Recommendations for the writing of theses and evaluation criteria

in the study courses of biology
at the Heinrich Heine University Düsseldorf

- Handout for students and lecturers -

The purpose of this outline is to provide teachers and students criteria for writing and evaluating theses that transparently reflect the requirements and thus contribute to a fair and uniform evaluation of experimental theses.

These are recommendations for experimental theses, which are the norm in most biology courses at HHU.
It is strongly recommended that students discuss the preparation of the thesis and the evaluation criteria together with their supervisors and first and second reviewers in thesis meetings.

Students are strongly encouraged to talk with their faculty mentors and supervisors to discuss these recommendations. It is the responsibility of both parties to communicate extensively about thesis writing and evaluation, especially if there may be significant deviations from these recommendations, such as theoretical literature review tasks.

Aim of the thesis

Students demonstrate with their (scientific) thesis the extent to which they have mastered the skills and specialist knowledge acquired in the course of their studies and are able to apply them to a scientific problem.

Students demonstrate

- to what extent they can work on a scientific topic from the biological field in an original way and independently with adequate methods.
- to what extent they can describe, explain and document their scientific approach in a way that is comprehensible to outsiders.
- to what extent they can justify their scientific approach, understand the results and place them in a scientific context.

Rules of good scientific practice

The rules of good scientific practice apply to the preparation of theses. HONEST and CRITICAL experimental and theoretical work as well as CORRECT citation are a basic requirement for any scientific work.

All parties involved can and should consult the HHU website for comprehensive information on the rules of good scientific practice.

Excerpt from the HHU information page on good scientific practice. (https://www.uni-duesseldorf.de/home/studium-und-lehre-an-der-hhu/studium/ordnung-ueber-die-grundsaetze-zur-sicherung-guter-wissenschaftlicher-praxis.html):

"Scientific work is based on fundamental principles that are the same in all scientific disciplines. First and foremost is honesty towards oneself and others. The basic prerequisite for scientific work is the honesty of all scientists. The university as a place of research, teaching and promotion of young scientists has an institutional responsibility in this respect.

Based on these considerations, the Heinrich Heine University pursues the assurance of scientific quality standards, especially honesty and accuracy in research, as a central task of its members and staff.

Therefore, Heinrich Heine University Düsseldorf has adopted the "Ordnung über die Grundsätze zur Sicherung guter wissenschaftlicher Praxis.""

A current version of the Order on the Principles of Good Scientific Practice at HHU is available as a pdf file on the above-mentioned page.

If a conflict regarding good scientific practice arises during the exercise of the thesis, the Biology examination board can be contacted.

A) Writing of theses

1. outline

The thesis must be organized in the manner described, with the individual sections covering the relevant content.
This format has stood the test of time in academia and serves the purpose of ensuring that the thesis is comprehensible and thus assessable.

In many ways, the guidelines of scientific journals for manuscript preparation are similar or even identical to our recommendations and guidelines.
It therefore makes sense to specifically check publications of original papers for the outline, content, quality of figures and tables, writing style, and other formal aspects, and to use these as a guide when writing your own thesis.

* Abstract (1 page)
- CONTAINS PRECISELY FORMULATED background, open questions, specific objectives and work plan, as well as results and conclusions.

* Introduction:
- CURRENT state of knowledge provided with current literature citations.
- Especially in the Master's thesis: elaboration of a current working model/hypothesis by integrating and evaluating the results of original work.
- Open questions leading to the aims

- Preliminary work not published that is relevant to understanding the objectives and work program

* Objectives/aims (1 page):
- CONCRETE objectives of the work
- Overview work plan and flowchart

* Materials and Methods.
- Includes specific materials, equipment, and other supplies (lists are sufficient) and method descriptions (in all cases as flowchart text) essential to REPRODUCIBILITY of results.
- Complete workflows consisting of several individual methods connected in series including analysis and evaluation steps (e.g. preparation of recombinant plasmids, cultivation and physiological procedures, extraction and quantitative analysis, etc.) should preferably be described in thematic blocks.
- Consultation with supervisors is advisable.

IMPORTANT:
Make sure that the results shown can be reproduced, for example, it is important to describe the processing of raw data to the preparation of final figures and tables

* Results:
- Listed in paragraphs according to objectives and experiments.
- Include figures and tables numbered consecutively in the text in a meaningful way

IMPORTANT:
- It is useful to explain both the AIM and PURPOSE as well as the EXPECTATION of a single experiment in 1-2 sentences each at the beginning of each paragraph and to give a brief evaluation of the result with conclusion related to it at the end of each paragraph (without detailed discussion).
- The results must be written as continuous text, with reference to the figures/tables. It is not sufficient to simply refer to a figure/table without describing the result with sentences itself,
e.g., "The result of GFP transcription factor (TF) protein localization can be taken from Fig. 15." is not acceptable. Instead, describe, e.g., "GFP fluorescence was exclusively visible in the nucleus, from which localization of GFP-TF in the nucleus can be inferred (Fig. 15)."
- For the preparation of figures and tables, be sure to follow the instructions in paragraph "4. Formal Aspects."

* Discussion:
- Divided into meaningful sections according to conclusions, discuss the APPROACH/TECHNICAL ASPECTS and INTEGRATION to open questions and objective.
- If necessary, with COMPARATIVE EVALUATION, for example, of methods and materials used.
- overall conclusion
- Perspectives

IMPORTANT:
- Discussion includes further consideration of results and conclusions by comparing different types of results or applications of methods or comparing with literature, e.g., experiments were conducted whose results lead to the same or opposite conclusion. Or the result from one experiment raised an open question that could or could not be answered with the result from another experiment. Or the results are compared with assumptions from literature data and the experimental approach is evaluated, etc.
- The discussion is by no means a repeated reproduction of all results with additional explanations.

* Literature list:
- Listed according to a uniform system, e.g., alphabetically according to names of first authors.
- With indication of all (or up to eight, then et al.) authors, full title, year, journal name, volume/page number or DOI (= Digital Object Identifier).

2. extent

Bachelor thesis: usually 20-40 pages
Master thesis: usually max. 80 pages

3. formal aspects

* Language: German or English

* Font /Format
- Well readable font and format, e.g. Cambria, 12 pt.
- 1.5 line spacing
- Margins min. 2.5 cm

* Units:
- According to conventions of the SI system of units.

* Species names:
- Binary nomenclature, Latin species names in italics, once complete, later with abbreviated genus name, e.g., *Escherichia coli*, hereafter *E. coli*.

* List of abbreviations:
- Only abbreviations frequently used in the field of work for terms, technical terms or substances (e.g. PCD, programmed cell death, programmed cell death; SA, salicylic acid, salicylic acid; PCR, polymerase chain reaction, polymerase chain reaction).
- No abbreviations of species names (e.g., *E. coli*), SI units (e.g., µl), or gene and protein names (abbreviation will be introduced in the text) in this list.

* Figures and tables:
- Figure with subtext (number, title, and legend).
- Table with number and title in top line and explanation in subline, if applicable.

IMPORTANT:
- Complete and legible labeling with e.g. axis labeling including units of numerical values, sample names, arrows or others.
- Self-explanatory legend, e.g. with details of experiment, sample application, abbreviation, statistical analysis method, etc.
- Raw data are an important part of the work and have to be archived, i.e. raw data have to be presented to the supervisors, usually digitally and in the original. However, due to the wealth of information and specific presentation, it is unacceptable to use unprocessed raw data in the thesis for documentation purposes.
- Raw data must therefore be processed and compiled into appropriate understandable diagrams, photocollages, tables, or the like, e.g., through calculations, statistical analysis, image processing. The procedure for processing raw data is to be described in the "material and methods section".

B) Evaluation criteria of final theses

In the foreground of final theses are scientific experimental works (usually by integration of the students into a working group), scientific understanding, documentation and argumentation.
In the case of a master thesis, a greater degree of the student's own scientific work and in-depth integration of the material is expected for a generally more complex topic than in the case of a bachelor thesis.
In contrast to a doctoral thesis, the real scientific new knowledge value from the work and the associated own clearly visible scientific profile are rather secondary for the evaluation of the work.
The weighting in awarding marks for the individual items of the assessment is at the discretion of the examiners and should be discussed with the students.

Criteria for Grading:

The level of difficulty of the topic and experiments (e.g. variety and complexity of experiments, establishment of new methods, size and number of samples, results situation) are of great importance for the evaluation of both the written work and the practical work and are included in the assignment of grades.

1. written work:

(a) Scientific understanding and experimental presentation, argumentation and documentation of results.

- Knowledge of the scientific background and current state of research including relevant preliminary work.
- Presentation and explanation of the specific objective of the work and overview of the experimental work plan.
- Experimental descriptions including explanation of choice of methods, description of results and explanation of conclusions.
- Elaboration of results and presentation of results in appropriate form in figures and tables.
- Evaluation, discussion and classification of results in a scientific context.

b) Formal design of the written work

- Structure and layout of the work
- use of technical terms
- linguistic quality
- quality of figures and tables

2. underlying practical work

- Independence in planning and carrying out experiments after familiarization.
- Self-initiative and own problem-solving behavior in research and procedure.
- Carefulness and accuracy in recording experimental data.
- Optimization of work processes, quantity of results.
- Implementation of criticism, integration into the work group and ability to work in a team.

Appendix: Example for the determination of the overall grade for the final thesis	
Grade	Grade Examination of the final paper reveals that the evaluation criteria have been met at least .....%:
1,0	95,5
1,3	90,9
1,7	84,8
2,0	80,3
2,3	75,8
2,7	69,7
3,0	65,2
3,3	60,6
3,7	54,4
4,0	50
nicht bestanden	< 50 %