae et al., 1987, p. 453).

TAp63 is a sequence-specific transcription factor that regulates epithelial stem cell maintenance and epithelial differentiation (Heyne et al., 2006, p. 3159).

Discrepancies arise among magnitudes as derived from local earthquake data (M_L), body waves (M_B) and surface waves (M_S) (Gutenberg & Richter, 2010, p. p. 7).

1.1.1.2. Examples: Abstract: Context: Definition

ALTER is an open web-based tool to transform between different multiple sequence alignment formats (Glez-Peña, 2010, p. 1).

Graphene is a rapidly rising star on the horizon of materials science and condensed-matter physics. This strictly two-dimensional material exhibits exceptionally high crystal and electronic quality... (Geim & Novoselov, 2007, p. 103).

Electron energy-loss spectroscopy (EELS) is an analytical technique that measures the change in kinetic energy of electrons after they have interacted with a specimen (Egerton, 2009, p. 9).

A gross Earth datum is a single measurable number describing some property of the whole Earth, such as mass, moment of inertia, or the frequency of oscillation of some identified elastic-gravitational normal mode (Backus & Gilbert, 1968, p. 169).

1.1.1.3. Examples: Abstract: Context: Statement of Intention

Successful reprogramming of differentiated human somatic cells into a pluripotent state would allow creation of patient-and disease-specific stem cells (Takahashi, 2007, p. 1).

Here, we demonstrate the generation of iPS cells from adult human dermal fibroblasts with the same four factors: Oct3/4, Sox2, Klf4, and c-Myc (Takahashi, 2007, p. 1).

Here we show, using mice with a reporter introduced into the endogenous Foxp3 locus, that IL-6, an acute phase protein induced during inflammation 8,9, completely inhibits the generation of Foxp31 Treg cells induced by TGF-b (Betelli et al, 2006), p. 235.

Here, we report that the central portion of NIR binds to the transactivation domain and the C-terminal oligomerization domain of TAp63 (Heyne et al., 2010, p. 3159).

A new modification of silver staining is presented... (Blum et al., 1987, p. 93).

Return to Abstract   Return to Top

1.1.1.4. Examples: Abstract: Context: Action Taken

This review examines the principles of Ca2+ signaling, from changes in protein on formations driven by Ca2+ to the mechanisms that control Ca2+ levels in the cytoplasm and organelles (Clapham, 2007, p. 1047).

To elucidate the structural divergence and evolution of mt genomes between Babesia/Theileria and Plasmodium, we determined five new sequences from *Babesia bigemina*, *B. caballi*, *B. gibsoni*, *Theileria orientalis*, and *T. equi* (Hirosaka et al., 2009, p. 3).

We explored alternative methods that detect correlated rates using protein-coding nucleotide sequences in order to better estimate the rate of nonsynonymous substitution at each branch (d_N) normalized by the underlying synonymous substitution rate (d_S) (Clark & Aquadro, 2010, p. 2).

Fluorescence spectra of a number of native and denatured proteins have been analysed ... (Burstein et al., 1973, p. 263).

Biopsies are graded in four categories... (Knodell et al., 1981, p. 431).

1.1.2. Examples: Abstract: Objective or Purpose of the Study

The aim of the twenty-year follow-up survey was to determine the incidence and natural history of thyroid disease in this cohort (Vanderpump et al., 1995, p. 55).

This review examines the principles of Ca2+ signaling, from changes in protein conformations driven by Ca2+ to the mechanisms that control Ca2+ levels in the cytoplasm and organelles (Clapham, 2007, p. 1047).

To elucidate the structural divergence and evolution of mt genomes between Babesia/ Theileria and Plasmodium, we determined five new sequences from Babesia bigemina, B. caballi, B. gibsoni, Theileria orientalis, and T. equi (Hikosaka et al., 2009, p. 3).

We explored alternative methods that detect correlated rates using protein-coding nucleotide sequences in order to better estimate the rate of nonsynonymous substitution at each branch (d_N) normalized by the underlying synonymous substitution rate (d_S) (Clark & Aquadro, 2010, p. 2).

This review describes the patterning of proteins and cells using a non-photolithographic microfabrication technology... (Kane et al., 1999, p. 2363).

A new modification of silver staining is presented... (Blum et al., 1987, p. 93).

Here, we report that... (Heyne et al., 2010. p. 3159).

1.1.3. Examples: Abstract: Subjects or Materials

Of the 1877 known survivors, 96% participated in the follow-up study and 91% were tested for clinical, biochemical and immunological evidence of thyroid disfunction (Vanderpump et al., 1995, p. 55).

Under code, three pathologists and three hepatologists evaluated 14 liver biopsy specimens obtained from five patients with asymptomatic chronic active hepatitis (Knodell et al., 1981, p. 431).

Here, we present the first general test of the GT effect in invertebrates, using 15 genes from 143 species spread across the major ermetazoan superphyla (Thomas et al., 2010, n.p.).

We report on an analysis of 40,000 end-to-end route measurements conducted using repeated 'traceroutes' between 37 Internet sites (Paxson, 2006, p. 41).

We investigate electronic transport in lithographically patterned graphene ribbon structures where the later confinement of charge carriers creates an energy gap near the charge neutrality point (Han et al., 2007, n.p.).

1.1.4. Examples: Abstract: Method or Design

We present a method that uses measured scene radiance and global illumination in order to add new objects to light-based models with correct lighting. The method uses a high dynamic range image-based model of the scene, rather than synthetic light sources, to illuminate the new objects (Debeve, 2008, n.p.).

Since its introduction, the 'single step' method has become widely used for isolating total RNA from biological samples of different sources. The principle at the basis of the method is that RNA is separated from DNA after extraction with an acidic solution... (Chomczynski & Succi, 2006, p. 581).

DESIGN, PATIENTS AND MEASUREMENTS Subjects were traced at follow-up via the Electoral Register, General Practice registers, Gateshead Family Health. Eight hundred and twenty-five subjects (30%) of the sample had died... (Vanderpump et al., 1995, p. 55)

A direct numerical simulation of a turbulent channel flow is performed. The unsteady Nevier-Stokes equations are solved numerically at a Reynolds number 3300, based on the mean centreline velocity and channel half-width... (Kim, Moin, & Moser, 1987, p. 133).

1.1.5. Examples: Abstract: Statistical Treatment of Data

A large number of turbulence statistics are computed and compared with the existing experimental data at comparable Reynolds numbers (Kim, Moin & Moser, 1987, p. 133).

The fat content varied from 5 to 50% of body-weight in the men and from 10 to 61% in the women (Durnen & Womerley, 1974, p. 32).

Good correlation was seen between severity of liver biopsy lesions as judged by conventional histological descriptions and Histology Activity Index scores (Knodell et al., 1981, p. 431).

1.1.6. Examples: Abstract: Results

We find significant evidence that rates of molecular evolution are correlated with GT in invertebrates... (Thomas et al., 2010, n.p.).

The method revealed significantly correlated evolution between nuclear pore proteins... (Clark & Aquadro, 2010, p. 2).

We find that Internet paths are heavily dominated by a single prevalent route... (Paxson, 2006, p. 41)

We find that the likelihood of encountering a major routing pathology more than doubled between the end of 1994 and the end of 1995... (Paxson, 2006, p. 41).

Both effects are antagonized by methylxanthines but not by blockage of adenosine uptake or inhibition of phosphodiesterase activity (van Calker et al., 1979, p. 999).

Here, we report that the central portion of NIR binds to the transactivation domain and the C-terminal oligomerization domain of TAp63 (Heyne at al., 2010, p. 3159)

The mean incidence (with 95% confidence intervals) of spontaneous hypothyroidism in women was 3-5/1000 survivors/year... (Vanderpump et al., 1995, p. 55).

At the January 2005 cutoff, the median progression-free survival was 5.5 months in the sorafenib group and 2.8 months in the placebo group... (Escudier et al., 2007, p. 125).

The temperature dependent conductance measurements show larger energy gaps opening for narrow ribbons (Han et al., 2007, n.p.).

We have discovered bulk superconductivity at $T_c = 38$ K in Fe2 As2 with x $\approx$ 0.4 (Rotter, Tegel, & Johrendt, 2008, n.p.).

1.1.7. Examples: Abstract: Conclusions

The object-oriented nature of the C++ libraries underlying Mercury makes it easy to re-use the code in other applications, and this has facilitated three-dimensional visualization in several other programs produced by the Cambridge Crystallographic Data Centre (Macrae et al., 2006, p. 453).

These results suggest that the Theileria mt genome is highly diverse... (Hikosaka et al., 2009, p. 3).

..the disease-causing isolates have arisen from multiple lineages, suggesting that virulence evolved independently in the highly epidemic lineages (He et al., 2010, p. 7527).

These findings demonstrate that iPS cells can be generated from adult human fibroblasts (Takahashi, 2007, p. 861).

Hence, these sequence-based methods are a complementary approach for detecting correlated evolution and could be applied genome-wide to provide candidate protein-protein interactions and functional group assignments using just coding sequences (Clark & Aquadro, 2010, p. 2)

This system provides definitive endpoints for statistical analysis of serial changes in liver histology and offers an alternative to the use of conventional pathological descriptions in following the natural history and treatment responses of asymptomatic chronic active hepatitis (Knodell et al., 1981, p. 431).

This historical cohort study has provided incidence data for thyroid disease over a twenty-year period for a representative cross-sectional sample of the population, and has allowed the determination of the importance of prognostic risk factors for thyroid disease identified twenty years earlier (Vanderpump et al., 1995, p. 55).

A differential rendering technique allows for good results to be obtained when only an estimate of the local scene reflectance properties is known (Debeve, 2008, n.p.).

Our results suggest, that superconductivity in these systems evolves essentially from the $(FeAs)_\delta$- layers and may occur in other related compounds (Rotter et al., 2008, n.p.).

The [Salagar-Meyer](#) Method of Writing an Abstract

Instead of a science example, we will use an example from business. The authors of a journal article entitled *Concerns of College Students Regarding Business Ethics* provided the following abstract for their article:

Abstract (Original)

Although some attention has been devoted to assessing the attitudes and concerns of businesspeople toward ethics, relatively little attention has focused on the attitudes and concerns of tomorrow's business leaders, today's college students. In this investigation a national sample was utilized to study college students' attitudes toward business ethics, with the results being analyzed by academic classification, academic major, and sex. Results of the investigation indicate that college students are currently somewhat concerned about business ethics in general, and that female students in particular are more concerned about ethical issues than are their male counterparts ([Beltramini et. al., 1984](#)).

Having read the article, we then created three versions of the Salagar-Meyer abstract format. The first version is the outline version that Salagar-Meyer recommends in her article. The second is a numerical version that is nearly identical to the outline version. The third is a traditional layout in paragraph format. Although the paragraph format is still the most common, the two outline formats are becoming more popular, especially in medical journals.

Abstract (Ouline Format)

Study Objective: To investigate attitudes of university students toward issues of business ethics.

Subjects: 2,856 university students from 28 universities were polled. Both sexes, all undergraduate years, and a wide variety of major subjects were represented.

Design: 200 of the students were initially requested to list their concerns related to business ethics. The 10 most frequently mentioned concerns were then phrased as questions about ethical issues in business, and the participants were asked to rate each issue on an attitude scale from "extremely concerned" to "extremely unconcerned.."

Statistical Treatment of Data: Percentages of each rating for each of the ten questions were tabulated. Analyses of variance were then performed to determine if there were significant variations between groups participating in the study.

Results: Among others, business majors were more concerned with the issues than were students from other majors. On the whole, female students were more concerned with each issue than were male students.

Conclusions: All university students appear to be concerned, at least to some degree, with ethics in business. Because female students appear to be more concerned than male students, however, there is reason to believe that increasing numbers of women in pivotal positions in business will have an effect on the changing ethical climate in the business world. As ethical norms change over time as a result of many variables, studies of this kind should be undertaken periodically to judge the changing attitudes of students toward business ethics. These attitudes can contribute to an intelligent decision-making process among teachers, business people, and lawmakers.

Abstract (Numerical Format)

I. To investigate attitudes of university students toward issues of business ethics.

II. 2,856 university students from 28 universities were polled. Both sexes, all undergraduate years, and a wide variety of major subjects were represented.

III. 200 of the students were initially requested to list their concerns related to business ethics. The 10 most frequently mentioned concerns were then phrased as questions about ethical issues in business, and the participants were asked to rate each issue on an attitude scale from "extremely concerned" to "extremely unconcerned.."

IV. Percentages of each rating for each of the ten questions were tabulated. Analyses of variance were then performed to determine if there were significant variations between groups participating in the study.

V. Among others, business majors were more concerned with the issues than were students from other majors. On the whole, female students were more concerned with each issue than were male students.

VI. All university students appear to be concerned, at least to some degree, with ethics in business. Because female students appear to be more concerned than male students, however, there is reason to believe that increasing numbers of women in pivotal positions in business will have an effect on the changing ethical climate in the business world. As ethical norms change over time as a result of many variables, studies of this kind should be undertaken periodically to judge the changing attitudes of students toward business ethics. These attitudes can contribute to an intelligent decision-making process among teachers, business people, and lawmakers.

Abstract (Traditional Format)

The purpose of the study was to investigate attitudes of university students toward issues of business ethics. 2,856 university students from 28 universities were polled. Both sexes, all undergraduate years, and a wide variety of major subjects were represented. 200 of the students were initially requested to list their concerns related to business ethics. The 10 most frequently mentioned concerns were then phrased as questions about ethical issues in business, and the participants were asked to rate each issue on an attitude scale from "extremely concerned" to "extremely unconcerned.." Percentages of each rating for each of the ten questions were tabulated. Analyses of variance were then performed to determine if there were significant variations between groups participating in the study. Among others, business majors were more concerned with the issues than were students from other majors. On the whole, female students were more concerned with each issue than were male students. All university students appear to be concerned, at least to some degree, with ethics in business. Because female students appear to be more concerned than male students, however, there is reason to believe that increasing numbers of women in pivotal positions in business will have an effect on the changing ethical climate in the business world. As ethical norms change over time as a result of many variables, studies of this kind should be undertaken periodically to judge the changing attitudes of students toward business ethics. These attitudes can contribute to an intelligent decision-making process among teachers, business people, and lawmakers.

It is clear that a great deal more useful information is included in the six-part Salagar-Meyer format. Such an abstract is of much greater value to a researcher. You will note, however, that this method says nothing about setting a context or giving a background at the beginning of the abstract. The original authors did this with the first sentence of their abstract:

"Although some attention has been devoted to assessing the attitudes and concerns of businesspeople toward ethics, relatively little attention has focused on the attitudes and concerns of tomorrow's business leaders, today's college students."

Such a sentence or two can easily be added to the beginning of the Salagar-Meyer format.

Using the Salagar-Meyer method of abstract writing will help you to avoid the kind of useless abstract that is seen in many published papers. This type of abstract looks something like the following:

A simulation of the growth of a rabbit population is performed. Computer simulation software is used to model the population. All relevant statistical operations are

carried out. Results are compared with a randomly selected population of rabbits. Agreements and discrepancies between the model and the real population are investigated in detail. Correlation statistics are given. The results are explained and recommendations for further studies are given.

You will notice that this kind of abstract tells you nothing about the study except that it involves rabbits. Such an abstract is a waste of words and effort. You can easily avoid this problem by following the Salagar-Meyer method and using one of the three patterns given above.

1.1. a. Examples of Abstracts: Biology

Journal Article Abstract (Biology)

Mitochondrial (mt) genomes from diverse phylogenetic groups vary considerably in size, structure, and organization. The genus Plasmodium, causative agent of malaria, of the phylum Apicomplexa, has the smallest mt genome in the form of a circular and/or tandemly repeated linear element of 6 kb, encoding only three protein genes (*cox1*, *cox3*, and *cob*). The closely related genera Babesia and Theileria also have small mt genomes (6.6 kb) that are monomeric linear with an organization distinct from Plasmodium. To elucidate the structural divergence and evolution of mt genomes between Babesia/Theileria and Plasmodium, we determined five new sequences from *Babesia bigemina*, *B. caballi*, *B. gibsoni*, *Theileria orientalis*, and *T. equi*. Together with previously reported sequences of *B. bovis*, *T. annulata*, and *T. parva*, all eight Babesia and Theileria mt genomes are linear molecules with terminal inverted repeats (TIRs) on both ends containing three protein-coding genes (*cox1*, *cox3*, and *cob*) and six large subunit (LSU) ribosomal RNA (rRNA) gene fragments. The organization and transcriptional direction of protein-coding genes and the rRNA gene fragments were completely conserved in the four Babesia species. In contrast, notable variation occurred in the four Theileria species. Although the genome structures of *T. annulata* and *T. parva* were nearly identical to those of Babesia, an inversion in the 3-kb central region was found in *T. orientalis*. Moreover, the *T. equi* mt genome is the largest (8.2 kb) and most divergent with unusually long TIR sequences, in which *cox3* and two LSU rRNA gene fragments are located. The *T. equi* mt genome showed little synteny to the other species. These results suggest that the Theileria mt genome is highly diverse with lineage-specific evolution in two Theileria species: genome inversion in *T. orientalis* and gene-embedded long TIR in *T. equi* (Hikosaka et al., 2009, p. 3).

M.Sc Thesis Abstract (Biology):

Fish are not abundant at hydrothermal vents due to the toxicity of venting fluids. Those that are present usually roam the periphery of the vent field or visit occasionally to feed on the abundance of life supported by chemosynthesis. In the past decade, dense aggregations of a newly described flatfish, *Symphurus* n.sp, have been observed in association with hydrothermal vents in the western Pacific hydrothermal vent biogeographic province. In this thesis I provide evidence that *Symphurus* n.sp is a vent obligate and consider the ramifications that this association with hydrothermal vents may have for its distribution, population characteristics, behaviour and diet.

    Symphurus n.sp has a widespread but disjunct distribution throughout the western Pacific hydrothermal vent biogeographic province. *Symphurus* n.sp appears to be restricted to hydrothermally active, shallow, sulphur rich seamounts. *Symphurus* n.sp occurs on unconsolidated volcanoclastic ash and solid sulphur crusts and in close association with molten elemental sulphur. The obvious affinity that this species has for native sulphur is unusual and remains unexplained. Unlike most vent-associated fish, *Symphurus* n.sp occurs in close contact with point source venting and its distribution extends to the periphery of vent fields but not beyond. The density of flatfish on these seamounts surpasses density estimates of flatfish nursery grounds on the continental shelf. On Daikoku Seamount (Mariana Volcanic Arc), mean flatfish abundances were 100 and 66 individuals m^{-2} in 2005 and 2006 respectively. The prey items that

support such high densities of flatfish vary over spatial scales. Differing prey, in turn, results in differing foraging modes. On Nikko Seamount (Mariana Volcanic Arc), *Symphurus* n.sp is a "sit and wait" predator that feeds exclusively on a vent endemic shrimp, *Opaepele loihi*. On other seamounts, *Symphurus* n.sp is an opportunistic forager that preys mostly on polychaetes and small crustaceans. By counting annuli on otoliths I constructed growth curves and determined that growth rates differ between seamounts. This difference in growth rates is likely due to differences in their diet and foraging strategies. *Symphurus* n.sp may be allocating more energy to growth when less energy is required to forage. Furthermore, size distributions also differ between populations, likely due to variability in growth rates as well as differences in strong recruitment years (Tyler, 2005, pp. ii-iv).

Ph.D. Dissertation Abstract (Biology):

Proteins modularity enhances the multi-functionality and versatility of proteins byproviding such properties as multiple and various ligand-binding sites, increased ligand affinity through the avidity effect, and the juxtaposition of ligand-binding modules near catalytic domains. An NMR-based "dissect-and-build" approach to studying modular protein structure and function has proven very successful, whereby modules are initially characterized individually and then correlated with the overall function of a protein. We have used the dissect-and-build approach and NMR to study two modular protein systems.

Chapter 2 details the NMR solution structure of the weak-lysine-binding kringle IV type 8 (KIV$_8$) module from the apolipoprotein(a) (apo(a)) component of lipoprotein(a) was determined and its ligand-binding properties assessed. *In vitro* studies have demonstrated the importance of the apo(a) KIV$_7$ and KIV$_8$ modules in mediating specific lysine-dependent interactions with the apolipoproteinB-100 (apoB-100) component of LDL in the initial non-covalent step of lipoprotein assembly. Notable differences identified in the lysine binding site (LBS) of the KIV$_8$ were deemed responsible for the differential modes of apoB-100 recognition by KIV$_7$ and KIV$_8$. In addition, the KIV$_8$ structure has brought to light the importance of an RGD sequence at the N-terminus of the apo(a) KIV$_8$ module, which may mediate important apo(a)-integrin interactions.

In Chapters 3-6, structure-function studies of the *Cp*GH84C X82 and the *Cp*GH84A dockerin-containing modular pair were conducted to understand how the varying modularity unique to the C-terminal regions of the secreted multi-modular family 84 glycoside hydrolases influences the spreading of *Clostridium perfringens*. Identification of a *Cp*GH84C cohesin module (X82), and the structural characterization of a dockerin-containing modular pair provides the first evidence for multi-enzyme complex formation mediated by non-cellulosomal cohesin-dockerin interactions. The formation of large hydrolytic enzyme complexes introduces a novel mechanism by which *C. perfringens* may enhance its role in pathogenesis (Chitayat, 2007, pp. ii-iii).

Return to Abstract   Return to Top

1.1. b. Examples of Abstracts: Chemistry

Journal Article Abstract (Chemistry)

TAp63 is a sequence-specific transcription factor that regulates epithelial stem cell maintenance and epithelial differentiation. In addition, the TAp63 isoform with an N-terminal transactivation domain functions as an inducer of apoptosis during the development of sympathetic neurons. Previous work has indicated that the co-activator and histone acetyltransferase (HAT), p300, can bind to TAp63 and stimulate TAp63-dependent transcription of the p21Cip1 gene. Novel INHAT Repressor (NIR) is an inhibitor of HAT. Here, we report that the central portion of NIR binds to the transactivation domain and the C-terminal oligomerization domain of TAp63. NIR is highly expressed in G2/M phase of the cell cycle and only weakly expressed in G1/S. Furthermore, except during mitosis, NIR is pre- dominantly localized in the nucleolus; only a small portion co-localizes with TAp63 in the nucleoplasm and at the p21 gene promoter. Consistent with NIR acting as a repressor, the induced translocation of NIR from the nucleolus into the nucleoplasm resulted in the inhibition of TAp63-dependent transactivation of p21. Conversely, knockdown of NIR by RNAi stimulated p21 transcription in the presence of TAp63. Thus, NIR is a cell-cycle-controlled, novel negative regulator of TAp63. The low levels of nucleoplasmic NIR might act as a buffer toward potentially toxic TAp63 (Heyne et al., 2010, p. 3159).

M.Sc. Thesis (Chemistry)

An infrared active polyatomic molecule has several vibrational modes, each of which has a characteristic frequency. If the molecule is trapped in a matrix of perturbing atoms, those vibrational frequencies will shift, and if the vibrational mode is degenerate, the perturbation may lift the degeneracy. Such shifts and splitting are due to the dependence of the chromophore/matrix-atom interaction potential on the internal vibrational motion of the chromophore. Applying a previously-developed model for the shifting and splitting of the triply degenerate v_3 mode of SF6 perturbed by a rare gas atom, we use Monte Carlo simulations to sample the accessible equilibrium configurations of the system and to predict the associated thermally averaged perturbed IR spectra. Since the experimental spectrum has 10 peaks while the triply degenerate v_3 mode of SF6 in a particular environment could have at most 3 peaks, the observed spectrum must be a combination of spectra for SF6 trapped in different types of lattice sites. A fit to experiment of simulated spectra generated from a family of lattice sites is then used to identify the peaks in the experimental spectrum, determine the relative importance of the various lattice sites, and semi-quantitatively reproduce the experimental spectrum (Peng, 2005, p. iii).

Ph.D. Dissertation (Chemistry)

In this work, atmospheric radicals were measured using the chemical amplification technique. To calibrate the chemical amplifier, a UV water photolysis radical source was built and tested. This source proved to be reliable and portable. and capable of delivering radical concentrations within the range of values found in the troposphere. We tested the performance of our instrument at the

Peroxy Radical InterComparison Exercise II (PRICE II). In this intercornparison seven chemical amplifiers participated measuring several HO, and CH302 concentrations. Results from this campaign indicate that all of the chemical amplifiers are equally capable of measuring HO2 and CH302 radicals from two different radical sources (KG-HO2 source and UEA-CH302 source). The average response towards the ICG and UEA sources were 70% and 45%. respectively. Losses in the delivery system are thought to be responsible for these low responses. Radical measurements were taken at 4 contrasting sites: Atlantic '96 (clean continental), SONTOS '92 and '93 (rural), Calabozo '93 (tropical clean continental), and Pacific '93 (predominantly urban), where maximum RO, concentrations ranged from 17 to 52 pptv. These values are consistent with those found in the literature for similar regions. The measured radical concentrations reflect the interaction between the main production and loss processes at the different sites, as for example ozone photolysis and HN03 formation. At Calabozo, the combination of moderate O, low NO, and small Zenith angles resulted in the highest RO, measured. At the Pacific '93 site. O3 is higher, but NO_x concentrations are also very high, enhancing the radical loss processes, and explaining the moderate radical concentrations observed. At Atlantic '96 the very low NO_x concentration might account for the radical concentrations observed, even in the presence of low O3 concentrations. At SONTOS, the highest ozone concentrations were observed. so we would expect the radical production to be also high. However, NO_x levels at the site probably prevented the accumulation of radicals. The radical data obtained during these campaigns were used to calculate local ozone and hydrogen peroxide production rates, as tools to assess the importance of the local production versus transport on the observed ozone and H202 concentrations. Results indicate that in most of the sites transport plays a significant role in the measured concentrations (Arias, 1998, pp. iv-v).

1.1. c. Examples of Abstracts: Engineering / Computer Science

Journal Article Abstract (Computer Science)

The large-scale behavior of routing in the Internet has gone virtually without any formal study, the exception being Chinoy's analysis of the dynamics of Internet routing information [Ch93]. We report on an analysis of 40,000 end-to-end route measurements conducted using repeated 'traceroutes' between 37 Internet sites. We analyze the routing behavior for pathological conditions, routing stability, and routing symmetry. For pathologies, we characterize the prevalence of routing loops, erroneous routing, infrastructure failures, and temporary outages. We find that the likelihood of encountering a major routing pathology more than doubled between the end of 1994 and the end of 1995, rising from 1.5% to 3.4%. For routing stability, we define two separate types of stability, 'prevalence,' meaning the overall likelihood that a particular route is encountered, and 'persistence,' the likelihood that a route remains unchanged over a long period of time. We find that Internet paths are heavily dominated by a single prevalent route, but that the time periods over which routes persist show wide variation, ranging from seconds up to days. About 2/3's of the Internet paths had routes persisting for either days or weeks. For routing symmetry, we look at the likelihood that a path through the Internet visits at least one different city in the two directions. At the end of 1995, this was the case half the time, and at least one different autonomous system was visited 30% of the time (Paxson, 2006, p. 41).

M.Sc. Thesis Abstract (Engineering)

The goal of this thesis is to develop a methodology for designing 3D target shapes for accurate LIDAR pose estimation. Scanned from a range of views, this shape can be attached to the surface of a spacecraft and deliver accurate pose scanned. It would act as an LIDAR- based analogue to fiducial markers placed on the surface and viewed by CCD camera(s). Continuum Shape Constraint Analysis (CSCA) which assesses shapes for pose estimation and measures the performance of the Iterative Closest Point (ICP) Algorithm is used as a shape design tool. CSCA directly assesses the sensitivity of pose error to variation in viewing direction. Three of the CSCA measures, Noise Amplification Index, Minimal Eigen-value and Expectivity Index, were compared, and Expectivity Index was shown to be the best index to use as shape design tool. Using CSCA and numerical simulations, a Cuboctahedron was shown to be an optimal shape which delivers an accurate pose when viewed from all angles and the initial pose guess is close to the true poses. Separate from Constraint Analysis, the problem of shape ambiguity was addressed using numerical tools. The Cuboctahedron was modified in order to resolve shape ambiguity - the tendency of the ICP algorithm to converge with low registration error on a pose configuration geometrically identical, but actually different from a "true pose". The numerical characteristics of geometrical ambiguity were studied, and a heuristic design methodology to reduce shape ambiguity was developed and is presented in this thesis. A Reduced Ambiguity Cuboctahedron is the resultant shape that delivers an accurate pose from all views and does not suffer from shape ambiguity. The shapes were subjected to simulation and experimental validation. They were manufactured using 3D Rapid Prototyper, and a NEPTEC Design Group TriDAR Scanner was used to obtain experimental data for three shapes: the Tetrahedron,

Cuboctahedron, and reduced Ambiguity Cuboctahedron. The Tetrahedron, which has poorly constrained views, was included in the testing process as a comparison shape. The simulation and experimental results were congruent, and validated the design methodology and the designed shapes (Choudhuri, 2007, p. iii).

Ph.D. Dissertation Abstract (Engineering)

One of the most important parameters in a lightning flash that is of interest to researchers is the lightning return-stroke current as it causes most of the destructions and disturbances in electrical and telecommunication networks. In most cases, the lightning return-stroke current can not be directly measured and current characteristics are determined from measured electric and magnetic fields through the use of lightning return-stroke models. The main objective of this work is the development of a lightning return-stroke model for an elevated object. Also, an important objective is the correlation of the wavefront parameters (peak, maximum rate of rise and risetime) of the returnstroke current with the wavefront parameters of its associated lightning electromagnetic pulse (LEMP), measured 2 km north of the tower. The developed field-current parameter relationships for CN Tower lightning return strokes are compared with those obtained from measurements conducted at the Peissenberg Tower in Germany.

A 3-section transmission line (TL) model of the CN Tower, along with the derivative of the modified Heidler function, is used to simulate the measured current derivative signal. Then, the spatial-temporal distribution of the lightning current along the CN Tower and the lightning channel, during the lightning return-stroke phase, is determined. The presented model simulates the measured current derivative signal instead of the current as has been used by other researchers. The use of the derivative of the modified Heidler function to simulate the lightning current derivative proved to be superior than simulating the lightning current.

For the quantitative assessment of the proposed model, a comparison between the simulated field, obtained through the usage of Maxwell's equations and the simulated current, and the measured field is performed. The developed 3-section TL model based on the measured current derivative and the derivative of the modified Heidler function produced a simulated magnetic field that is much closer to the measured field in comparison with previous models.

The developed field-current parameter relationships as well as the experimentally verified lightning return-stroke model can contribute to solving the inverse-source problem, one of the most challenging problems in lightning research, where the lightning current characteristics are estimated based on the characteristics of the measured LEMP (Milewski, 1999, pp. iv-v).

Return to Abstract   Return to Top

1.1. d. Examples of Abstracts: Medicine

<u>Journal Article Abstract (Medicine)</u> (Note that medical abstracts often follow the Salagar-Meyer <u>method</u>)

BACKGROUND AND OBJECTIVE: The original Whickham Survey documented the prevalence of thyroid disorders in a randomly selected sample of 2779 adults which matched the population of Great Britain in age, sex and social class. The aim of the twenty-year follow-up survey was to determine the incidence and natural history of thyroid disease in this cohort.

DESIGN, PATIENTS AND MEASUREMENTS: Subjects were traced at follow-up via the Electoral Register, General Practice registers, Gateshead Family Health Services Authority register and Office of Population Censuses and Surveys. Eight hundred and twenty-five subjects (30% of the sample) had died and, in addition to death certificates, two-thirds had information from either hospital/General Practitioner notes or post-mortem reports to document morbidity prior to death. Of the 1877 known survivors, 96% participated in the follow-up study and 91% were tested for clinical, biochemical and immunological evidence of thyroid dysfunction.

RESULTS: Outcomes in terms of morbidity and mortality were determined for over 97% of the original sample. The mean incidence (with 95% confidence intervals) of spontaneous hypothyroidism in women was 3.5/1000 survivors/year (2.8-4.5) rising to 4.1/1000 survivors/year (3.3-5.0) for all causes of hypothyroidism and in men was 0.6/1000 survivors/year (0.3-1.2). The mean incidence of hyperthyroidism in women was 0.8/1000 survivors/year (0.5-1.4) and was negligible in men. Similar incidence rates were calculated for the deceased subjects. An estimate of the probability of the development of hypothyroidism and hyperthyroidism at a particular time, i.e. the hazard rate, showed an increase with age in hypothyroidism but no age relation in hyperthyroidism. The frequency of goitre decreased with age with 10% of women and 2% of men having a goitre at follow-up, as compared to 23% and 5% in the same subjects respectively at the first survey. The presence of a goitre at either survey was not associated with any clinical or biochemical evidence of thyroid dysfunction. In women, an association was found between the development of a goitre and thyroid-antibody status at follow-up, but not initially. The risk of having developed hypothyroidism at follow-up was examined with respect to risk factors identified at first survey. The odds ratios (with 95% confidence intervals) of developing hypothyroidism with (a) raised serum TSH alone were 8 (3-20) for women and 44 (19-104) for men; (b) positive anti-thyroid antibodies alone were 8 (5-15) for women and 25 (10-63) for men; (c) both raised serum TSH and positive anti-thyroid antibodies were 38 (22-65) for women and 173 (81-370) for men. A logit model indicated that increasing values of serum TSH above 2mU/l at first survey increased the probability of developing hypothyroidism which was further increased in the presence of anti-thyroid antibodies. Neither a positive family history of any form of thyroid disease nor parity of women at first survey was associated with increased risk of developing hypothyroidism. Fasting cholesterol and triglyceride levels at first survey when corrected for age showed no association with the development of hypothyroidism in women.

CONCLUSIONS: This historical cohort study has provided incidence data for thyroid disease over a twenty-year period for a representative cross-sectional sample of the population, and has allowed the determination of the importance of prognostic risk factors for thyroid disease identified twenty years earlier <u>(Vanderpump et al., 1995, p. 55).</u>

<u>M.Sc. Thesis (Medicine)</u>

The objectives of the current research were (1) to determine the contribution of Mendelian inherited disease to the burden of disease caused by Endstage renal disease; (2) to explore the possibility that polygenic disorders could contribute to the development of Endstage renal disease; and (3) to describe the natural history of single-gene disorders associated with Endstage renal disease identified in the Newfoundland population, with particular focus on new data associated with Bardet-Biedl Syndrome.

To determine the risk of renal failure in family members of probands with Endstage Renal Disease (ESRD), all patients who were receiving treatment for ESRD during 1987-1993 in the province of Newfoundland and Labrador, Canada were studied. Detailed family histories were taken from 584 (87%) of the 669 eligible probands. Of the 85 patients with incomplete family histories, 60 (9%) could not be located and 25 (3.6%) refused to participate. The rate of renal failure in relatives of probands was compared to the rate of renal failure in spousal control families. Spousal controls were chosen because they have been shown to be less subject to recall bias and generally are similar to their spouses for environmental influences. Family histories were collected on 499 (85.4%) of the eligible spouses of probands. No spouses or next of kin would be identified for 65 (11%) of the probands and 20 (3.4%) of potential controls refused to participate.

To determine the original cause of rend disease in the probands the medical records were reviewed The information gathered was reviewed by a single clinical nephrologist who was blinded to the identity of the patient. Diseases with a Mendelian pattern of inheritance accounted for ESRD in 8.4% of the cases, 4.5% being autosomal dominant polycystic kidney disease, 2.5% Alport's syndrome and the remaining 1.4% to other genetic diseases. This group of cases was excluded from the subsequent familial risk analysis. Glomedonephritis was the renal diagnosis in 25% of the probands, diabetes rnellitus in 20%, unknown in 14%, other in 12%, interstitial in 11%, hypertensive sclerosis in 5% and multiple causes in 4%.

Primary outcomes were defined as a positive family history of renal failure associated with renal replacement therapy in a first, second or third degree relative of a proband or control. In the group without a Mendelian pattern of inheritance, 28% had a first, second or third degree relative with renal failure associated with death or requiring dialysis versus 15% of controls. 1.2% of first degree relatives of probands developed renal failure compared to 0.4% of first degree relatives of controls (OR=3.0,95% CI: 1-7-5.2). No difference was observed in risk for second degree relatives, but a highly significant increased risk was observed for third degree relatives of probands (OR=2.1,95% CI: 1.2-3.4). The highest rate of affected first degree in relatives occurred in relatives of probands with hypertensive nephrosclerosis (2.3%), diabetes rnellitus (1.6%) and interstitial disease (1.6%).

The second control group utilized was the provincial population. The proportion of relatives of probands registered with the Canadian Organ Replacement Registry (CORR) was compared to the rate of the general population. The provincial incidence of ESRD, registered with CORR, from 1981 - 1993 was 79/million, excluding 8% of patients with Mendelian inherited disease. The comparable rate of ESRD in first degree relatives of probands without Mendelian inherited renal disease was 297/million, almost four times the provincial rate. The comparable rate for first degree relatives of controls was 135/million.

Conclusions: We conclude that not only is the contribution of Mendelian inherited disease to ESRD high, but there is also an increased risk of renal failure in first degree relatives of probands without Mendelian inherited renal disease in a Caucasian population (Flynn O'Dea, 1997, pp. ii-iv).

Ph.D. Dissertation Abstract (Medicine)

Background: Reduced bone mineral density (BMD) is an established complication of anorexia nervosa (AN). There is inconclusive evidence as to whether this reduction in bone mass is permanent or can be reversed with recovery from AN. The objectives of this study were to: i. determine the extent of reversal of skeletal deficits with recovery from AN, and the duration of recovery required for complete reversal, if this occurred; and, ii. evaluate the effect of key illness characteristics on BMD.

Methods: Women (aged 17-40 years) who had previously received inpatient treatment for AN at one of two hospital-based programs were selected for this cross-sectional study; 514 healthy premenopausal women recruited from the community served as a control group. A detailed lifetime illness history was obtained by a Life History Calendar interview. BMD was measured by dual-energy X-ray absorptiometry (DXA) at the spine, hip and total body. Low BMD was defined as a weight and age-matched standard deviation (Z-score) of ! -1.5 at one or more skeletal sites. Participants were considered recovered if they had maintained a body mass index 18.5 kg/m2 and resumed regular menstruation for 1 year.

Results: Of 190 AN participants, 77 were considered recovered and 113 were ill. The prevalence of low BMD was 11.7% in the recovered group, 47.3% in the ill group and 6.8% in the control group. The odds of low BMD in the recovered participants was significantly lower than in the ill participants (odds ratio [OR] = 0.17, 95% CI 0.07, 0.36, $p<0.0001$) and was not significantly different from the controls (OR = 1.81, 95% CI 0.79, 3.78, p=0.15). Duration of illness was associated with low BMD (OR = 1.16, 95% CI 1.08, 1.25, $p<0.0001$) and was negatively associated with the odds of AN recovery. Normal mean BMD values at each skeletal site were observed in women recovered " 3 years.

Conclusion: The results emphasize the importance of early and sustained AN recovery for the prevention and treatment of low bone mass in this population and may offer motivation for AN patients to make positive behavioural changes leading to successful, long-term recovery (Waugh, 2009, pp. ii-iii).

Return to Abstract   Return to Top

1.1. e. Examples of Abstracts: Physics

Journal Article Abstract (Physics)

The ternary iron arsenide $BaFe_2As_2$ becomes superconducting by hole doping, which was achieved by partial substitution of the barium site with potassium. We have discovered bulk superconductivity at $Tc = 38$ K in $(Ba_{1-x}K_x)Fe_2As_2$ with $x \approx 0.4$. The parent compound $BaFe_2As_2$ as well as KFe_2As_2 both crystallize in the tetragonal $ThCr_2Si_2$-type structure, which consists of $(FeAs)\delta-$iron arsenide layers separated by barium or potassium ions. $BaFe_2As_2$ is a poor metal and exhibits a spin density wave (SDW) anomaly at 140 K. By substituting Ba^{2+} for K^+ ions we have introduced holes in the (FeAs)–layers, which suppress the SDW anomaly and induce superconductivity. This scenario is very similar to the recently discovered arsenide-oxide superconductors. The Tc of 38 K in $(Ba_{0.6}K_{0.4})Fe_2As_2$ is the highest critical temperature in hole doped iron arsenide superconductors so far. Therefore, we were able to expand this class of superconductors by oxygen-free compounds with the $ThCr_2Si_2$-type structure. Our results suggest, that superconductivity in these systems evolves essentially from the $(FeAs)\delta-$layers and may occur in other related compounds (Rotter et al., 2008, n.p.).

M.Sc. Thesis Abstract (Physics)

The plate scale is a parameter which relates the observed angular distance in the sky to the physical distance in a telescope's focal plane. In the telescopes of the VERITAS project the correct interpretation of shower images in the camera plane is only possible if the plate scale is properly known. Well understood images help to better calculate the shower parameters, thus allowing more effcient background rejection and more accurate estimation of primary gamma-ray properties. The VERITAS telescopes' plate scale has been calculated and simulated but never actually measured or studied in detail. The purpose of this thesis is to measure the plate scale and compare it to the simulated and calculated values. The effect that the plate scale has on the angular resolution and the source location reconstruction is also analyzed. It was found that a known plate scale effect was not being handled properly by the offline analysis and was causing systematic error. As a result of this research, the plate scale effect was recently added to the shower reconstruction analysis code, thus improving the calculations of the primary gamma-ray properties (Bautista, 2009, p. xi).

Ph.D. Dissertation Abstract (Physics)

In this dissertation, many-body physics techniques are used to study and improve ideas related to the description of heavy ion collisions at very high energy. The first part of the thesis concerns the production of tensor mesons in proton-proton (pp) collisions. An effective theory where the $f2$ meson couples to the energy-momentum tensor is proposed and a comparison of the inclusive cross-section computed in the collinear factorization, the $k\perp$-factorization and the color glass condensate is performed. A study of the phenomenology in pp collisions then shows a strong dependence on the parametrization of the unintegrated distribution function. The conclusion is

that *f2* meson production can be utilized to improve the understanding of the proton wavefunction. In the second part, a similar investigation is performed by analysing the production cross-section of the η' meson in *pp* and proton-nucleus (*pA*) collisions. The nucleus and proton are described by the CGC and the $k\perp$-factorization respectively. A new technique for the computation of Wilson lines - color charge densities correlators in the McLerran-Venugopalan model is developed. The phenomenology shows that the cross-section in *pA* collisions is very sensitive to the value of the saturation scale, a crucial ingredient of the CGC picture. In the third part of the thesis, the collision term of the Boltzmann equation is derived from first principles at all orders and for any number of participating particles, starting from the full out-of-equilibrium quantum field theory and using the multiple scattering expansion. Finally, the emission of photons from a non-abelian strong classical field is investigated. A formalism based on Schwinger-Keldysh propagators relating the production rate of photons to the retarded solution of the Dirac equation in a background field is presented (Fillion-Gourdeau, 2009, pp. ix-x).

Return to Abstract   Return to Top

1.2. Dissertation: Acknowledgements

Immediately following the abstract is a page of acknowledgements. Here the writer thanks those who have been most helpful during the process of studying and writing. The acknowledgements typically begin with a short paragraph thanking the thesis supervisor. A typical example is the following, from which names have been removed:

Acknowledgements

I am grateful to my mentor and supervisor, XXXXXXX, who hired me as an undergraduate student and has since guided me through my doctorate degree. I began this journey without any knowledge of the research field and through my time in the XXXXXXX lab I gained a true passion for science. The past nine years in the lab have been thoroughly enjoyable and an amazing learning experience. Thank you XXXXXXX for leading me into a highly rewarding career; with your guidance I have been able to become a confident scientist ready for the road ahead.

I would like to thank my wife, XXXXXXX, for having patience for what seemed like a long-term appointment as a student and for being my rock (I couldn't get around the cliché). You have stood by my side through it all, especially during the high stress, always supporting me and pushing me through it. Your encouragement has been the reason for my success.

And of course I would like to thank my fellow lab mates, who have provided much support during failed and successful experiments or just simply when I couldn't remember how to calculate something. You have all contributed to this experience and made it fun!

Finally, I would like to thank my supervisory committee who helped guide me through this experience and prepared me very well for successfully completing this degree (Mayer, 2009, p. iv).

Return to Top

1.3. Dissertation: Table of Contents

The Table of Contents follows the Acknowledgements page. Each chapter and subsection should be included, along with page numbers. If the dissertation is produced electronically, it is helpful to provide hyperlinks from each item in the Table of Contents to the relevant chapter or subsection. The first chapter begins on page 1. Previous materials is paginated with small Roman numerals. Sub-sections are indented. A typical example follows:

Contents

(Wilks, n.d. pp. iv-viii)

Return to Top

1.4. Dissertation: List of Figures (Illustrations)

Following the Table of Contents are pages listing the figures (also called illustrations) and the tables that are used throughout the dissertation. Usually, but not always, the list of figures is placed before the list of tables. Figure number, brief descriptions, and page numbers are included. An example extract from a list of figures follows:

List of Figures

(Chen, 2004, p. 11)

Return to Top

1.5. Dissertation: List of Tables

Following the Table of Contents are pages listing the figures (also called illustrations) and the tables that are used throughout the dissertation. Usually, but not always, the list of tables is placed after the list of figures. Table number, brief descriptions, and page numbers are included. An example follows:

List of Tables

(Chitayat, 2007, p. xvii)

Return to Top

1.6. Dissertation: List of Symbols and Abbreviations

After the lists of figures and tables and immediately before the first chapter of the dissertation, it may be advisable to include a list of the symbols and/or abbreviations used in the work. Occasionally this section is called "Nomenclature". It should not be called "Glossary". Example extracts follow:

LIST OF SYMBOLS

A	Area [m_2]
B	Fraction of ice in a unit mass of wet snow (usually 0.95 to 0.97)
c	Speed of light [$3{\cdot}10_8$ m s$_{-1}$]
c_i	Specific heat of ice [kJ kg$_{-1}$ K$_{-1}$]
C	Location coefficient [dimensionless]
$C_i(t)$	Concentration of an ion i at time t [meq m$_{-3}$]
$C_i(0)$	Initial concentration of an ion i in the snowpack [meq m$_{-3}$]
CF	Concentration factor; $CF = C_i(t)/C_i(0)$ [(meq m$_{-3}$) (meq m$_{-3}$)$_{-1}$]
CF_{max}	Concentration factor o$_{-3-3-1}$

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Abbreviations

ABS	Acrylonitrile butadiene styrene
Ave	Average
BI	Overland flow due to formation of a basal ice layer
BW	Runoff water, which had sustained contact with a basal ice layer
CEL	Cryospheric environmental laboratory, located at Centre for Hydrology, University of Saskatchewan
DDI	Deionized distilled water
DI	Distilled water
DOC	Dissolved organic carbon
HDPE	High density polyethylene
JD	Julian Day
LAI	Leaf area index
LDPE	Low density polyethylene
MIF	Mineral interflow
MIF*	Mineral interflow with evidence of substantial organic contact
MSW	Mineral soil water
MW	Runoff water, which had sustained contact with a mineral soil layer
n.d.	Below detection limits

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(Lilbæk, 2009, pp. xviii-xxii)

1.7. Dissertation: Introduction

The introductory chapter of a dissertation is the first full chapter. It usually consists of all or some of the following sections, or moves, in the order presented. If the Literature Review is included as a separate chapter, it should follow the Introduction. The last move, Structure of Dissertation, is sometimes omitted.

Move	Contents	Language
Background and/or Context of the Study	• Describe the area of research. • Show how the area has developed, either by referring to major advancements in the field or by providing a literature review (See below.).	Language Patterns and Examples
Literature Review (if not included in the Background)	• Trace the major research in the area. • Group studies according to specific findings. Find areas of consensus and disagreement. • Identify areas where more work is needed, especially as related to your research. • Give enough information so that readers do not have to refer to the source materials.	Language Patterns and Examples
Purpose of Study	• Give the purpose of the research. • Explain why the research was undertaken. • Explain why the results of the research will be valuable.	Language Patterns and Examples
Structure of Dissertation	• Give an overview of the sections or chapters of the dissertation, showing the logical development of the text.	Language Patterns and Examples

Some of the words and phrases most commonly used in thesis introductions are here.

Return to Top

Language Patterns: Dissertation

1.7.1. Introduction: Background and/or Context of the Study

Examples:

With over 171 million people affected by diabetes mellitus (1), a number that is expected to double by 2030, researchers are continually seeking to uncover the molecular mechanisms involved in its development, with the hopes of developing better treatments. Diabetes was first documented in ~1500 BCE in an Egyptian papyrus (2) and although our knowledge has progressed since the early clinical observations of a disease with 'honey like urine' by the Indian physician Sushruta in ~600 BCE (2), there is still much to be understood. In 1939, Harold Imsworth... (Mayer, 2009, p.2).

Lightning has been a source of fear and respect among people since beginning of times. In many civilizations lightning was associated with magical powers possessed by gods who in many cases carried lightning bolts. For example, the ancient Vedic books of India describe how Indra, who was thought to be the son of Heaven and Earth, carried thunderbolts on his chariot [1]. With all the interest in lightning throughout the centuries no scientific study was performed until the second half of the 18th century when Benjamin Franklin...(Milewski, 2009, p. 1).

The idea that matter is topological defects of space-time is an old dream that dates back to more than a century ago when Lord Kelvin proposed that atoms were knots in ether[1]. Kelvin's proposal failed due to its flawed setting and especially the limited knowledge people had about our universe at that time. Nevertheless, this dream was implanted in physicists thereafter. Various proposals of topological matter have arisen as physicists deepen and broaden their recognition of nature. An example is the topological Geon model due to Wheeler and others[2–6], but geons in this model were unstable and classical. To make stable geons[3], Finkelstein invented the notion of topological conservation laws that led to advances in condensed matter physics, e.g., topologically conserved excitations in 1 + 1 condensed matter models such as sine-Gordon theory. Finkelstein's idea was not compatible with quantum gravity until the recent work by Markopoulou et al.[7–9] that motivated the work described in this thesis (Wan, 2009, p. 1).

1.7.2. Introduction: Literature Review

If the author devotes a section, a group of sections, or an entire chapter to the literature review, closely related information will be grouped together and discussed, as in the following extract from a literature review that contains several sections:

1.2.1. Basic Macrolide Chemistry and Pharmacology
The chemistry and basic pharmacology of the macrolide antimicrobials has been extensively reviewed (Prescott 2000; Chambers 2001; Papich and Riviere 2001). The macrolide antibiotics are a group of chemically related compounds. The original member of the group, erythromycin was isolated from the soil borne bacteria Streptomyces erythreus in 1952 by McGuire and co-workers. The other members of the group were derived from related bacteria (e.g. tylosin) or by chemical modification of the original compounds (e.g. tilmicosin, azithromycin, tulathromycin and clarithromycin). The basic chemical structure of the group is highly complex. It is classed as being a macrocyclic lactone, with between 12 and 20 carbon atoms in the lactone ring structure depending on the compound (Figures 1.1, 1.2). The group consists of erythromycin, tylosin, tilmicosin, roxithromycin, dirithromycin, azithromycin, clarithromycin, spiramycin, tulathromycin, oleandomycin, carbomycin and flurithromycin. The group of drugs may be further subdivided into tylonides such as tylosin, tilmicosin; azalides such as azithromycin and triamilides such as tulathromycin. Erythromycin, clarithromycin and azithromycin are licensed for human use and are the focus of most research publications for this class of drugs This group of antibiotics is closely associated in activity to the lincosamides and to chloramphenicol and related compounds. However the chemical morphology of these other compounds differs greatly (Clark, 2008, p. 4).

Another example is the following:

Lesions can be recognized only once normal variation in the morphology of tissues is ascertained. Since normal reproductive organs may vary considerably in gross and microscopic morphology in association with age and the physiologic cycle, this discussion would be incomplete without considering both normal and abnormal morphologic variation. Congenital abnormalities that prevent successful reproduction were excluded from this study and will not be discussed. Relevant information on this subject may be found elsewhere (Youngquist and Braun. 1993: Ladds. 1993a).

1.1 Ovarv
The ovine ovary is normally 1.0 to 1.5 cm long and oblong in shape. Preovulatory follicles, found in the ovarian cortex, were 7-9 mm in diameter in Suffolks and 5-7 mm in diameter in the Finn breed (Webb and England, 1982). This is in contrast to a previous report of the most common size being 9-10 mm with an upper limit of 18 mm, breed not specified (Grant, 1934). The ovulation site or corpus hemorrhagicum is red immediately postovulation. Luteal tissue develops in the ovulatory fossa until 10 days after ovulation, producing elevations in circulating

progesterone levels, and then it decreases in all dimensions starting at day 14. The corpus luteum (CL) is red/pink to orange while active, and tums yellow in the next ovulatory cycle (Casida and McKenzie, 1932; Oldham and Lindsay, 1980) (Tomlinson, 1998, pp. 3-4).

More commonly, literature will be cited as it becomes relevant throughout the thesis. An example of this is the following segment from a middle chapter of a dissertation:

The crystal structures of the BlaR1 sensor domain (*i.e.* BlaRS) revealed no significant conformational changes upon acylation of Ser389 by a β-lactam antibiotic (**Chapter 2**). In solution, however, circular dichroism and Fourier-transformed infrared spectroscopy (FT-IR) have implied that acylation of BlaRS produces an enhancement of secondary structure and reorientation into a more ordered, less dynamic state (Golemi-Kotra et al., 2003; Thumanu et al., 2006). Surprisingly these results contradict similar experiments and others performed using the sensor domain of BlaR from *Bacillus licheniformis* which indicated no such change in conformation (Hanique et al., 2004). Instead, the extracellular loop connecting the second and third transmembrane segments of BlaR (*i.e.* L2) was suggested to play a key role in transducing the acylation signal into the cytosol (Wilke, 2008, p. 64).

Return to Dissertation: Introduction   Return to Top

1.7.3. Introduction: Objectives

Near the end of the Introduction, the author usually gives a brief explanation of the objectives of the investigation reported in the thesis. Here are two examples:

1.5 OBJECTIVES OF THESIS

The continued evolution and dissemination of antibiotic resistance in pathogenic bacteria demands a sustained stream of innovations in antimicrobial therapy to avert the emergence of panresistant superbugs. Furthermore, the diminishing interest of the pharmaceutical sector in the development of novel antibiotics implies that government and academic labs will share the greatest degree of responsibility in elucidating the molecular details of resistance. This thesis aims to contribute to our understanding of how resistance to β-lactam antibiotics is regulated in two notoriously resistant bacterial pathogens. It is heartening that bacteria regulate resistance mechanisms at all, as it suggests that—at least in some cases—constitutive expression of resistance determinants incurs a fitness cost that weakens their survival in the absence of antibiotic pressure. (Wilke, 2008, pp. 32-33).

1.4 Thesis Objective

The overall objective of this thesis is to develop calibration methods for quantitative on-site sampling and sample preparation using SPME. The fundamental base for the calibration focuses on diffusion mass transfer (Chen, 2004, p.31).

Return to Dissertation: Introduction   Return to Top

Language Patterns: Dissertation

1.7.4. Introduction: Structure of the Dissertation

Occasionally the last part of the introduction describes the structure of the dissertation. This is an optional part and is not always present. However, when it appears, It gives a brief description of the content of each of the chapters. An example follows:

1.7 Thesis Organization
In Chapter 2, a new uniform composite element is developed and tested for various damaged beams. The damage is present in the form of a through thickness edge crack and formulated by combining a DFE with the local flexibility concept. This blending of theories ultimately produces a Dynamic Finite Cracked Element (DFCE) capable of accurately modeling the frequency response of Euler-Bernoulli bending and St. Venant torsion materially coupled laminated composite beams. The validity of the calculated natural frequencies is confirmed by experimental data provided in literature and also compared with other existing numerical methods.

In Chapter 3, a uniform DSM is developed and generated for slender beams with the inclusion of a second geometric type coupling. Then, for thick composite beams, where shear deformation becomes more significant, a robust Timoshenko DSM provided by Banerjee is implemented and combined with a modified local flexibility (shear corrected) to produce a new cracked shear deformable composite beam element, called a Timoshenko Crack-Dynamic Stiffness Matrix (TC-DSM).

In Chapter 4, the DFCE formulation, presented for the first time in Chapter 2, is customized to include geometric coupling. The motivation for implementing geometric coupling into the element formulation is to have a free vibration model capable of characterizing a wing. The natural frequencies for various piece-wise stepped beams and crack situations (including multiple cracks) are considered, tested and compared.

In Chapter 5, the flutter and divergence of a dually tapered composite wing is investigated using a *Refined* Dynamic Finite Element (*R*DFE) method. Implementation of deviator terms is shown to enhance the convergence of the solution to the natural frequencies. The wing is approximated using a thin walled wing-box with composite material layed up in a Circumferentially symmetric Stiffness (CAS) configuration. The convergence provided by the *R*DFE is shown to produce highly accurate natural frequencies, and consequently, a better evaluation of the flutter and divergence speeds compared to both the DSM and FEM.

A natural extension to Chapter 5 is to investigate the aeroelastic response of a laminated composite damaged wing. In Chapter 6, the crack induced changes in the flutter and divergence

speeds of a wing are monitored and illustrated. A prerequisite to an aeroelastic analysis is to calculate the natural modes of free vibration. Combining the DFE formulation in Chapter 4 and the aeroelastic solution methodology in Chapter 5 (modified to accommodate damage) flutter and divergence for a through thickness edge crack is then evaluated.

In Chapter 7, the non-destructive detection of multiple cracks is evaluated in laminated composite wings using frequency data. The development of a second crack indicator is formed and tested for various beam geometries and theories, namely, uniform, piece-wise stepped, Euler-Bernoulli and Timoshenko. The Multi-Crack Detection (MCD) developed in this chapter is observed to be a highly robust technique in detecting cracks, with a suedo error in the range of 0-3 % attached to the 'measured' natural frequencies.

In Chapter 8, conclusions are drawn and the author's contributions are specified with the direction of future work stated (Borneman, 2009, pp. 10-12).

1.7.5. Dissertation: Introduction: Common Words and Phrases

able	should be able to
accordance	in accordance with the
addition	in addition to the
alone	either alone or in combination with
analysis	for the analysis of
appear	appear to be
approach	of this approach is
associate	known to be associated with may be associated with
assume	it is generally assumed that
attention	attention was paid to less attention was paid
author	the authors concluded that the authors suggest that
base	is based on the based in part on that are based on which is based on
case	in the case of
cause	that does not cause
change	changes also refer to
chapter	in chapter 4 the
characteristic	on the characteristics of
clear	it is unclear whether
common	is the most commonly
complicate	is complicated by the fact
consider	is considered as the
context	in the context of

criterion	the criteria used to
decade	in the last decade
decide	to decide whether or
description	the description of the
design	in the design of
determine	were to determine the
development	in the development of
different	were not significantly different
discuss	will be discussed in detail
effect	the effects of (prolonged)
employ	can be employed to
ensure	to ensure that the
evidence	some evidence to suggest that there has been evidence there is some evidence
example	for example can be
expect	would not be expected to
factor	factors that affect the key factor in the
figure	in figure in fig
find	it was found that have been found in can be found in no ___ were found at (in) has been found to be were found to be
follow	one of the following
function	as a function of
hand	on the other hand

highly	shown to be highly
hypothesize	it has been hypothesized
implicate	has been implicated in the
intend	that are intended to
involve	involved in the development
know	it is not known
	it is still unknown whether
	are known as the
likely	it is likely that
measure	measures that are intended
methodology	methodology to achieve a
model	model based on the
need	there is a need
note	it should be noted that
number	by a number of
	in a number of
	an increase in the number
one	is one of the most
order	in order to be
paper	this paper
part	in part on the
possible	it is possible that
presence	in the presence of
product	is the product of
propose	was first proposed by
purpose	purpose of this paper was (is)
recent	in recent years
refer	often referred to as

report (verb)	has been reported
report (noun)	there are no (published) reports of
research	scope of this research the research work presented
researcher	a number of researchers have investigated
result	as a result of may be a result of the results of the the results obtained from our results do not
role	may play a role in the
sample	limited by a small sample
scope	is outside the scope of
section	discussed in the (next) section (entitled)
see	one will see that
sense	in the sense that
show	as shown in figure it is shown that has (also) been shown to be have been shown to
some	that some of the
study	in a study investigating studies have reported similar studies have demonstrated that studies have reported that studies have investigated the the majority of the studies the present study these studies in the study of to the study of
suggest	it has been suggested that
summarize	can be summarized as follows
susceptible	may be (particularly) susceptible to

system	that the system needs
table	in table
the	the ___ of ___
thesis	of this thesis is to presented in the thesis the scope of this thesis in this thesis we rest of the thesis
time	is the time required
transform	can be transformed into
use	that can be used it has been widely used in the most commonly used
variety	a wide variety of
well	as well as the
work	work presented in the

1.8. Dissertation: Materials / Methods (Methodology, Procedure)

Materials and methods may be presented in several different formats. In some cases it may be appropriate to devote an entire chapter to materials that were needed for the investigation. More often, the methods that were used in the investigation are described in the same chapter with the materials. The exact arrangement of this information will depend on the nature of the investigation.

If a study involves more than one experiment or investigation, there may be a separate materials and methods section for each experiment. As you plan the layout of your dissertation, you should consider which arrangement of information is most appropriate to your topic and the way in which you wish to present your information.

If methods are presented in a separate chapter, it is sometimes called "Methodology" or "Procedure".

Some of the most common phrases used in this section of a dissertation are listed below, followed by example extracts:

associate	are associated with the
base	at the base of
calibrate	used to calibrate the were used to calibrate used in calibrating the
calibration	calibration and validation samples
carry out	analyses were carried out experiments were carried out measurements were carried out were carried out at were carried out in carried out on a
consider	were considered to be
control	in a semi-controlled may be controlled through
define	is defined as the
determine	used to determine the
find	can be found at was found to be

function	is a function of
functionality	functionality of the system
hand	on the other hand
induce	and then induced to
interface	at the interface between
measure	was measured with a
normal	were not normally distributed
note	should be noted that
number	the total number of is the number of
observation	observations were used to
parameter	the parameter associated with
part	a part of the
place	was placed on top
proportional	is proportional to the
rate	a maximum rate of
ratio	defined as the ratio of frequency and frequency ratio
represent	which represents a typical
respect	with respect to the
rest	the rest of the
result	as a result of
root mean square	the root mean squared error of
show	as shown in eq models are shown in
size	the size of the
statistics	of statistics for estimating
structure	the structure of the

temperature	the average temperature at
	at room temperature for
	temperature was maintained at
	temperature was ramped from
time	at the time of
	the perception reaction time
treat	cells were pre treated
	cells were treated with
use	are used in the
	used to obtain the
	used to validate the
	was used for the
	was used to determine
	were used to determine
	which is used to
validate	to validate the models
value	the values of the
	values were divided by
	values were obtained from
well	as well as the
wrap	was wrapped around the

Example Extracts from Materials and Methods Sections:

2.1.5 Reagents

The gases used in this system were CO (99%, technical grade) and NO (100-200 ppmv, Scott Speciality gases Certified Standard). The CO was passed through a trap containing charcoal and iodine, to remove metal carbonyls [Stedman et al, 19791, which can be found in compressed CO cylinders and depress the sensitivity of the luminol detector [Cantrell et al, 1993b]. The NO flow was passed through two ferrous sulphate converters, to assure that no NO_2 was present.

The thermostated NO_2 permeation devices (MC1 Metronics) were kept at 35°C and flushed with N_2. The air used was zero air (from cylinders) or air from an AADCO Mode1 737-12A clean air generator. The air from the air generator was routinely checked against zero air cylinders (Arias, 1998, p. 60).

2. Materials and Methods
2.1 Reproductive tracts- gross specimens

Between January and April of 1997. 405 reproductive tracts were collected from ewes slaughtered at a small abattoir in Schomberg, Ontario. Ewes are selected for slaughter for reasons such as infertility, mastitis, footrot. and dental attrition. It was assumed that such a population would maximize the opportunity to evaluate infertile ewes. To be included, subject ewes had to have been through at least one breeding season. i.e. greater than one year of age as indicated by their dentition (Appendix 1: Dyce et al.. 1996). Ewes having congenital abnormalities of the reproductive tract which would have precluded successful reproduction were not admitted to the study. Animals were identified at the time of slaughter with ear tags which remained with the carcass until the time when the reproductive tract was removed.

Generally, the reproductive tract of each ewe was collected with the cervix attached, and was placed on a clean surface (fresh sheet of aluminum foil) for examination. Ovarian structures such as corpora lutea and follicles were measured to the nearest mm with a metric ruler. A form with a checklist of items to be collected was filled out (Appendix 2). The instruments used to collect samples were dipped in alcohol and flamed between collection of successive uterine tubes. The left and right uterine tubes were identified separately and, with an approximately 2 x 2 cm sample of each uterine horn, uterine body, cervix, and placenta when available, placed in 10% formalin. Any gross abnormalities in the reproductive tract or additional comments were recorded. The appearance of the uterine tubes was graded according to a subjective scheme reflecting type and seventy of lesions. as summarized in Table 2.1, and their distribution (focal or diffuse and unilateral or bilateral) was recorded separately. Severity of lesions reflects the inferred significance of such lesions in relation to function of the uterine tube,and fertility of the ewe (Tomlinson, 1998, pp. 30-31).

1.9. Dissertation: Results and Discussion (Conclusions)

Results are the outcomes of experiments or investigations. They usually appear as data and may be shown in the form of graphs, tables, charts, etc. Important outcomes are grouped and attention is drawn to them. This section usually consists largely of visuals with explanatory text accompanying the visuals.

Discussion (Conclusions) involves commenting on the meaning of the results. Similarities, differences, and causes and effects are explained. Reasons are given. The importance of the findings is stressed. This section often ends with a brief discussion of future work that would logically follow from the work described in the dissertation.

The following patterns are used to present results and discussion:

Pattern 1: One section or chapter is devoted to results.
One section or chapter is devoted to discussion of the results.

RESULTS
DISCUSSION
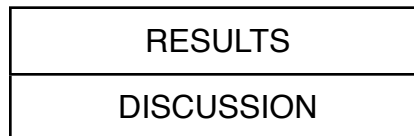
This method has the advantage of making it easier for the reader to locate the results that may be of interest.

Pattern 2: One section or chapter is devoted to results and discussion combined.

RESULTS + DISCUSSION
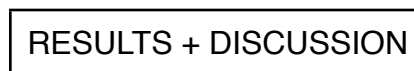
This method has the advantage of presenting the discussion of a result near the result that is being discussed. However, this arrangement can be confusing to the reader and should be avoided if possible. Try not mix results and discussion.

Pattern 3: One subsection of each chapter or section is devoted to the results of that section and a discussion of those results.

INVESTIGATION #1
RESULTS + DISCUSSION #1
INVESTIGATION #2
RESULTS + DISCUSSION #2
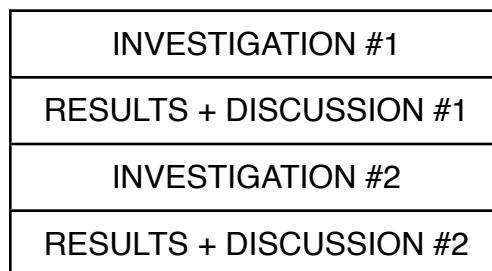
etc.

This method has the advantage of clarifying the parts of a complex study. If the study contains several experiments or investigations, it is usually easier for the reader if the results and discussion of each part of the study are kept together with the relevant part.

Some common phrases used in the results and discussion parts are the following:

absence	in the absence of
affect	does not affect the
agreement	the agreement between the
amount	the amount of extracted
anova	one way anova with
associate	was (not) associated with
assume	is assumed to be
between	between the ____ and the ____
case	in the case of
clear	it is clear that
concentration	the concentration of the
consistent	is consistent with
consumption	the power consumption of
curl	the curl of the
data	data were normalized to
determine	in order to determine if
difference	(significant) difference between
difficult	it is difficult to
duration	a long duration of
effect	effect of ____ on the (overall) effect of
experiment	the ____ experiment
explain	can be explained by

find	is (was) found to be it was found that
formation	the formation of
increase	an increase in the
interesting	it is interesting to note
know	are known to have
likely	were (more / less) likely to (have / be) it is likely that
magnitude	an order of magnitude
nature	the nature of the
necessary	it was necessary to
normalize	was normalized to
observe	was observed for the
obvious	it is obvious that
onset	at onset of an
possible	it (is / was) (not) possible (to / that)
presence	in the presence of
production	the production of the
quantitative	the semi quantitative grading
range	is in the range of
rank correlation	rank correlation coefficients
respect	with respect to the
result	the results of the a result of the
result	these results indicate that the results from the was a result of
show	is shown in Table / Figure ___ as shown in Table / Figure ___

sign rank	the sign rank test
Spearman	Spearman's rank correlation
study	in / of the present study
susceptible	isolates were susceptible to
than	than that of the
treat	were treated with
use	is used as the
yield	the yield of the

A few extracts from results and discussion sections of dissertations are shown below:

<u>Results</u>

In the pregnant guinea pig, the mean level of total hair FAEE was 0.43 ± 0.33 pmol/mg (range 0.05 - 1.07 pmol/mg). The most predominant esters were ethyl palmitate, ethyl oleate, and ethyl stearate, whose mean concentrations respectively were 0.14 ± 0.14 pmol/mg, 0.14 ± 0.11 pmol/mg, 0.14 ± 0.13 pmol/mg. The mean concentration of ethyl myristate was 0.01 ± 0.01 pmol/mg. The median AUC-BEC was 2253.29 mg/dl/h (range 1632.99 - 3345.01 mg/dl/h). The incorporation rates for individual ethyl esters, as well as total FAEE are displayed in table 2.1. For convenience, the inverse ICRs and their ranges are displayed in table 2.2. The ratios between guinea pig and human ICRs (column 4, Table 2.1) are equal to the ratios of the inverse ICRs, and therefore are omitted in Table 2.2.

Table 2.1 Guinea pig and human hair FAEE incorporation rates

Fatty Acid Ethyl Ester	Guinea Pig ICR*	Human ICR*	Guinea Pig ICR/ Human ICR
Ethyl Myristate	0.000000	0.000130	**
Ethyl Palmitate	0.000071	0.000650	9.2***
Ethyl Oleate	0.000057	0.000982	17.1***
Ethyl Stearate	0.000119	0.000171	1.4***
Total FAEE	0.000151	0.001909	12.6***

* Units of ICR are pmol/mg of FAEE per mg/dl/h of systemic ethanol exposure

** Interspecies ICR difference could not be assessed

*** Interspecies difference in ICR were significant

Table 2.2 Guinea pig and human hair inverse FAEE incorporation rates and their rang

Fatty Acid Ethyl Ester	Guinea Pig ICR^{-1}*	Human ICR^{-1}*
Ethyl Myristate	0 (0-208081.5)	7674.2 (785.5-207603.3)
Ethyl Palmitate	14152.9 (0-47048.6)	1539.2 (55.6-10470.7)
Ethyl Oleate	17417.0 (9802.4-253599.0)	1018.4 (64.9-5349.1)
Ethyl Stearate	8384.4 (0-59801.1)	5859.5 (239.3-22300.4)
Total FAEE	6605.2 (3008.9-17417.0)	523.9 (25.7-2726.21)

* Units of inverse ICR are mg/dl/h of systemic ethanol exposure per pmol/mg of FAEE

The mean level of total hair FAEE among alcohol detoxification patients was 4.40 ± 2.30 pmol/mg (range 1.29 - 10.96 pmol/mg). The most predominant esters were ethyl oleate and ethyl palmitate. Mean concentrations of ethyl oleate, palmitate, stearate and myristate were 1.91 ± 0.92 pmol/mg, 1.69 ± 1.01 pmol/mg, 0.47 ± 0.17 pmol/mg, and 0.32 ± 0.42 pmol/mg, respectively. The median AUC-BEC was 2390 mg/dl/h (range 91.90 - 11417.83 mg/dl/h). The incorporation rates for individual esters, as well as total FAEE are displayed in table 1, and for convenience their inverse is displayed in Table 2.2 (Kulaga,2009, pp. 88-90).

Discussion

The ultimate physical content of the 3-strand braids is not fully comprehended at this stage. As a work on the 3-valent approach, [39] proposed a tentative mapping between the 3-valent braids and Standard Model particles, with, however, the absence of dynamics. In the 4-valent approach, such a direct mapping, if not impossible, is at least still obscure. A reason is that the dynamics of 4-valent braids strongly constrains the possible set of twists, crossing sequence, and end-node states of an actively propagating or actively interacting braid. In addition, the closed form of this constraint is still missing. Consequently, one should not assign to a 4-valent braid any topological property just in order to make it a Standard Model particle. We need more study and maybe new mathematical tools to reveal whether the 4-valent braids can directly correspond to Standard Model particles (Wan, 2009, p. 112).

This thesis indicates the convergence of our work with other areas of Mathematical Physics such as Group Field Theory, Tensor Category, and so on. We expect to resolve the current issues in our approach and answer those open questions by reformulating our approach in one or more of

these frameworks of Mathematical Physics. Below, we shall sketch our plan and work in progress (Wan, 2009, p. 115).

In this dissertation, the dynamics of micromachined resonant beam systems were studied by developing an analytical continuous model. The beam was clamped at both ends, and was excited by electrostatic comb-drives. Moreover, vibration of the beam could be detected using another similar comb-drive. At the first stage, the resonant structure was modeled as a beam-point mass system, in which the beam was subjected to an axial force. It was shown that the attached point mass reduced the natural frequencies of the beam, whereas, the extent of this reduction was a function of the point mass location on the beam. Then, the rotary inertia of the comb-drive was added to the model. The beam-lumped mass model showed that the lumped mass, if placed properly, can increase the natural frequency of the resonator. The natural frequencies of a beam-lumped mass system was shown to have an upper limit, when the radius of gyration of the lumped mass was being increased. The model of a beam-guided mass system demonstrated that the upper limit is the natural frequency of the equivalent beam-guided mass system. The analytical model indicated that the mode shapes of vibration of a beam-lumped mass system are not orthogonal to each other under the classic definition of orthogonality. A generalized orthogonality condition was introduced and employed for investigating the forced vibration of the beam-lumped mass system. Later, the linear model of the resonator was used to investigate the influence that large amplitudes of vibration might have on the free and forced vibration. It was shown that the large amplitudes could be a contributing factor only for extremely small damping ratios (Hassanpour Asl, 2008, pp. 162-163).

In this project, the lumped mass was assumed to be symmetric about the beam neutral axis. The excitation force, and consequently the amplitude of vibration, was so small that the effect of eccentricity was negligible. An extension to this research can be modeling this effect, when the amplitude of vibration is large. In that case, other issues arise. For example, the electrostatic comb-drive rotates, whatsoever large its rotary inertia is. Consequently, the stability of the comb-drive must be investigated to determine whether pull-in happens or not. Even if no pull-in occurs, the rotation of the fingers may result in an applied electrostatic moment to the beam (Hassanpour Asl, 2008, p. 166).

Return to Top

1.10. Recommendations

Occasionally, a dissertation may end with several recommendations for future work. These may be in a separate section or combined with Results and Discussion. As a stand-alone section, it is often called "Conclusion". This should not be confused with "Conclusions". "Conclusions" (plural) are the results of a study. "Conclusion" (singular) is the last section of a paper. An example follows:

8.0 Conclusion

Mammalian SLC11A2 proteins have long been predicted to conform to a 12 transmembrane domain topology model that places their termini in the cytoplasm [20]. Recently, the topologically diverse leucine transporter LeuT was proposed to share a similar fold to SLC11A proteins [42,92]. The topological information collected herein is consistent with both these models and provides the first experimental validation (to our knowledge) of the orientation of the hydrophilic loops separating TMDs 4/5, 5/6, 6/7, 10/11 and 11/12 (Figure 6). Our inability to unambiguously map the putative hydrophilic loops separating TMDs 1/2, 2/3, 3/4, 8/9 and 9/10 (Figure 6) suggests that epitope insertion within these sites may compromise the functional and/or structural properties of SLC11A2. These sites should be central in future structure:function studies and an attempt at mapping their topology may involve repeating the same epitope mapping approach but making insertions at alternate positions within these putative loops, or using an alternate experimental approach. The data collected herein is also consistent with experimentally derived topology models made in prokaryotic SLC11 orthologs [87], and consequently suggests that it will be equally applicable to other eukaryotic SLC11A. (Czachorowski, 2008, p. 56)

Return to Top

1.11. Dissertation: Title Page

The title page is the first page of the dissertation. The following shows a typical format for a dissertation title page:

[TITLE]

by

[Author's Name]

A thesis submitted in conformity with the requirements
for the degree of [Name of Degree]
Graduate Department of [Department Name]
[Name of University]

© Copyright by [Author's Name] [Year]

Insert the missing information between the brackets and remove the brackets.

2. Journal Article

A journal article may have some or all of the following parts:

- The parts usually appear in this order.
- INTRODUCTION usually includes background information, literature review, and a statement of the study objective (purpose of the study)
- SUBJECTS and DESIGN (methodology) are often combined into one section.
- STATISTICAL TREATMENT OF DATA and RESULTS and DISCUSSION are often combined into one section.
- RESULTS contains an orderly presentation of the factual data without interpretation.
- CONCLUSIONS contains the author's interpretations of the RESULTS. Recommendations are sometimes added to this section.
- CONCLUSION sums up the main points of the study and usually points to the future of the research.

Click on a link on the left for more information about that part.

Return to Top

2.1. Journal Article: Introduction

The introduction of a journal article typically consists of several parts, or moves. These have been researched by Swales (1990) and described by Weissberg & Buker (1990). The following presentation is based partly on the work of these researchers. The standard moves of journal article introductions, and the order in which they are presented, are listed in the table below:

Move	Contents	Examples
Setting	A few general sentences provide a setting or background for the research.	Examples of Setting
Literature review	Specific sentences cover the contributions of the primary researchers in the field. Information is grouped according to areas of consensus among authors. Disagreements between authors are pointed out.	Examples of Literature Review
Need for further research	A few sentences explain the need for further research in this area.	Examples of Need for Further Research
Purpose	The purpose of the present study, as a result of the need for further research, is explicitly stated.	Examples of Purpose
Value	Optionally, a few sentences justifying the present study and/or referring to its value are presented.	Examples of Value

Some of the words and phrases most commonly used in article introductions are here.

Return to Journal Article   Return to Top

2.1.1. Journal Article: Introduction: Common Phrases

absence	in the absence of
accumulation	accumulation of cyclic amp
basis	as a basis for
carry	have been carried out
characterize	it is characterized by
constant	a fairly constant density of about
culture	cultured in the presence
discovery	the recent discovery of
find	can be found in
generate	can be generated from
hand	on the other hand
number	a large number of
one	one of the most
paper	in this paper we of this paper is
possible	it is possible to
presence	in the presence of
produce	produced large amounts of
rise	can give rise to
set	a given set is
show	been shown to be
study	a number of studies in this study we
use	can (also) be used to
well	as well as in

2.1.2. Journal Article: Introduction: Setting

The first part, or move, of an article introduction gives the setting or background of the study. This will introduce the general area of research and specifically name the focal point of the research. The setting provides the information necessary for the reader to understand the literature review, which follows it. Here are some examples of setting:

Multiple sequence alignments (MSAs) are at the core of many bioinformatic analyses that benefit from the comparison of genomic sequences, from phylogenetic reconstruction to functional prediction (1,2). MSAs can be stored in a large variety of formats (e.g. FASTA, PIR, PHYLIP, NEXUS, etc.), and very often, researchers are obligated to transform between these in order to use different tools. Some conversion utilities have been extremely useful in this regard, the most popular being ReadSeq (http://iubio.bio.indiana.edu/soft/molbio/readseq/java/). Indeed, there are other tools developed mainly for other purposes that can also import and export aligments in several formats, like ReadAl/TrimAl (3), SeaView (4), Se-Al (http://tree.bio.ed.ac.uk/software/seal/) or even ClustalX2 (5), among others. Moreover, projects like BioPython (6) or BioPerl (7) also offer conversion capabilities. (Glez-Peña et. al. 2010, p. 1).

The recent discovery of graphene [1], a single atomic sheet of graphite, has ignited intense research activities to elucidate the electronic properties of this novel two-dimensional (2D) electronic system. Charge transport in graphene is substantially different from that of conventional 2D electronic systems as a consequence of the linear energy dispersion relation near the charge neutrality point (Dirac point) in the electronic band structure [2, 3]. This unique band structure is fundamentally responsible for the distinct electronic properties of carbon nanotubes (CNTs) [4].

When graphene is patterned into a narrow ribbon, and the carriers are confined to a quasi one-dimensional (1D) system, we expect the opening of an energy gap. Similar to CNTs, this energy gap depends on the width and crystallographic orientation of the graphene nanoribbon (GNR) [5, 6]. However, despite numerous recent theoretical studies [7-15], the energy gap in GNRs has yet to be investigated experimentally. (Geim & Novoselov, 2007, p. 1).

The 5-year survival rate for patients with metastatic renal-cell carcinoma is less than 10%.1 High-dose interleukin-2 therapy rarely induces a durable complete response, and interferon alfa provides only a modest survival advantage. (Escudier et al 2007, p. 126).

2.1.3. Journal Article: Introduction: Literature Review

The literature review move follows the setting and gives information about the most important and most relevant studies that have been carried out to date in the specific area of research. The summarized information should be presented in such a way that it reveals commonalities and differences clearly. It should not be a mere list of article summaries. The literature review should clearly lead to the following section of the introduction, which states the need for further research. Some examples of literature review sections are the following:

As a result, a large number of experimental and computational studies of channel flow have been carried out. Nikuradse (**1929**) and Reichardt (**1938**) were among the first to investigate fully developed turbulent channel flow. Nikuradse's measurements were limited to the mean flow ; Reichardt reported velocity fluctuations in the streamwise and normal (to the wall) directions. Laufer (**1951**) was the first to document detailed turbulence statistics. His measurements were made at three Reynolds numbers (**12300, 30800,** and **61600),** based on the mean centreline velocity and the channel half-width. Comte-Bellot (**1963**) provided the most extensive data, including many higher-order Statistics such as two-point correlations, energy spectra, skewness and flatness factors. Her measurements were made over the Reynolds-number range **57000-230000.** Clark (**1968**) reported additional detailed information in the regions very near the wall over the Reynolds-number range **1500045600.** Hussain & Reynolds (**1975**) conducted experiments in an extremely long, two-dimensional channel to confirm that the higher-order turbulence statistics reached a fully developed state. The ratio of their channel length to the channel half-width was about **450,** compared with **86,122** and **120** of Laufer, Comte-Bellot and Clark, respectively. The Reynolds-number range in the experiment of Hussain & Reynolds was **13800-33300.** Eckelmann (**1970**) carried out his experiment with oil as the working fluid, and at very low Reynolds numbers, **2800** and **4100,** to facilitate measurements in the region very close to the wall. Detailed information regarding the turbulence structures near the wall in the same facility were also reported by Eckelmann (**1974**) and Kreplin & Eckelmann (**1979).** Johansson & Alfredsson (**1982**) presented recent measurements at a Reynolds-number range of 450 (Kim, Moin & Moser 1987, p. 133).

In 1975, Diffie and Hellman [3] introduced the concept of public key cryptography. Since then, several attempts have been made to find practical public key systems (see, for example, [6], [7], [9]) depending on the difficulty of solving some problems. For example, the RivesShamir-Adleman (RSA) system [9] depends on the difficulty of factoring large integers (Elgamal 1985, p. 469).

While the management of hyperglycaemia, the hallmark metabolic abnormality associated with type 2 diabetes, has historically taken centre stage in the treatment of diabetes, therapies directed at other coincident features, such as dyslipidaemia, hypertension, hypercoagulability, obesity and insulin resistance, have also been a major focus of research and therapy. Maintaining glycaemic levels as close to the non-diabetic range as possible has been demonstrated to have a powerful beneficial effect on diabetes-specific microvascular complications, including retinopathy,

nephropathy and neuropathy, in the setting of type 1 diabetes [4, 5]; in type 2 diabetes, more intensive treatment strategies have likewise been demonstrated to reduce microvascular complications [6–8]. Intensive glycaemic management resulting in lower HbA1c levels has also been shown to have a beneficial effect on cardiovascular disease (CVD) complications in type 1 diabetes [9, 10] (Nathan et al. 2009, p.18).

2.1.4. Journal Article: Introduction: Need for Further Research

Following the literature review is a short remark explaining that there is a need for further research in the specific topic area. This opens the way for the research that is described in the paper. Some examples follow:

However, despite numerous recent theoretical studies [7-15], the energy gap in GNRs has yet to be investigated experimentally (Han et al., 2007, n.p.).

Despite the significant effort in this relative simple flow, there is poor agreement among the reported measurements, even in lower-order statistics such as turbulence intensities, especially in the vicinity of the wall. Part of the discrepancy may be due to the wide range of Reynolds numbers used in the experiments - for example, it is well known that there is a significant Reynolds-number effect on the log law of mean velocity profiles-but most of the scatter is probably a result of experimental uncertainty involved in measuring turbulence quantities near the wall, where the presence of high shear and small scales of turbulent motions makes measurements extremely difficult. Johansson & Alfredsson (1984) reported the effect on turbulence msasurements of imperfect spatial resolution due to probe length. The low-Reynolds-number experiments in the oil channel by Eckelmann and his colleagues at Gottingen attempted to reduce this difficulty by making the wall layer thick enough to allow reliable measurements in this region (Kim, Moin, & Moser, 1987, p. 134).

...however, current studies have failed to demonstrate a beneficial effect of intensive diabetes therapy on CVD in type 2 diabetes [11–13] (Nathan et al., 2009, p. 18).

Until recently, there have been no other treatments for patients with renal-cell carcinoma who are ineligible for, or unable to tolerate, these cytokines (Escudier et al. 2007, p. 126).

2.1.5. Journal Article: Introduction: Purpose

Near the end of the introduction, it is customary for the writer to state the purpose of the study. This is usually done briefly in a sentence or two. This move should be a brief answer to the research question. Examples follow:

In this study, we set out to investigate whether a GT effect on substitution rates might be operating in invertebrate metazoans, using a phylogenetic comparative approach (Thomas, 2010, p. 6).

Here we present evidence that these two effects of adenosine are mediated by two different types of receptors present on the outer surface of the cells (van Calker et al.,1979, p. 999).

The aim of this paper is to explain in a straightforward way the expected performances and limitations of photometric redshifts computed from broad-band photometry. This study has been conducted with our public code called hyperz , which adopts a standard SED fitting method, but most results should be completely general in this kind of calculations. This program was originally developed by Miralles (1998) (see also Pelló et al. 1999), and the present version of the code hyperz is available on the web at the following address: http://webast.ast.obs-mip.fr/hyperz (Bolzonella et al., 2008, p. 2).

Occasionally, the author(s) will include a short section, outlining the plan of the paper. An example of this follows:

The plan of the paper is the following. In Section 2 we present the method used by hyperz and the involved set of parameters. The accuracy of the redshift determinations and the expected percentage of catastrophic identifications, as a function of the filter set and the photometric errors, are studied through simulations in Section 3. The influence of the different parameters on the accuracy of photometric redshifts is investigated in Section 4, using both simulations and spectroscopic data from the HDF. Section 5 is devoted to the analysis on the expected accuracy and possible systematics when exploring real data, coming from deep photometric surveys. A general discussion is given in Section 6 and conclusions are listed in Section 7. (Bolzonella, 2008, p. 2).

2.1.6. Journal Article: Introduction: Value

Optionally, the introduction may end with a statement of the value of the research. Two examples follow:

This scoring system is both objective and reproducible, and it may be useful as either an alternative or supplement to the use of conventional pathological terminology in the study and management of asymptomatic CAH patients in whom histological changes in serial liver biopsy specimens may be the only prognostic indicator available for evaluation (Knodell et al., 1981, pp. 431-432).

Our systematic studies further demonstrate that pretreatment of gels with **a** defined concentration of thiosulfate increases the sensitivity of silver staining. We show here that the combination of these two effects results in a sensitive and reproducible staining procedure which is easy to handle and which allows the detection of nanogram quantities of proteins and nucleic acids with optimal contrast on a colorless, transparent background (Blum et al., 1987, p. 93).

2.2. Journal Article: Subjects and Design / Materials and Method

Subjects and Design, also called Materials and Method, are usually discussed together in one section. Subjects or materials are the entities being investigated (e.g. a chemical, living organism, people receiving a medical treatment, etc.). Design or method refers to the steps in the research process. The writer informs the reader of the way in which the study was carried out. This must be done precisely enough so that an expert reader could replicate the study and find the same results. Past passive verb forms are usually used here (e.g. *was carried out, were measured,* etc.). Some of the most common words and phrases used in this section are listed here. Examples of excerpts from Subjects and Design sections follow:

Parasite Species
Mitochondrial genome sequences were determined from the following seven parasite species: *Babesia bigemina* (Kochinda stock) (Fujinaga et al. 1980), *B. caballi* (USDA strain) (Avarzed et al. 1997), *B. gibsoni* (National Research Center for Protozoan Diseases strain) (Ishimine et al. 1978), *B. bovis* (Miyama stock) (Fujinaga et al. 1980), *Theileria orientalis* (Ikeda stock) (Kim et al. 2004), *T. equi* (USDA strain) (Avarzed et al. 1998), and *T. parva* (Muguga stock) (Kairo et al. 1994). Their host animals are cattle for *B. bigemina*, *B. bovis*, *T. orientalis*, and *T. parva*; horses for *B. caballi* and *T. equi*; and dogs for *B. gibsoni* (supplementary table S1, Supplementary Material online).

DNA Sequencing
Parasite genomic DNA was extracted from animal bloods infected with *B. bigemina*, *B. gibsoni*, *B. bovis*, *T. orientalis*, and *T. parva*, and from cultures of *B. caballi* and *T. equi*, using QIAamp DNA Blood Mini Kit (QIAGEN, Hilden, Germany) according to the manufacturer's instructions. Nucleotide sequences of the mt genomes were determined by direct sequencing of polymerase chain reaction (PCR) products using specific primers (supplementary table S2a, Supplementary Material online). The primers were designed by aligning reported mt genome sequences of *B. bovis* (DDBL/EMBL/GenBank accession number EU075182), *T. parva* (Z23263 [GenBank]), and *T. annulata* (NW_001091933). Amplification was carried out in a 20 μl reaction mixture containing 0.2 μM each of forward and reverse primers, 400 μM each of deoxynucleotide triphosphate (dNTP), 1 U of LA-Taq (Takara, Shiga, Japan), 2 μl of 10x PCR buffer, 2.5 mM of MgCl$_2$, and 1 μl of genomic DNA. PCR conditions were as follows: initial denaturation at 94 °C for 1 min and amplification for 40 cycles at 94 °C for 30 s, 55–68 °C (depending on primers used) for 30 s, and 72 °C for 1–6 min (depending on amplicon size, 1 min/kb), followed by a final extension at 72 °C for 10 min. (Hikosaka et al., 2009, pp. 5-6).

2 Materials and methods
2.1 Chemicals
All chemicals used for the preparation of buffers and gels were analytical grade, ethanol (EtOH) and methanol (Me0H)were chemically pure. The coat protein of tobacco mosaic virus (TMV, *M,* 17 500) was prepared by dissolving a suspension of TMV in sodium dodecyl sulfate (SDS)

sample buffer. The molecular weight standards were from Boehringer (Mannheim, FRG) and Serva (Heidelberg, FRG): phosphorylase a (Mr 92 *500)*, bovine serum albumin *(M,* 68 000), fumarase *(M,* 48 *500)*, carbonic anhydrase (Mr **30** 000) and chymotrypsinogen *(M, 25* 000). Sodium thiosulfate was from Roth KG (Karlsruhe, FRG), silver nitrate from Degussa AG (Frankfurt, FRG). Carrier ampholytes Servalyt, pH 3-10, pH 4-6 and pH 6-8 were from Serva. All solutions for the preparation of polyacrylamide gels to be silver stained have to be prepared with distilled or bidistilled water with a conductance of less than 5 **pS** and have to be filtered through a 0.45 um nitrocellulose filter.

2.2 Biological materials

The vulgar strain of TMV was from the collection of Dr. K. W. Mundry. pBR **322** DNA (1 pg/ pL) was digested with *Hinff* (0.5 units per pg DNA) for **3** h at 37 *'C*. The digestion products were subjected to electrophoresis without further treatment. Unfractionated tRNA was isolated from rabbit liver as described [61. Pure valine-specific tRNA was purified from unfractionated tRNA by several column chromatographies [71. 2.3 Isolation and inoculation of protoplasts Protoplasts were isolated from young leaves oftobacco plants *(Nicotiuna rusticu)* and inoculated with purified TMV preparations as described [Sl. Aliquots were removed after appropriate periods of incubation and used for gel electrophoretic analysis.

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2.4 One-dimensional SDS polyacrylamide gel electrophoresis

One-dimensional gel electrophoresis was carried out in vertical SDS-polyacrylamide gels (10 x 14 x 0.15 cm) containing 0.1 % SDS [91, with a 1.5 cm long 5 % stacking gel on top of an 8.5 cm long 11 % separating gel. All solutions and buffers were filtered through 0.45 pm nitrocellulose filters in order to avoid staining of dust particles. Protoplasts were lysed in sample buffer (50 mM Tris-HCI, pH 6.8,2 % SDS, 10 % glycerol, 3 % 2-mercaptoethanol), heated for 3 min at 95 "C and subjected to electrophoresis. Gels were subsequently fixed overnight and silver stained.

2.5 Extraction of plant proteins

Plant proteins were prepared by extraction with trichloroacetic acid (TCA)/acetone [101. Wheat germs, tobacco leaves *(Nicotiana rustica,* 8 weeks old) and wheat leaves **(7** days old) were dry-crushed in a liquid nitrogen-cooled mortar... .

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(Blum et al.,1987, pp.93-94).

MATERIALS AND METHODS

This work is based on patients entered into the Nottingham/Tenovus Primary Breast Cancer Study. To date, over 2200 patients with primary operable breast cancer have been treated

consecutively under the care of a single surgeon (Professor R.W.Blamey) by mastectomy or local excision and radiotherapy, with loco-regional lymph node sampling. Long-term clinical follow-up has been maintained by regular visits to the clinic. Major recurrences are recorded as loco-regional (recurrences requiring some form of major treatment such as radio-therapy) or distant (confirmed radiologically by isotope scan or liver function tests). Mortality data are recorded on all patients when available. A total of 1951 patients presenting with primary operable breast carcinoma in the study period **1973- 1989** were entered, and histological grading performed where appropriate.

TISSUE PREPARATION

To obtain the best results it is very important that careful attention is paid to specimen preparation. Fixation should be prompt. We use **10%** phosphate buffered formalin which gives good preservation of cytological detail. Autolytic artifacts are kept to a minimum by slicing specimens in the fresh state immediately after resection. This may require special arrangements, the simplest of which is to ensure that specimens are sent to the laboratory fresh. The practice of immersion of the whole breast unsliced into formalin should be discouraged. In the Nottingham/ Tenovus study a skilled laboratory technician has been specially trained to sample tumours immediately after excision in the operating theatre laboratory. The turnour is sliced in a cruciate manner and segments are removed and snap frozen (for receptor assay, immunochemistry and archival storage), leaving quadrant leaves of tissue for routine histology (Figure **1).** Blocks obtained in this way give a good representation of the whole tumour from central core to periphery. The number of blocks which can be obtained depends on overall tumour size but, bearing in mind the potential value of archival material, no upper limit should be set. Careful processing of paraffin blocks is required and 4-6 pm-thick sections are cut: nuclear detail is obscured if sections are too thick. Conventional staining with haematoxylin and eosin is adequate and no **special** stains are required routinely.

GRADING TECHNIQUE

Histological grading is directed principally at invasive adenocarcinornas; tumours of other types or those which are completely or predominantly of *in situ* type are not suitable for the particular method we describe... . (Elston & Ellis, 1991, pp. 404-405).

Return to Article: Subjects and Design   Return to Journal Article   Return to Top

2.2.1. Journal Article: Subjects and Design / Materials and Method

Some of the common words and phrases used in this move are listed below. In general, this move answers the questions: *Who are the subjects?* (or *What materials were studied?*), *How were these selected?* and *What process was used to study them?* The step-by-step language of process is usually used.

average	averaged over ten trials
change	changed every other day
confidence interval	95 confidence intervals of
data	as the data source
determine	was to determine the
due to	is due to the
equal	is equal to the
equivalent	is equivalent to breaking
expect	we would expect to
find	we found that the we have (not) found
harvest	cells were harvested by
identical	is identical to the
measure	antibodies were measured by was measured to the
medium	the medium was changed medium was replaced with
model	be modeled by a
normalize	was normalized to the
number	the total number of
perform	was performed using the
quartile	and third quartiles of
random	randomly assigned to study a randomly selected sample of

result	as a result of
same	in the same way
section	described in section ____ in this section we
solve	can be solved for
study group	the study group assignments of the study group
take	was taken to be
transfect	cells were transfected with
transfer	and transferred to a
use	can then be used was used to calculate

2.3. Journal Article: Statistical Treatment of Data

The statistical treatment of data involves mathematical processes performed on the data. The data are then arranged, usually in the form of tables and/or figures. Usually, some discussion of these data is included. In the following example, the authors begin the data section by explaining the procedure they followed and the statistical tests they used:

Statistical analysis

To test for significant variation in substitution rates between the members of each comparison pair, we used Likelihood Ratio Tests, comparing the fit of a two-rate model (in which the pair had a common substitution rate, and the outgroup species another rate) to a three-rate model (in which both pair members and the outgroup had separate rates). Twice the difference in log likelihood was then compared to a Chi-square distribution, with one degree of freedom. Z-tests were employed to test whether this rate variation applied across the dataset as a whole (Whitlock 2005) (Thomas et al., 2010, p. 9).

The following reproduction from a page of a journal indicates how statistical information might be presented on a page in the form of tables and/or figures:

Table 3. Electron dose to produce damage and the corresponding limit to spatial resolution, for 20 nm specimen thickness and 200 keV incident energy (Egerton 2007). The spread in D_c values corresponds to different specimen materials within each category. The last column relates to the detection of 10% calcium (at SNR = 5) from the L_{23}-edge.

Damage mechanism	Type of specimen	Damage dose D_c $(C\,cm^{-2})$	d (nm) for low-loss EELS	d (nm) for 350 eV-EELS
Radiolysis	Organic	10^{-3}–1	<0.5	1–300
Radiolysis	Inorganic	0.1–10^6	<0.05	0.01–30
Sputtering	Metallic	2000–40 000	$<5 \times 10^{-4}$	<0.2

Radiation damage limits the number of electrons incident on each resolution element of size d to $(D_c/e)d^2$, where e is the electronic charge and D_c a *critical* dose (charge per unit area) needed to cause the damage. The number of inelastically scattered electrons (the EELS signal) is therefore limited to $n \approx (t/L)(D_c/e)d^2$, where t is the specimen thickness and L is some effective MFP that depends on the specimen and the inelastic-scattering process involved. Associated with these n electrons is an electron-beam shot noise $n^{1/2}$, giving a signal/noise ratio SNR $= n/n^{1/2} = n^{1/2}$, assuming Poisson statistics where the standard deviation is the square root of the mean value. Combining the two expressions gives $(t/L)(D_c/e)d^2 = n = (SNR)^2$ and taking SNR $= 5$ (the so-called Rose criterion for visibility), the resolution limit imposed by radiation damage is

$$d \approx 5(L/t)^{1/2}(e/D_c)^{1/2}. \qquad (35)$$

Estimates of d are given in table 3, which shows that radiation damage sets the spatial-resolution limit ($d >$ atomic dimensions) for organic specimens and some inorganic compounds. For more radiation-resistant specimens, other
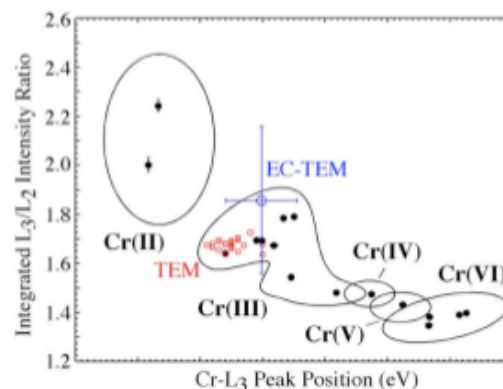
Figure 26. Chromium L_3/L_2 ratio plotted against L_3 threshold energy for inorganic compounds (data points within curved boundaries) and measured for *S. oneidensis* (central data point with large error bars). Reproduced from Daulton *et al* (2003), with permission of Cambridge University Press.

(Egerton, 2009, p. 21)

2.4. Results and Discussion

Results are the summarized facts, derived from the data. The writer attempts to show the most important outcomes of the study. If the results are presented in a separate section, there should be no interpretation of them. Interpretation is reserved for the discussion section. In many instances, results and discussion are presented together, with each important result followed by the author's interpretation of the meaning of that result. Some of the words and expressions commonly used in this section are here.

Results presented alone

If results are presented alone, the section answers the question: "What was observed?" The writer notes the outcomes of the experiment(s) and lists them in a logical order, as in the following example:

Among the stressors employed, only the nucleolar stressor and inhibitor of rRNA synthesis actinomcyin D (ActD) induced translocation of NIR from the nucleoli to the nucleoplasm in all interphase cells (100%), at a dose (0.5–1.0 mg/ml) well below the one needed to cause global transcription inhibition (>5–10 mg/ml) (Figure 2C). Nucleoplasmic localization of a subset of nucleolar proteins upon Act D treatment has been reported before (35); these, however, are not known to interact with TAp63. Some increase in nucleoplasmic NIR was also observed following ultraviolet (UV) irradiation (100 J/m2) and exposure to mycophenolic acid (25 mg/ml) in all four cell types. As ActD induced NIR translocation most consistently, this compound was used in the further studies (Heyne et al., 2010, p. 3164).

Discussion presented alone

The discussion involves the author's interpretation of the findings or results. It answers the question: "What have we learned from these results?" The following is a brief discussion section from a journal article:

The *55* per cent mortality in hospital in this series is similar to that reported by others for oesophageal variceal ligation. In Alker's (1964) series, 6 of the 16 cirrhotic patients died postoperatively. However, in most of the other reported series the Boerema-Crile operation has been employed (Orloff, 1966, 1967). In this procedure a longitudinal incision is made through both the muscular and mucosal layers and oesophageal closure is potentially less safe. Indeed, in the series of 58 patients reported by Rothwell-Jackson and Hunt (1971) there were 10 patients in whom the anastomosis leaked and all of these died. There was only one anastomotic leak in our series. It is difficult to compare the results of the various series because of differences in type and severity of liver disease, but comparison would be facilitated by the adoption of a grading system such as we have used. Both types of operation seem to control variceal haemorrhage in most patients and the high operative mortality is to a large extent a reflection of the

severity of the underlying liver disease. The outcome of operation in our series did not seem to be influenced by the age or sex of the patient, the presence of jaundice or encephalopathy, or individual liver-function tests considered separately. However, with one exception no patient with moderate or gross ascites or a combination of jaundice, ascites, and encephalopathy survived to leave hospital. Our method of grading the severity of liver disease is more flexible than that originally described by Child (1964) in which a low serum albumin alone was sufficient to place a patient who otherwise had good liver function into grade C. In the present series the operative mortality and long-term survival were closely related to the preoperative grade, and in grade C the results were so poor that operation on such patients does not seem justified unless there is a clear additional and reversible factor which may partially account for the poor liver function. For instance, in I patient the C grading on admission was partly due to a period of heavy drinking and her score improved by 5 points postoperatively whereas no other patient improved by more than 2 points. If all grade C patients are omitted from analysis the operative mortality in our series is reduced to 35 per cent. It was disappointing that bleeding continued or recurred in hospital after operation in 11 of the 38 cases. Although the source of the haemorrhage was not always obvious, in most cases it seems likely to have been due to varices at or above the suture line, and a more extensive portasystemic disconnexion (Tanner's operation; Tanner, 1961) might have been more effective although this is a more major operation. Only 5 patients were considered suitable to follow the planned course and to undergo elective portacaval anastomosis, and this is an indication that most patients admitted as emergencies with bleeding varices have severe underlying liver disease. However, it is interesting that only 2 of the 12 patients who were discharged without a further procedure have re-bled and 7 of these patients are still alive (Pugh et al.,1973, p. 648).

Results and Discussion

Often the results and discussion are presented together. In the following extract, the authors first state the major finding of their study, namely "evidence that differences in GT can affect rates of molecular evolution in invertebrates" and then go on to discuss the importance of this finding ("This result is important for 2 reasons."):

Using a large data set of 143 species and 15 genes, across 8 different phyla, we have found evidence that differences in GT can affect rates of molecular evolution in invertebrates. This effect is observed in both nuclear and mitochondrial ribosomal RNAs and in nonsynonymous and synonymous substitutions in mitochondrial protein-coding sequences and is evident despite heterogeneity in quality in our estimates of GT and inevitable errors in the estimation of molecular branch lengths. This result is important for 2 reasons. Firstly, the demonstration of a GT effect in animals has thus far been restricted to vertebrates, whereas we show that it is a general phenomenon observable across a wide range of animal taxa. Secondly, in much of the previous literature, the GT effect was assumed to be a feature of synonymous changes only (e.g., Gillespie 2001), but we show that it can also be detected for nonsynonymous substitution rates (Thomas et al., 2010, p. 13).

2.4.1. Journal Article: Results and Discussion: Common Words and Phrases

add	was added to the
aim	the aim is to
approximation	a good approximation to
assume	we assume that the
average	the average value of ____ an average of the average of the values
basis	on the basis of
by	by as much as
case	in the case of
clear	is not clear at
combination	combinations of
compute	we can compute from
confirm	needs to be confirmed
consensus	our consensus is that
constant	there exist constants ____
contrast	in contrast to this
depend	which depend linearly on
determine	determined by the data
differs	differs only slightly from
equation	in equation ____
estimate	as an estimate of can be estimated from
evident	it is evident that
factor	be a factor of
figure	as seen in figure
find	as found directly from

fit	can be fitted to
function	as a function of
	is a (known) function of
hand	on the other hand
hope	we cannot hope to
important	it is important to
independent	is independent of the
like	(ideally) we would like to
measure	we have measured the
minimize	can be minimized by
paper	in the present paper we
point out	pointed out that the
possible	it is not possible
problem	the problem is to
	our problem is to
relation	of the relation between
section	in section ___ we
set	a given finite set
table	listed in table
take	can be taken as
	then we can take
term	in terms of m
try	we might try to
use	can be used to
	can be used for
	for use in the
	has been used to

2.5. Conclusions / Conclusion

The two terms "Conclusions" and "Conclusion" are often used interchangeably to identify the final section, or move, of a journal article. Actually, they are not the same. "Conclusions" refer to interpretations of the results. The author will typically take each major finding separately and comment on it. The Conclusions section now answers the questions "What do these findings mean?" "How are these findings valuable?"

"Conclusion", on the other hand, provides a brief summary of the main outcomes of the research. It may also provide a context for the research by speculating about the future of the project, indicating how the research project could form a part of a larger study, and/or stating the limitations of the study. It should end by answering the question, "Where do we go from here?"

Elements of both "Conclusions and "Conclusion" may be contained in a single section.

The following is an example of a **Conclusion**. It reviews the field and indicates future directions for research.

Within the last decade, TEM-based energy-loss spectroscopy has undergone steady development. Gun monochromators have become commercially available, making the TEM-EELS energy resolution comparable to that typical of XAS (~0.1 eV). Partly for this reason, and also prompted by demands of the semiconductor industry and nanotechnology initiatives, more attention has been given to the low-loss region of the spectrum. This has led to renewed interest in the theory of surface-plasmon and Čerenkov losses in thin specimens, as first investigated by Kröger (1968). Core-loss spectroscopy has benefited from a better understanding of relativistic effects and of the delocalization of inelastic scattering in crystalline materials. Bayesian deconvolution techniques have been applied to both low-loss and core-loss regions with the aim of revealing additional fine structure. Taking advantage of such developments and of the improved stability of a modern TEM, EELS is being applied to the structural and chemical analysis of practical materials down to the atomic scale. Once instrumental limitations have been overcome, the ultimate spatial resolution is set by scattering delocalization and radiation damage to the specimen. Future instrumental developments may include improved monochromator designs and the adoption of high-brightness electron sources, possibly based on carbon nanotubes (Fransen *et al* 1999). Another useful development would be an energy-loss spectrometer for transmission EELS and energy-filtered imaging in a scanning electron microscope (SEM). Because the SEM uses an accelerating voltage of 30 keV or lower, transmission measurements will be restricted to ultrathin specimens, such as nanotubes and nanoparticles. However, the low electron energy provides higher STEM-image contrast and makes it easier to achieve good energy resolution. With the addition of a suitable monochromator, it might be possible to achieve an energy resolution (~10 meV) sufficient to examine vibrational modes of energy loss and to investigate the chemical bonding and phonon modes in nanostructures. After correction of lens aberrations, atomic resolution at 30 keV should be possible (Krivanek *et al* 2008). Further

information on the basic theory and practice of TEM-EELS is given in introductory form by Brydson (2001) in greater detail by Egerton (1996) and in two multi-author volumes edited by Reimer (1995) and Ahn (2004). Research papers on TEM-EELS are to be found in microscopy journals, particularly *Ultramicroscopy* and *Micron*, and scattered among various physics and materials science journals. A recent review by Spence (2006) is largely complementary to the present one, with more emphasis on STEM, channelling effects and applications to glasses and nanotubes. A short review of biophysical applications has been given by Leapman (2004b) ([Egerton, 2009](#), p. 22).

The following section gives **Conclusions**, based on the research. Here, the conclusions are numbered sequentially.

7. Conclusions
We have presented the characteristics and the performances of our public code hyperz, available on the web, which make use of the template SED fitting technique. We can summarize the main conclusions as follows:
1. Simulations of ideal catalogues have shown the main trends of the accuracy on zphot calculations. In particular, zphot estimates are improved when the filters set spans a wide wavelength range, including near-IR and U filters, and when the photometric errors become small.
2. We have investigated the weight of the different parameters on the final results, using both a spectroscopic subsample of HDF and simulations. In particular, the templates, the flux decrement by Lyman forest, the age of the stellar population, the reddening, the cosmology, the metallicity, the IMF and the presence of emission lines have been discussed. According to these results, the zphot preciseness seems to be more sensitive to the photometric accuracy rather than to the detailed set of parameters. Nevertheless, a subset of these parameters (reddening, age of the stellar population and Lyman forest blanketing) has to span a sufficiently wide range of values to obtain accurate zphots.
3. The robustness of the method has been illustrated through realistic deep field simulations, aiming to reproduce the redshift distribution, photometric accuracy and limiting magnitudes encountered in deep field surveys.
4. We have pointed out some of the manifold applications of the photometric redshift in present and future projects.
5. We plan to include AGN SEDs in the present scheme of hyperz, as well as stellar templates, in order to automatically classify objects in a photometric survey through a unique pipeline. This particular application is presently under development (Hatziminaoglou et al. 2000) ([Bolzonella, 2000, pp. 17-18](#)).

3. Grant Application / Proposal

A grant application, also called a proposal, may have some or all of the following parts:

Summary	This is an executive summary, giving a detailed overview of the project in non-technical language. It should be written last and placed at the top of the document. A title page may also be required.
Requirements	State all physical and other requirements needed for the project. This includes equipment, space, overhead, personnel, transport, etc. List each item, briefly describe it, explain its role. and explain why it is needed.
Situation / Problem / Objectives	This section gives a context for the project by providing background information leading to the current project, stating the problem or research question, and listing the objectives of the project.
Management and Organization	In this section explain how the project will be managed, what the role of each participant is, how the management hierarchy is organized, and who has ultimate responsibility for carrying out the project.
Timeline, Other Funding Sources	As precisely as possible, provide a timeline for the project by dividing the project into steps or stages. Justify the amount of time allotted to each stage. If any parts of the project are to be funding wholly or partially by another funding source, give this information here.
Future Funding	If the project will require future funding, estimate the amount and the timeline and provide a justification for these estimates.
Budget	Provide a detailed budget for the project. List all equipment, wages, transport expenses, overhead, etc. and provide justification for the amounts. For expensive equipment, provide prices from several suppliers, if possible. If the least expensive option is not desirable, explain why.
Conclusion	Justify the project in the context of other research currently being done in the area and point to material and other benefits that could be expected from the project's outcomes. In particular, indicate how the funding agency will benefit.

These may appear in a slightly different order as long as the Summary is at the beginning and the Conclusion is at the end.

An excellent online short course in proposal writing is available at:

http://foundationcenter.org/getstarted/tutorials/shortcourse/index.html

Often the applicant is required to fill out a form. In that case, the relevant parts of the application will be included with specific instructions on the form.

For research in science and technology in Canada, a major funding body is NSERC. Most of the information that follows is related to NSERC grant applications.

For information about NSERC grant applications, the following sites are helpful:

www.nserc.ca
http://www.grad.uwaterloo.ca/scholarships/NSERC%20hints%2005.pdf
http://www.unb.ca/research/ors/news/nserc_writing_guide_pres.pdf

NSERC forms and instructions are available at:

http://www.nserc-crsng.gc.ca/onlineservices-servicesenligne/forms-formulaires_eng.asp

Return to Top

4. Engineering Design Report

An engineering design report demonstrates the feasibility of a device or design. It may involve a comparison and/or contrast between or among two or more designs. The report generally consists of the following parts, or moves, arranged in the given order:

Title Page	The title page includes the title, the author's identification, the course identification, and the date. The title should be as specific as possible.
Summary	Briefly state the topic, the method, the major findings, and the main conclusions. Do not give background or references. This is not the same as an abstract.
Table of Contents	Use the decimal point numbering system. Indent subsection titles.
Introduction	Give a brief background of the topic. State the purpose and aims, and present any theory or other technical knowledge needed to understand the report.
Report	Present the information from your research. Organize it under headings and subheadings. The usual sections are *Objectives*, *Materials and Procedures*, *Results and Discussion*. Use tables, figures, and/or lists if these would help to make the information easier to understand.
Conclusions	These should relate to the aims, as stated in the Introduction. Give a brief summary of major outcomes and key findings. This section may also contain recommendations for solving a problem or for undertaking future work. If there are many recommendations, a separate section for recommendations should be included.
References	Provide the necessary in-text references and end-of-text citations.

Appendices	Include related material that can help the reader to understand the report. This material could include extensive tables of raw data, extracts from related studies, or any other material that would interrupt the flow of reading if it were placed in the report itself. Number each appendix and give it a title.

For a basic example, see http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/assess_tuts/technical_reports_LL/samples/Aerospace%20Engineering%20sample%20report.pdf

For a detailed discussion with examples, see http://www.monash.edu.au/lls/llonline/writing/engineering/technical-report/1.1.xml

The following link to the Online Writing Lab at Purdue University provides a download of a PowerPoint presentation on writing engineering reports: Writing Engineering Reports

Return to Top

5. Research Proposal

A research proposal typically has the following parts:

- Background
- Objective(s)
- Scope
- Methodology and Approach
- Facilities
- Budget
- Deliverables and Programme Schedule
- References
- Appendices

It should be presented in Times 12 pt. font and be no longer than 15 pages.

A page of links to sites on writing a research proposal is linked here: http://researchproposalguide.com/

Among others, this site links to the research proposal template from the University of Auckland, New Zealand, which is reproduced below. Modify the template to fit your area of study. The template is located here: http://web.auckland.ac.nz/uoa/fms/default/engineering/postgraduates/docs/SAMPLE%20RESEARCH%20PROPOSAL2.pdf

Another useful template, from the University of KwaZulu-Natal, South Africa, is available here: The best template ever (.doc)

Return to Top

6. Consulting (Management) Report

According to [Silyn-Roberts](#) (2000, pp. 114-115), a typical structure for a consulting or management report is the following:

- Title Page
- Letter of Transmittal
- Executive Summary
- Recommendations
- Table of Contents
- List of Figures
- List of Tables
- Glossary of Terms and Abbreviations
- Acknowledgements
- Purpose Statement
- Procedure Statement
- Problem Statement
- Background (Introduction)
- Body (sections and subsections with headings)
- Conclusions
- References
- Appendices

(Note: Not all sections will necessarily appear in a given report.)

An example of a management report from the city of Burlington, Canada, is given here:
http://cms.burlington.ca/AssetFactory.aspx?did=9469

[Return to Top](#)

7. Recommendation Report

According to [Silyn-Roberts](#) (2000, pp. 114-115), a typical structure for a consulting or management report is the following:

- Title Page
- Executive Summary, Summary, or Abstract
- Recommendations (or Conclusions and Recommendations at the end)
- Table of Contents
- List of Illustrations
- Glossary of Terms and Abbreviations
- Acknowledgements
- Purpose Statement
- Scope (or Scoping) Statement
- Procedure Statement
- Problem Statement
- Background (Introduction)
- Body (sections and subsections with headings, covering method and results)
- Conclusions (or Conclusions and Recommendations)
- References
- Appendices

(Note: Not all sections will necessarily appear in a given report.)

The report is read by non-experts who may read only the Executive Summary, Recommendations, and Conclusions.

An example of a recommendation report may be found at:

http://www.aiaa.org/pdf/public/Inside_Aerospace09_Report_and_Recommendations.pdf

(The first 11 pages contain the report.)

[Return to Top](#)

8. Thesis Proposal

According to [Silyn-Roberts](#) (2000, pp. 92-93), a typical structure for a thesis proposal is the following:

Summary:	Similar to an abstract, but more general and without proven results.
Research Question / Objectives:	Try to make these as clear and unambiguous as possible. They will probably be refined as you continue your research.
Background and Literature Review:	This will be incomplete at this stage in the research. Try to include the major works in your specific area.
Materials and Methods:	Use the future tense, since the study has not yet been done.
Timeline (if required)	
Required Resources:	List the facilities, equipment, coworkers, etc. that will be needed.

Attach any relevant materials, completed chapters, appendices, etc.

A typical example of a thesis proposal in the sciences can be found at:
https://webspace.utexas.edu/cherwitz/www/ie/samples/w_gordon.pdf

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[Return to Top](#)

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[Return to Top](#)

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[Return to Top](#)

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[Return to Top]()