

This is a summary of what to think about when completing a degree project at the bachelor's and master's levels in environmental science, including a written thesis and an oral presentation, at the Department Environmental Science and Analytical Chemistry (ACES). The summary is largely based on the main elements of the book "*How to write and publish a scientific paper*" by Robert A. Day (ISBN 0521365724, ISBN 0521367603 (pocket)). However, the division described below regarding the written thesis does not apply to all types of degree projects at ACES, for example, investigation work. It is also important to consult the guidelines, learning objectives and grading criteria for the individual project.

Degree project at the bachelor's and master's levels

The degree project should contain a research question that is relevant to the field of environmental science and tested either experimentally or theoretically. The presentation of the background, research question and results should be clear and logical, and the statistical treatment (where applicable) should be relevant. The title of the project should be appropriate, and the summary should be understandable even to those who do not read the entire report.

Choice of language

The text should be relatively easy to read and engaging, and the language should be clear. The thesis can be written in either Swedish or English. Carefully consider the pros and cons of your choice of language. For example, English can be advantageous in the context of international studies or if you would like to pursue an academic career as a doctoral student. However, if you complete the degree project externally, for example in a municipality, it might be better to write in Swedish. The downside of English is that it often takes longer to write and can be of lower quality. The value and dissemination of information to the public, industry, etc., can also be lower when choosing English.

Completing the thesis

Before you start writing a thesis, it helps to create an outline of the content, i.e. roughly divide the text using main headings and subheadings. To help with this, you can use the *Outline* function on the *View* tab in MS Word. If you have not used this before, ask your supervisor or another teacher at the department to show you. Templates using a structure with main headings for degree projects in environmental science at the bachelor's and master's levels are available under Education on the ACES website.

It is important to prepare the manuscript carefully before you submit it for comments. Use the spell-check feature in your word processor. It is good if the supervisor and student together plan how the supervisor should proofread the written thesis before it is submitted. It is increasingly common to use electronic documents and to write comments in the text with tracked changes (e.g. in Word). If you are not sure how the Track Changes feature works, ask your supervisor to show you. Your manuscript should be read by your supervisor several times before it is submitted to the examiner for grading.

Title

The title of your degree project may consist of a single main title or a short main title and a longer subtitle. Ideally, the title should arouse interest and reflect your work. It should be comprehensible and not contain any abbreviations.

Summary

The thesis should include a summary, which should be presented after the title in the beginning of the thesis. This section should provide a general summary of the entire thesis. Most of or even the entire summary should be written in the past tense, since it refers to work that has already been carried out.

Introduction

A good introduction should:

- place the research questions in a wider context;
- provide an overview of previous studies in the field;
- clearly present the nature and scope of the studied problem – why did you do this;
- explain what is new and unique about the study;
- specify how the problem will be solved;
- specify the aim and hypotheses.

Most of the introduction should be written in the present tense, since you are referring to your research questions and the current state of knowledge in the field.

Materials and methods

This section should clearly describe the experimental setup, or how the data were collected, in such a way that others can repeat the experiment. You can liken this section to recipes in a cookbook. The quality of the collected data should also be possible to assess. Most of this section should be written in the past tense, since it refers to work that has already been carried out.

Results

The results section typically contains two parts:

1. You should present the results of the various parts of the study in the form of explanatory text, tables, figures, or images, without repeating details that you have previously described in the materials and methods section.
2. You should present the data without “discussing” them, i.e. you should not draw any conclusions from the results.

This section is largely based on figures and tables for which you should write an explanatory text. When using tables, the text should be written above the table, and when using figures (or photos), the text should be placed directly below the figure. The text should explain what is shown in the table/figure, but not provide any comments or interpretations. It should not be necessary to read the results section in order to understand what the figure or table intends to show; this should be clear from the text in the figure or table. It is very important that you present representative data, i.e. not all data you obtained in the study, but a processed selection. Figures and tables should be clear to the reader. For example, use a sufficiently large font for the values displayed on the axes of the graph.

Discussion and conclusions

This section should provide answers to the hypotheses or predictions you defined in the introduction. The results should be placed in a wider context. What do the results mean? How do your data relate to other studies? Highlight your most important results. Are there any weaknesses in the study? Summarise if necessary. The conclusions drawn should be well informed and deducible from the results. In the discussion, the use of verbs may alternate between the past and the present tense. The rule is that results (established knowledge) from other studies that you cite should be written in the present tense, while your own results should be written in the past tense.

Acknowledgements

There are two main things that should be addressed in this section. First of all, you should thank everyone who helped you with your project in a significant way. This may involve help with field or laboratory work, but it might also include people you discussed your work with and who provided comments that increased the quality of the work.

Literature

Relevant literature should be cited properly in the text, and the references in the reference list should be listed correctly. There are two main rules in this section. Firstly, you should only include published references. References to unpublished data, articles in progress, or oral information should not be included in the literature list. If such references are absolutely necessary, add the information in brackets in the text or as a footnote. Secondly, verify that all references that you used in the text are included in the literature list. Double-check just in case, as mistakes are very common.

In the natural sciences, we typically use the so-called Harvard system with references in the text and a full bibliographic description in a reference list. The style of the reference list varies between different publications. Below are a few examples of how scientific articles, book chapters, and Internet references can be written.

Scientific article:

Johnsson, J. I., Petersson, E., Jönsson, E., Björnsson, B. Th., & Järvi, T. (1996) Domestication and growth hormone alter antipredator behaviour and growth patterns in juvenile brown trout, *Salmo trutta*. Canadian Journal of Fisheries and Aquatic Sciences 53, 1546-1554.

Book chapter:

Smith, R. J. F. (1997) Avoiding and deterring predators. In Behavioural ecology of teleost fishes. (Ed. Godin, J.-G. J.). pp. 163-190. Oxford University Press, New York.

Internet reference:

FAO Fisheries Department. (2002) The state of world fisheries and aquaculture 2002 (FAO, Rome); www.fao.org/sof/sofia/index_en.htm. 21st of February 2002.

Referencing literature

When you reference an article that you have read, write the name of the author/authors in brackets, e.g. for one author (Andersson, 1998), or two authors (Andersson and Pettersson, 2000). If there are more than two authors, write (Andersson et al., 2002). The same author might publish more than one article per year. In the text, these are separated by a, b, and c after the

year, e.g. (Andersson, 2003a,b). Sometimes, more than one article may point to the same conclusion. In such cases, write (Andersson, 1998; Bertilsson et al., 2001; Jansson and Bengtsson, 2003). Please note that they should be sorted by year of publication, i.e. the oldest first and the newest last. Complete information about each reference should be written in the reference list.

It is becoming increasingly common to refer to information found on the Internet. However, you should avoid this source of information unless you are referring to a report or reviewed article. Web pages should be referenced with name and year, similar to articles, and the full description (with URL) should be specified in the literature list. Please specify the date you obtained the reference from the Internet.

Table of contents

Scientific articles normally do not include a table of contents. However, if the article is very long and contains many paragraphs, a table of contents may be justified. For bachelor's and master's theses, a table of contents is recommended (see the template on the ACES website).

Abbreviations

The first time you use an abbreviation (after the summary), it should be written in brackets after the word in question, e.g. the Department Environmental Science and Analytical Chemistry (ACES). After that, only use the abbreviation. The summary is separate from the thesis in the sense that if abbreviations are used in the summary, they should be written in the same way as described above. If you use many abbreviations, it is recommended to write a list of all abbreviations included in the full text. The list of abbreviations should be placed at the beginning of the thesis.

Plagiarism

It is strictly prohibited to copy sentences or parts thereof from other documents without carefully stating the source. Copying another author's text without indicating the source is called PLAGIARISM, which is just a fancy word for theft. If you change some of the words in a copied text, and the basic idea of the text remains, this is still considered plagiarism. Direct quotations of a text must always be placed in quotation marks and accompanied by a reference. Quotations should be avoided in the body of text and only be used under special circumstances.

It is strictly prohibited to steal images from other documents without asking the creator/publisher (photographer, artist or company) for permission. The creator/publisher may require payment or prohibit you from using the image. Even if you have received permission to use the image, you must always specify the source of the image. Remember that photographers and artists are professionals who make their living creating images that they can sell. If the creator/publisher writes explicitly that the image may be used freely, you can use the image without indicating the source. The copyright of an image is generally limited to a period of 75 years, after which it becomes a so-called "free image". This applies unless the original creator sells the copyright to another person or company. Thus, you can never be completely sure that old images are free images.

The Internet is subject to exactly the same rules as other documents. You are not permitted to copy and distribute images without the creator/publisher's permission, unless it is explicitly stated that the images may be used freely. Just like other documents, copied text from the Internet should be cited as a quotation, i.e. by marking the text and indicating the source.

Preparations for the oral presentation

It is good to practise a few times before the final oral presentation of the degree project. Here, your supervisor is a great resource that you should make use of if given the opportunity. It can also be good to let someone outside the project hear the presentation, since it is easy to become “blind” to your own material and miss things that are obvious to others who are not familiar with the project.

The oral presentation can be organised in the same way as the written thesis. Start with the problem/question and finish with the solution. There are some differences, however:

1. The **time** for the presentation is limited and should be kept, which means that you have to pick out the most important or interesting parts. Rehearse your presentation and time yourself.
2. The presentation should have a clear **structure**, and the content should be accurate.
3. Provide a good and interesting **background** to the project. This will help the audience stay interested throughout the presentation.
4. You usually do not have to provide a full description of the methodology used in the study; pick out the most important parts (**materials & methods**)
5. You do not have to **cite** what others have done in the field in the same manner as the written version; focus on your results.
5. In an oral presentation, it is often difficult to separate the **results** from the **discussion**. When you show a figure or a table, you can both explain the result and discuss its significance.
6. **Figures** typically work better graphically than tables, but keep in mind that the images you use should be legible and adapted to the presentation.
7. The **summary** is often more important in an oral presentation than in a written one; you want the audience to take the message home.
8. Keep in mind that there is an **aesthetic** aspect of an oral presentation that is very important to the overall perspective.

The presentation should be adapted to the target audience in order to create interest in the research question. The presenter should have a good contact with the audience. The presenter should be able to answer questions and discuss the results.

Feel free to use PowerPoint or another program for the presentation. However, make sure not to fill the presentation with too much information on each slide. Such a presentation should not show everything; it should be an aid that will allow you to speak freely while having a few main points at hand. It will also help the audience identify the most important content of your presentation. In order to activate both sides of the audience’s brain, it is important to maintain a good balance between the flow of text and images in the presentation. This is the best way to make the audience understand everything. Where appropriate, you can include text and images on the same slides, but make sure that all the details of your images (e.g. the values on the axes of the graph) can be seen by the people sitting in the back of the room. Furthermore, make sure not to overload the presentation with too many things that flash, pop up, make a sound, etc.

Everyone gets nervous. Even if you think you know the work, write a script!

Formalities relating to the oral presentation

The thesis should be sent to the examiner and the course coordinator for degree projects at ACES one week before the seminar. The recommended duration of the seminar is 15-20 minutes (bachelor's) or 20-25 minutes (master's) for the presentation and 20 minutes for the discussion. The course coordinator will act as chair during the seminar, which entails presenting the student and the work and leading the discussion that follows the presentation. The student will be able to give the presentation without being interrupted by questions. Questions will be asked after the presentation.