



VILNIUS UNIVERSITY
LIFE SCIENCES CENTER

Name Surname

Title of the Final Thesis of the Bachelor's Degree Program

Bachelor's Thesis

Environmental Science study program

Thesis supervisor

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Consultant

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Thesis completed at

Center for Ecology and Environment of the
LSC Institute of Biosciences

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Abbreviations

LSC – Life Sciences Center

VU – Vilnius University

Introduction

This document describes the *Microsoft Word* template you can use to write bachelor's and master's theses. The template is based on the latest **VU LSC Thesis Guidelines** version and incorporates most of the technical thesis formatting requirements. Some parts of the Guidelines have been transferred to this document to illustrate and explain the features of the template. The current version of the *Microsoft Word* thesis template is **1.0**; it was released on **November 27, 2024**. If you have suggestions for improving this template, please email vytautas.petrauskas@bti.vu.lt.

When writing a thesis, you should adhere to the principles of academic writing: scientific objectivity, accuracy, fair presentation, and data description. There are many books, articles, and video materials on the Internet about the principles and subtleties of writing theses and scientific publications. For more on this topic, see advice in Alley (1996); Strunk & White (1999); Žilinskas (2016); Mensh & Kording (2017).

The description of the final thesis recommendations includes a requirement for margins: 2 cm for the top and bottom margins, 2.5 cm for the left margin, and 1.5 cm for the right margin. This template contains the top and bottom headers and footers, so the size of the top and bottom margins must be adjusted to the dimensions of the headers. In the page settings section of this document, the top and bottom margins are set to 1 cm. Do not change these values; headers and footers take up an extra 1 cm, so the final top and bottom text margins remain 2 cm.

1. Literature review

1.1. Structure of the Final Thesis

We recommend that you write your theses according to the following structure:

- **Title page**
- **Content**
- Abbreviations
- **Introduction**
- **Literature Review**
- **Materials and Methods**
- **Results**
- **Discussion**
- **Conclusions**
- Recommendations
- **Author's Personal Contribution**
- Dissemination of Results
- Acknowledgements
- **Abstract (in Lithuanian)**
- **Abstract (in English)**
- **References**
- Appendices

The parts in bold are compulsory for the final theses of all the LSC study programs, while other parts are included at the author's discretion or as required. The listed structural elements are normally written as sections in the document. It is customary to number only the sections of the body of the thesis – Literature Review, Materials and Methods, Results – (denoted by a single number with a dot, e.g., 1.) and their structural parts: subsections (denoted by two digits, e.g., 1.2.) and subsubsections (denoted by three digits, e.g., 1.2.3.). If you are dividing the structural parts of your written work into smaller units, structure the work so that the section to be divided has at least two subsections and the subsection has at least two paragraphs. Try not to make the structural levels of the paper smaller than paragraphs, as subdividing the body of the paper into even smaller levels makes it very difficult to understand the structure of the paper. If necessary, use document structuring elements such as headed paragraphs and numbered and unnumbered lists.

1.2. Title Page

The title page of the thesis includes the university and the core unit, the student's name, the title of the thesis, the degree and program of study, the supervisor(s), the advisor(s), the LSC unit where the thesis was carried out, the city and the year of work. This page is included in the general pagination, but it does not say the number. The Title page and the Table of Contents are created according to the rules defined in this template.

One of the most important elements of the title page is the title of the thesis. A good title should outline the area of research and provide details that distinguish the thesis from other works in a similar field. The title should reflect the main idea of the whole study. On the one hand, the title should not be abstract and cover a very broad field of research. On the other hand, a title that is too long is also a bad idea, as the reader may understand a limited amount of information. Sometimes the title is referred to as the reader's first barrier. If the reader does not understand the title, it is unlikely that they will be willing to undertake further reading. It is not easy to strike a balance between clarity, detail, and length of the title, so it is worth going over and over during the course of the work to see if the title still reflects the essential message of the work. Advice on how to write titles for scientific papers can be found in various publications (Alley, 1996; Buriak, 2014; Skrabalak, 2021).

2. Materials and Methods

The Materials and Methods section should consistently and clearly describe the materials used, the methods, the work steps, the equipment and the process. This section must be written so that it can be used as a basis for the next person to repeat the study. The methods section must also describe the subjects if you have conducted the study on human subjects and the objects of the study if you have conducted the study on animals, plants, fungi and other living or non-living natural objects. This section should include the depersonalized data of the subjects (age group, physical characteristics, etc.) and the criteria on the basis of which you selected them. When writing about the objects of study, please elaborate on the species you studied, the criteria used to select them, etc.

2.1. Materials

If you have carried out research on animals, you must include the number of the permission to conduct research of the Lithuanian Ethics Committee for the Use of Experimental Animals under the State Food and Veterinary Service. For human studies, permission must be obtained from the Bioethics Committee under the Ministry of Health of the Republic of Lithuania, and the number and date of the issue must also be indicated in the final thesis. If protected species have been worked with during the preparation of the thesis, written permission from the Wildlife Licensing Unit of the Environmental Protection Agency must be provided. If the research was carried out in a protected area, the consent of the staff responsible for the protected area must be provided.

When writing the Methods and Materials section, please specify the materials you used in your studies and the manufacturers of those materials. The Methods section should cover all stages of the study, describing the design and conduct of the experiments and explaining the essential procedures. Despite the details, the description should be concise; it is not necessary to transcribe verbatim the entire study protocol, but rather to summarize it. It is also not necessary to describe in detail routine procedures, e.g., the production of buffers, but the concentrations at which the solutions were prepared and used should be indicated.

2.2. Methods

It is also important to describe the measurement equipment and analytical methods used in the methodology. If standard manufacturer's kits were used in the work, it is sufficient to state that the manufacturer's recommendations were followed (and where these recommendations can be found). The statistical methods subsection should describe the quantitative data obtained in the study, the number of replications of the experiments, what statistical quantities were reported, and what tests were used to compare the data. The computer program used to analyze the data must also be

mentioned. Space-consuming, specific parts of the methodology (questionnaires, specialized sets of stimuli, figures, or similar) are recommended to be placed in the appendices.

It is essential to remember to mention collaboration with other institutions and colleagues if you or your supervisor have not been the only one to carry out certain experiments. For example, *Scanning electron microscopy analysis of the resulting silver nanoparticles was carried out at the National Center for Physical Science and Technology in collaboration with Dr. Y. Ygrikaitis.*

A description of the study sites is necessary when the material for the thesis is collected in the countryside, in a specific environment, or particular localities. You must give a geographical description of the site(s) if the material for the thesis was collected in several locations, the volume of material collected, and identify specific environmental features relevant to the thesis topic and influencing the results. Depending on the scope and importance of the final work, the description of the study sites may be written as a subsection of the Methods and Materials or as a separate section.

3. Results and Discussion

3.1. General Provisions

The Results section describes in detail the research data obtained by the author, their analysis, interpretation and discussion. At the beginning of this section, you may write a short introductory paragraph indicating whether the work has started a new line of research or is a continuation of work in the laboratory. At the beginning of the Results section, you can also remind the readers of the main objectives of the work by linking them to the research you plan to describe. The Results can be written in one of two ways: (1) presenting the Results together with the Discussion in one section, or (2) presenting the Results in one section and the Discussion in another. The first option is more often chosen by students preparing an undergraduate thesis. We would recommend the second way of describing the Results for Master's theses, as they contain a larger amount of results and it is therefore appropriate to separate the results and the more detailed discussion into individual sections. Be sure to discuss merging the Results and Discussion sections with your supervisor, as it is common practice in some technology-based programs to write these sections together in both undergraduate and postgraduate theses.

The results should be presented in an order that facilitates understanding of the logic and process of the whole study. It is important to describe the results that were obtained rather than those that were expected. When describing the experiments, it is not necessary to repeat information that has already been given in the Methods section, it is sufficient to refer to the relevant part of the methodology. The results should be presented clearly and consistently using tables, graphs, or charts where appropriate to demonstrate their statistical reliability. This section of the paper could also include a paragraph summarizing the main results of the study.

Each figure or table included in the thesis should be described in the text. The text relating to the figures and tables should be close to each other. From a methodological point of view, it would be fairest if the description of the table or figure appeared in the text before the figure or table itself. However, this is not always possible due to the size of the objects and the structure of the document.

If a table or figure is presented, at least one explanatory or summarizing sentence must be written. Organize the presentation of the results so that you do not need to present several tables or figures consecutively but rather separate them with text paragraphs. We recommend presenting several related figures as components of a single figure, denoted by small letters (a, b, c, ...) or capital letters (A, B, C, ...) rather than separately. Where a table in a manuscript takes up more than one page, the table heading should be repeated on all subsequent pages, indicating that it is a "continuation of the table". When presenting the results, avoid repeating the same information in figures and tables – choose the most effective way of presenting the data. The text of the paper

should also not reproduce verbatim information that is already presented in figures or tables. Figures and tables should be annotated, highlighting the most significant result. If there are a large number of results and figures, only the main ones, which are the most relevant, should be presented in the paper. Other results can be included in appendices or linked to an online storage location.

The Discussion section should provide an analysis and interpretation of the results obtained, and try to answer why they were obtained and what could be improved. In this section, it is important to compare your results with those of other authors, discuss possible discrepancies or contradictions, and try to explain the reasons for them. If the results can be interpreted in several different ways, they should all be discussed, and the author should indicate which of the alternatives they consider most valid. All results should be addressed, even if they are unexpected or negative. If the experiment failed, an attempt should be made to explain what went wrong and how such problems could be avoided in the future if the study were repeated. In this section, it is recommended to discuss the problems encountered during the work and propose how to solve them.

At the end of the Results and Discussion, we recommend one paragraph summarizing them. It is also worth including a summary sentence at the end of the larger subsections, as this style of writing makes scientific papers much easier to understand than those that leave the explanation and summary of all the results to the reader.

3.2. Language of the Thesis

The thesis must be written in correct Lithuanian or English and must be free of grammatical, proofreading, style, misuse of terms, and other errors. The thesis may be written in English if the student, supervisor, or advisor is a foreigner or the studies are conducted in English. The language of the thesis must be clear, the flow of ideas coherent and the transitions from one subject to another logical. The thesis must follow good practice in the representation of data in figures and tables, the spelling rules for sizes and units, and the requirements for references.

In scientific writing, both the active and the passive voice can be used, so do not try to avoid one or the other style of writing artificially (Ping Alvin, 2014). The main task of a scientific writer is to convey scientific information objectively, clearly, concisely, and understandably, and the choice of style depends on the objectives of the writing. In the final thesis, the Introduction, Literature Review, Results, and Discussion sections can be written alternately using the active and passive forms. In contrast, the Methods section will be more effective if you use the passive form, as it puts what has been done before who has done the research. The passive voice may also be very necessary for a Literature Review (e.g., if you cannot name the person who performed the action in the description of the study because they are unknown, unimportant or there are too many of them

to mention). In summary, scientific writing has no hard and fast rules, so it is up to you to choose your writing style. We recommend that you also discuss this issue with your supervisor.

3.3. Tables and Figures

Tables and figures are used in the final thesis to visualize the data and the processes under investigation. Each figure and table must have a caption consisting of a number and a title. A full stop at the end of the caption shall not be written. The number is necessary even if the thesis contains only one table or one figure. The numbering of tables and figures is separate and is usually in Arabic numerals. Thus, for example, a paper may have “Table 1” and “Figure 1”. If the work contains many tables or figures, the numbering of the tables or figures may be linked to the numbers of the body sections (e.g., Literature Review figures 1.1, 1.2, Results figures 2.1, 2.2, etc.). Table captions are written above the table and figure captions below. Use single-line spacing for table content, its caption, and notes. Try to insert tables and figures into the text after the paragraph in which they are first mentioned. This is not always possible if the object to be inserted is large and does not fit into the rest of the page. In this case, the figure or table should be inserted at the beginning of the next new page. You should not start a section or subsection with a table or figure. If the tables printed in the work have many columns and do not fit on a longitudinal page, the page should be formatted in landscape format. We recommend that large tables be presented in appendices, with only references to them in the text.

All tables and figures in the thesis without acknowledged sources are assumed to have been compiled by the author. If a table, figure, or their parts are taken from other sources, they must be attributed with proper quotation. If you present a figure in your work that is your adaptation of another figure (e.g., replacing three data curves in a graph with two or replacing English text elements in a drawing with Lithuanian ones), then you must acknowledge that the figure has been adapted by also citing the appropriate source.

The use of figures and tables in the paper should be justified, and their information should be clearly legible. The visual material should be discussed and explained in the text without duplicating the data in tables and figures. If appropriate for clarity of presentation, arrange the numbers in the tables so that the corresponding groups of numbers in the columns are exactly one above the other. Refrain from using redundant or irrelevant information in tables. For example, columns such as “Serial number” or “Units of measurement” are not recommended. Where appropriate, units should be indicated in brackets in the column headings of the table, e.g., ΔH (kJ/mol). Any notation not mentioned in the text should be explained in the captions of the tables or figures so that they are at least partially understandable without having to read their explanations in the text. When presenting the results of an experiment in figures, the method used to

obtain the experimental results of the experiment can be mentioned in its description. An example of the presentation of the data is shown in Table 1.

Table 1. Compounds with the highest observed affinity ($K_{d,obs}$) to carbonic anhydrase (CA) isoforms selected from the PLBD database. The corresponding intrinsic affinity estimates ($K_{d,int}$) were calculated according to the methodology described in Linkuvienė et al. (2018). All values were determined at 37 °C. The table was adapted Lingė et al. (2023)

Baltymas	Junginys	$K_{d,obs}$ (nM)	$K_{d,int}$ (nM)
CA I	VD11-61	25	0.000 66
CA II	VD10-49	0.79	45
CA III	TFMSA; TFS	1000	220
CA IV	EA3-2	1.4	0.0042
CA VA	EZA	19	1.7
CA VB	VD12-05	50	0.0017
CA VI	TFMSA; TFS	14	1.2
CA VII	VD10-49	0.22	11
CA IX	VD11-4-2	83	0.000 78
CA XII	EA12-3	0.4	0.0015
CA XIII	VD11-9	0.28	0.021
CA XIV	VD10-49	0.50	0.025

The illustrations, charts, graphs, diagrams, photographs, and other visual material presented in the work are collectively referred to as figures. When referring to figures in the text, the figure number follows the word “Figure” or its abbreviation “Fig.”, e.g., “Figure 1” or “Fig. 1”, respectively. Scale bars must be provided in images taken by microscope. For textual information in the figures (axes names, scale labels, curve descriptions, etc.), we recommend using the *Sans Serif* font family (e.g., *Helvetica*, *Calibri*, *Liberation Sans*, *Computer Modern*). The most common problem with presenting textual information in figures is the size of the fonts. Once the final dimensions of the image have been selected, the size of the text elements in the image should not differ by more than 25 % from the base font size of the document. For example, if a document base font is 12 pt, the fonts in the figure should range from 12 pt to 15 pt. The recommended font sizes for diagrams are as follows: 12 pt to 14 pt for axes headings, 10 pt to 12 pt for scale labels and other explanatory text elements. If the figure’s dimensions are very different from those you will use in your final work, ensure that the resized figure’s fonts still comply with the recommended ones. Try to keep the font style and size consistent across all figures in the paper.

Examples of visual material for written work are shown in Figure 1: (A) a diagram, (B) a flow chart, (C) an illustration, and (D) a fluorescence microscopy image. Diagrams represent experimental or theoretical data, while illustrations and diagrams visualize the objects, phenomena,

or processes described. Choose the type of chart that represents the data most effectively: *bar chart*, *pie chart*, *line chart*, *scatter chart*, etc. If sufficient space is available in the chart, it can be used to add inset charts, which show information that complements the primary data (see Figure 1 A). When a figure comprises several independent components, the caption should first give the overall title of the figure (what unites the component parts) and then write the captions for the individual parts, starting with their letter designation.

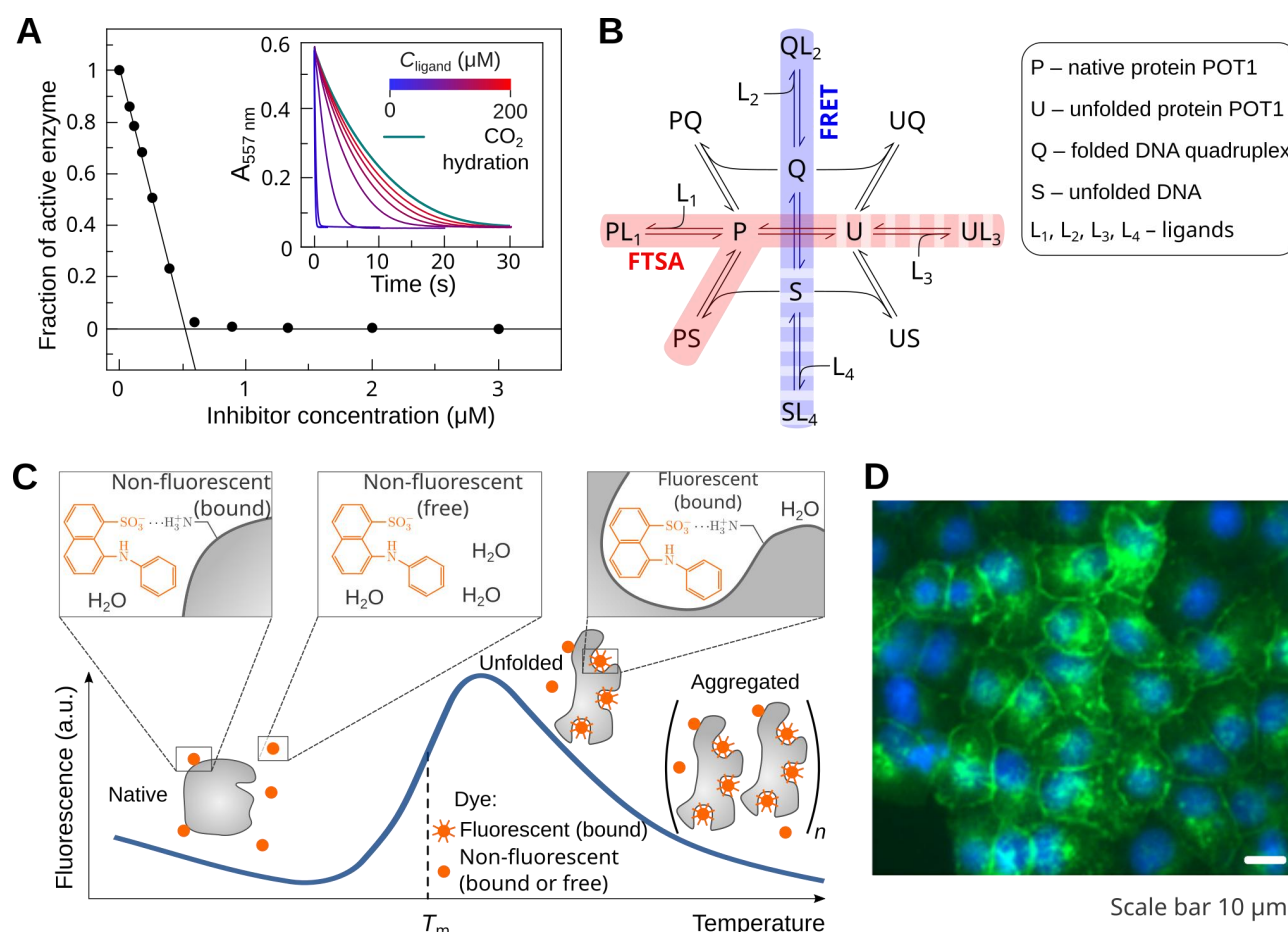


Figure 1. Examples of visual material in scientific writing. **(A)** Chart adapted from Linkuvienė et. al. (2018). **(B)** Diagram adapted from DeLeeuw et. al. (2021). **(C)** Illustration adapted from Petrauskas et. al. (2024). **(D)** Fluorescence microscopy image adapted from Matulienė et. al. (2022).

Experimental data in scatter charts are represented by points (circles, triangles, squares, etc.) and do not need to be connected by curves. An exception is made for experimental data with a large number of points (e.g., spectra), in which case the data points are not shown, but are connected by solid lines. Theoretical (model) data are shown on charts using curves (solid, dashed, dotted, etc.) without points. A logarithmic scale should be chosen if a scale is required to represent the data that spans several orders of magnitude (e.g., a scale of concentrations from 10^{-9} M to 10^{-3} M), a logarithmic scale should be chosen. Avoid very large or very small numbers on scales that require

many symbols. Instead, it is preferable to use metric prefixes (G, M, k, m, μ , n, etc.) or scientific notation (10^{-6} , 10^{-3} , etc.), which avoids excessive symbols in the charts.

Conclusions

The Conclusions section contains the main statements of the thesis, which are direct answers to the aim and objectives of the thesis. The conclusions are short, specific, and clear statements without extended explanation. They should communicate what has been learned from the work, rather than state the facts presented in the results or repeat the summaries in other sections of the thesis in the form of a summary of the body of the thesis. It is recommended that conclusions are supported by figures and the results of statistical tests.

Examples of **appropriate** conclusions:

- The binding of thiazolyl-substituted benzenesulfonamides at the para position to carbonic anhydrases is stronger than analogous meta-substituted compounds.
- The addition of a glycine amino acid at the N-terminus of the SARS-CoV-2 core protease reduces the enzyme's catalytic efficiency by 60-fold.

Examples of **inappropriate** conclusions:

- The literature on mutant protein purification was reviewed.
- A genetic construct encoding a protein from 10 to 279 a.a. was developed.

The Recommendations section can be separated from the Conclusions section if necessary. This section should contain recommendations relevant to the scientific community or the general public on applying the work results or the direction of further research.

VILNIAUS UNIVERSITETAS
GYVYBĖS MOKSLŲ CENTRAS

Vardas Pavardė

Magistro baigiamasis darbas

Magistro studijų programos baigiamojo darbo pavadinimas

SANTRAUKA

Santrauka lietuvių kalba yra formatuojama remiantis GMC baigiamųjų darbų ruošimo metodiniu aprašu. Baigiamuosiuose rašto darbuose turi būti pateiktos santraukos lietuvių ir anglų kalbomis. Jei darbą rašo kitos šalies pilietis nemokantis lietuvių kalbos, lietuviška santrauka yra neprivaloma. Kiekvienos iš santraukų apimtis neturi būti didesnė nei vienas puslapis. Santraukoje turėtų būti pateikta institucija, autorius, pavadinimas ir glausta baigiamojo darbo apžvalga, atspindinti temos aktualumą, darbo objektą, tikslą ir uždavinius, metodus bei rezultatus. Santraukoje rekomenduojama akcentuoti ir svarbiausias išvadas bei darbo reikšmingumą.

Santraukos lietuvių ir anglų kalbomis neprivalo būti viena kitos pažodinis vertimas, tačiau stenkitės jas padaryti kiek įmanoma panašesnes, t. y. anglų kalbos santraukos variante negali atsirasti teiginių, kurių nėra lietuviškoje santraukoje.

VILNIUS UNIVERSITY
LIFE SCIENCES CENTER

Vardas Pavardė

Master's thesis

Master's Thesis Title

ABSTRACT

The final written thesis must include abstracts in Lithuanian and English. A Lithuanian abstract is optional if the thesis is written by a national of another country who does not speak Lithuanian. Each of the abstracts must be no more than one page. The abstract should include the institution, the author, the title, and a brief overview of the thesis, reflecting the relevance of the topic, the subject, the aim and objectives, the methods and the results. It is recommended that the abstract should also highlight the main conclusions and the significance of the work.

The English and Lithuanian abstracts do not have to be a literal translation of each other but try to make them as similar as possible, i. e., the English version of the abstract must not contain any statements that are not in the Lithuanian abstract.

References

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