YBI-85812

BSc thesis Biology

Academic Year 2014-2015

Contact person

Marianne van de Peppel
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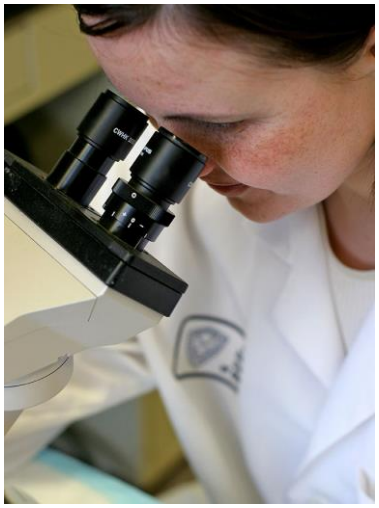
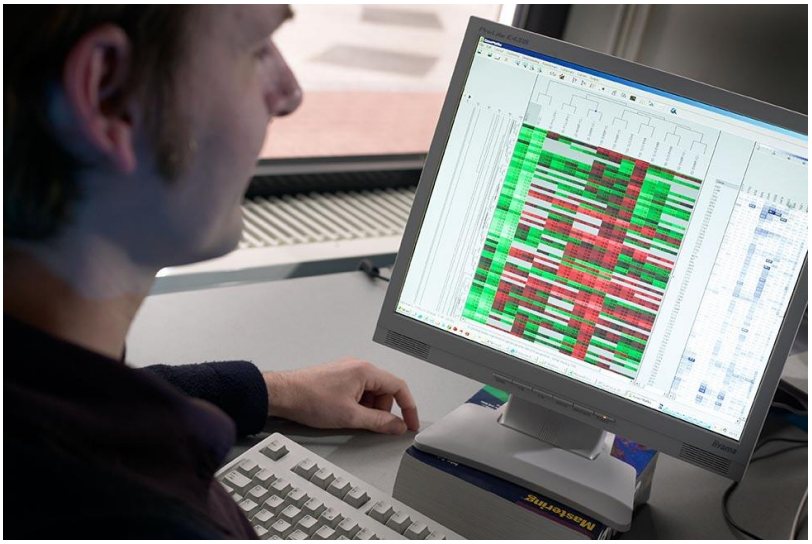
Registration

To enrol in this course, register with the Biology-office (marianne.vandepeppel@wur.nl). Registration via SSC is NOT sufficient.





BSc thesis (YBI-85812)

Language	Dutch / English
Credits	12
Period	All
Contact person	Marianne van de Peppel; office.biologie@wur.nl; 0317-484937
Lecturer(s)	ir. MV Coppens, ir. AJ Hoetmer, ing. A Teunissen MSc, dr. PW de Jong
Examiner(s)	ir. MV Coppens, ir. AJ Hoetmer, ing. A Teunissen MSc, dr. PW de Jong
Secretariat	Marianne van de Peppel; office.biologie@wur.nl; 0317-484937

Table of contents

1 General information on the BSc thesis

During this course you will finish BSc Biology. You have to use all knowledge and skills which you learned during the common part of the biology program and your major.

1.1 Learning outcomes

After successful completion of this course students are expected to be able to:

- Use advanced knowledge and understanding of the fundamental concepts and mechanisms in biology to answer a biological research question.
- Analyse concepts, approaches and methods and reflect upon scientific biological literature.
- Write a research plan (including theoretical background and problem definition, design of research plan, back-up strategies, project planning) in the field of his/her major within the BSc Biology.
- Carry out the research plan within the available time.
- Do experiments, collect data/literature and/or simulate data in the field of his/her major within the BSc Biology (under supervision).
- Gather and interpret relevant data in the field of his/her major in the BSc Biology using common research techniques.
- Report the results of the experiments in the form of an article.
- Orally present the results of experiments.

2 Before starting

Before you can start with your BSc thesis you should make sure you have met the admission requirements, found a BSc thesis subject, filled in the BSc thesis contract with your thesis supervisor and handed in the contract at the biology office.

2.1 Mandatory knowledge

This course is subject to a formal intake procedure by the coordinator of the BSc thesis. It is mandatory to have finished the following courses:
Major A:
Gene technology (MOB-20306) & Genetic Analysis, Tools and Concepts (GEN-30306)

Major B:
Concepts and Approaches in Developmental Biology (EZO-22306) & Plant Plasticity and Adaptation (PPH-30806)

Major C:
Cell Biology and Health (CBI-20306) & Behavioural Endocrinology (HAP-21806)

Major D:
Molecular and Evolutionary Ecology (GEN-20306) & Webs of Terrestrial Diversity (BIS-21306)
Or
Molecular and Evolutionary Ecology (GEN-20306) & Fieldcourse European Flora and Fauna (BIS20803) & Foodweb ecology and biodiversity (YBI30303)

Before starting with this course you should fill in and hand in the BSc thesis contract at the biology office

2.2 Finding a BSc thesis subject

You have to investigate a biological question making use of knowledge and skills which you acquired during the common part and your major of the BSc biology.

You can find a BSc thesis subject on the website tip.wur.nl or by getting in touch with the contact person of the chair group where you would like to do your BSc thesis.
On tip.wur.nl you will find BSc thesis subjects. If you found a subject that fits you, you can make an appointment with the contact person of this thesis subject to discuss with your potential supervisor the details of the subject.

If you would like to do a subject which is not on tip.wur.nl please contact the contact person education of the chair group where you would like to do your BSc thesis. You can find the contact person education of a chair group on www.studyhandbook.wu.nl.

Contract

If you decide to do a particular BSc thesis subject please fill in the BSc thesis contract together with your supervisor. You can find the BSc thesis contract on www.studenteninformatiebiologie.wur.nl. Note that every period has his own contract with deadlines specified for that particular period.
Hand in the contract at the biology office.
After approval by the BSc thesis coördinator you will get back the original contract, the biology office will keep a copy of the contract

BSc thesis supervisor

The daily supervision of your BSc thesis project can be done by a PhD student, Postdoc etc., but the final responsibility for the supervision at the chair group should be with a permanent staff member such as an associate professor, assistant professor or a professor.

3 Outline of the course

The BSc thesis Biology is set up as a regular course. On the first Monday of the period there will be an introduction lecture by the coordinator of the BSc thesis. On the last Friday of the period you will finish the course by presenting your results to your fellow students.

3.1 Activities

- Attending the introduction lecture (you can find the date and place on the BSc thesis contract, on blackboard or on www.rooster.wu.nl).
- You start your BSc thesis by writing your research plan (chapter 5 gives you a guideline for writing your research plan). This research plan has to be approved by your supervisor.
- On the Friday of the second week of the period you present your research plan to your fellow students.
- You conduct the actual research and will analyse the data.
- If you are performing experimental research you can find guidelines for keeping a lab journal in appendix 3.
- The report about your research has to be written in the form of a scientific article (chapter 6 gives a guideline for writing your article).
- Finally, you have to present the results of your work to your fellow students. Your supervisor is welcome at this final presentation.
- After you completed all aspects of your BSc thesis you should have a final meeting with your BSc thesis supervisor. In this meeting your supervisor will give you feedback on your performance during your BSc thesis.

You can find a schedule of the course on Myportal.

3.2 Handing in products

A printed- and a PDF version of the final research plan and the final article should be handed in to your supervisor of the chair group and the biology office (MO.091 of Radix; marianne.vandepeppel@wur.nl). Deadlines for handing in your research plan and final article you will find on the BSc thesis contract. The draft versions should only be handed in to your supervisor of the chair group.

For the deadlines and schedule of the BSc thesis in a specific period see the BSc thesis contract.

If you experience any problems during your research project please contact your supervisor or the coordinator of the BSc thesis course.

3.3 Literature

Knisely, K., 2013. A student handbook for writing in biology. Fourth Edition. Sinauer Associates. ISBN: 978-1-1641-5076-0. Available at the Wur-shop.

4 Assessment

You will be assessed on different evaluation criteria. In appendix 1 you can find the evaluation form for the BSc thesis. In appendix 2 you can find the evaluation criteria.

4.1 Evaluation criteria

Research competencies
Your research competencies will be evaluated on the following aspects: initiative, pro-activity and creativity, time management (planning), critical and self-reflective capacity, handling supervisors comments and analysis and processing (literature) data.

Laboratory skills
The execution of the research will be evaluated based on the research competences (30%) and laboratory skills (10%) if you did experimental research. If you did another type of research the execution of the research will be evaluated based in the research competences (40%).

Report
The article will be evaluated based on the criteria mentioned under report. Your research plan will not be assessed separately, but will be assessed within the assessment of the article.

Presentation
The presentation of your research plan will not be assessed with a mark, but you will get feedback from fellow students and the teacher. The final presentation of the results will be evaluated based on the criteria mentioned under presentation.

4.2 Final Mark

Your supervisor at the chair group fills in an evaluation form and sends this to the biology team. When you have two supervisors than they should fill in the evaluation form together. The biology team evaluates every thesis independently. If their mark differs not more than 0.5 from the mark of the supervisor, the supervisors evaluation will be copied. Does the mark of the Biology team differ more than 0.5 from the mark of the supervisor they will contact the supervisor and discuss the mark.
In this way it is made sure that the marks that are given for the BSc thesis Biology are comparable.
Research competence and laboratory skills are only assessed by the supervisor of the chair group, as these aspects can't be assessed by the biology team (see table 1).
The final mark for the BSc thesis is given by the biology team under responsibility of the examiner: Arno Hoetmer.

Table 1, Table 1, Who will assess which BSc thesis evaluation criteria.

Evaluation criteria	Supervisor chair group	Biology team
Research competence	X	
Laboratory skills	X	
Report	X	X
Presentation		X

4.3 Learning outcomes

Table 2 shows under which evaluation criteria the different learning outcomes are assessed.

Table 2, Overview of the learning outcomes and under which evaluation criteria they are assessed.

		Evaluation criteria			
		Research competence	Laboratory skills	Report	Presentation
Learning outcomes					
1	Use advanced knowledge and understanding of the fundamental concepts and mechanisms in biology to answer a biological research question.	X		X	X
2	Analyse concepts, approaches and methods and reflect upon scientific biological literature.	X		X	
3	Write a research plan (including theoretical background and problem definition, design of research plan, back-up strategies, project planning) in the field of his/her major within the BSc Biology.	X		X	
4	Carry out the research plan within the available time.	X			
5	Do experiments, collect data/literature and/or simulate data in the field of his/her major within the BSc Biology (under supervision).	X	X		
6	Gather and interpret relevant data in the field of his/her major in the BSc Biology using common research techniques.	X	X	X	
7	Report the results of the experiments in the form of an article.			X	
8	Orally present the results of experiments.				X

5 Research plan

5.1 Writing process

The type of project you will conduct (experimental, data analysis or literature research) will determine the process of writing your research plan:

Experimental project

Your supervisor usually will provide some literature that is relevant to the subject chosen. You should develop a thorough understanding of the scientific background of the research question by studying the relevant literature. It will generally be necessary to search for additional literature.

After this orientation period you can start collecting protocols for experimental methods and techniques that you are going to use to investigate your biological research question. Make a list of materials you need. Think about the type of data you are going to obtain and how you can analyse these data. Finally, make a detailed planning of your research project.

A well-documented introduction to the scientific background and formulation of the problem will represent the basic elements of the introductory chapter of the article. Also the major outline of the chapter on Materials and Methods can be written. Important for the research plan, of course, is the detailed timing of the various planned research activities, the processing of data and the final writing of the thesis report.

The complete research plan needs to be discussed thoroughly with the supervisor and, finally, presented to your fellow students. It is possible that the presentation will give rise to useful suggestions that still can be incorporated in the plan.

Data analysis project

Your supervisor will usually provide some literature that is relevant to the subject chosen. You should develop a thorough understanding of the scientific background of the research question by studying the relevant literature. It will generally be necessary to search for additional literature.

After this orientation period you can start looking at the data you are going to analyse and think about the methods you are going to use to analyse these data. Finally, make a detailed planning of your research project.

A well-documented introduction to the scientific background and formulation of the problem in fact already represent the basic elements of the introductory chapter of the article. Also the major outline of the chapter on Materials and Methods can be written. Important for the research plan, of course, is the detailed timing of the various planned research activities and the final writing of the thesis report.

The complete research plan needs to be discussed thoroughly with the supervisor and, finally, presented to your fellow students. It is possible that the presentation will give rise to useful suggestions that still can be incorporated in the plan.

Literature research project

Your supervisor usually will usually provide some literature that is relevant to the subject chosen. Purpose of a literature research project is that you analyse existing literature and come to a synthesis in which you show your own opinion on the subject and come to a hypothesis or model and a proposal for experiments or field research to test this hypothesis or model.

For your research plan you should develop a thorough understanding of the scientific background of the research area by studying the relevant literature. Define the research question. Look for additional literature that is useful to study your research question. Evaluate the amount of literature that might be useful to answer your research question. If necessary broaden or narrow down your research question. Make a detailed outline of the scientific article you are going to write including the subheadings of the subsections within the results section of the scientific article and preferably also the subjects of the paragraphs of the article.

The complete research plan needs to be discussed thoroughly with the supervisor and, finally, presented to your fellow students. It is possible that the presentation will give rise to useful suggestions that still can be incorporated in the plan.

5.2 Schematic outline

A) Title page
- Title research project
- Name student (including registration number), name supervisor, name chair group
- Date
- Major
- (Optional: illustration relevant to the subject)

B) Summary of problem and objectives and aim of the research project.

C) Introduction; elaboration and information on plan
- Introduction to subject
- Detailed elaboration of problem and aims including research question(s)
- Scientific relevance
- Societal relevance

D) Approach, analysis, presentation results
- Specification of materials or data or literature to be studied
- Description of (statistical, mathematical, experimental etc.) methods, techniques, apparatus(es) to be used *(not always for literature research project)*
- Estimation of amount of data that can be collected in time available *(only for experimental approach)*
- Description of how results will be presented. *For a literature research project this is including the subheadings of the subsections within the results section of the scientific article.*

E) Project planning
- Phasing of various stages of the research project
- Planning of activities (give graphic presentation)

F) Back-up strategies

- Identification of possible problems with proposed research plan
- What to do in case of failing experiments or lack of usable data?

G) Literature references

6 Article

The final result of your BSc thesis will be a scientific article. Guidelines on how to write such article you will find in the book "A student handbook for writing in biology" (for more details about the book see paragraph 3.3). *The article must be written in English.*

6.1 PLos Biology

In which style and detail you write your article depends on the audience you write for. Scientific papers are written for scientists, but not only for scientists of your own field. We will use PLoS (Public Library of Science) Biology as the journal you will write for.

PLoS (Public Library of Science) Biology is an open–access journal[1]. The journal features studies with relevance to all areas of biological science, from molecules to ecosystems, including work at the interface with other disciplines, such as chemistry, medicine, and mathematics. The audience includes the international scientific community as well as educators, policy makers, patient advocacy groups, and interested members of the public around the world.

You can use the PLoS Biology audience as your audience. You can use the PLoS Biology articles online as examples on how to write your own article.

6.2 Guidelines for writing your article

Guidelines on what should be in the article and how to write the article you can find in the book "*A student handbook for writing in biology*" (Knisely, 2013). In the next paragraphs you will find a short overview (for this overview we used the author guidelines of PLoS Biology and the guidelines from Knisely (2013).

Schematic outline

Your article should have the following sections:

- title;
- authors;
- abstract;
- introduction;
- materials and methods;
- results;
- discussion;
- acknowledgments;
- references;
- figure legends.

[1] Open access means that every paper is freely available for everyone to read, download, copy, distribute and use.

Page numbers are required for all sections. The overall manuscript has on average a length of 6.000 words. We urge authors, however, to present and discuss their findings concisely.

Title (150 characters, including spaces)

The title is a short, informative description of the essence of the paper. The title should be specific to the project, yet concise. It should be comprehensible to readers outside your field. Avoid specialist abbreviations.

Authors and Affiliations

Provide your first name and surname.

Abstract (approximately 300 words)

The abstract succinctly summarizes the paper. It should mention the techniques used without going into methodological detail and mention the most important results. The abstract is conceptually divided into the following three sections: Background, Methodology/Principal Findings, and Conclusions/Significance, although these headers should not appear in the published article. Please do not include any citations in the abstract. Avoid specialist abbreviations.

Introduction

The introduction should put the focus of the manuscript into a broader context. As you compose the introduction, think of readers who are not experts in this field. Include a brief review of the key literature. If there are relevant controversies or disagreements in the field, they should be mentioned so that a non-expert reader can delve into these issues further. The introduction should conclude with a brief statement of the overall aim of the experiments and a comment about whether that aim was achieved.

Materials and Methods

This section should provide enough detail for reproduction of the findings. Protocols for new methods should be included, but well-established protocols may simply be referred to. We encourage authors to put detailed protocols for newer or less well-established methods in an appendix.

> Students that did a literature research project should incorporate which search engines they used, which search terms they used in which combinations and/or with which wildcards. Furthermore, they should indicate how they selected articles from the thousands of hits they found with this search engines. In addition, they should explain how they defined the theme, content or scale of the literature research.

Results

The results section should provide details of all of the results that are required to support the conclusions of the paper. There is no specific word limit for this section, but details of experiments that are peripheral to the main thrust of the article and that detract from the focus of the article should not be included. The section may be divided into subsections, each with a concise subheading. Large datasets, including raw data, should be submitted as appendices. The results section should be written in the past tense.

To visualise and summarise your results use figures and tables. Describe each visual in turn and refer to in parentheses/brackets.

Figures

The aim of the figure legend should be to describe the key messages of the figure, but the figure should also be discussed in the text. It should be possible for a reader to understand the figure without switching back and forth between the figure and the relevant parts of the text. Each legend should have a concise title of no more than 15 words. Put the title and legend below the figure.The legend itself should be succinct, while still explaining all symbols and abbreviations. Avoid lengthy descriptions of methods.

Tables

All tables should have a concise title, placed above the table. The legend and footnotes should be placed above the table. Footnotes can be used to explain abbreviations. Citations should be indicated using the same style as outlined above. Tables occupying more than one printed page should be avoided, if possible.

Discussion

The discussion should spell out the major conclusions and interpretations of the work including some explanation on the significance of these conclusions. How do the conclusions affect the existing assumptions and models in the field? How can future research build on these observations? What are the key experiments that must be done? The discussion should be concise and tightly argued. If warranted, the results and discussion may be combined into one section.

Return in your discussion to the initial ideas and aims of your research. Use literature to put your research into the context of existing research.

Acknowledgements

People who contributed to the work, but do not fit the criteria for authors should be listed in the Acknowledgements, along with their contributions. The Acknowledgements section is reserved for statements of gratitude or thanks.

References

Only published or accepted manuscripts should be included in the reference list. Meetings, abstracts, conference talks, or papers that have been submitted but not yet accepted should not be cited. Limited citation of unpublished work should be included in the body of the text only. All personal communications should be supported by a letter from the relevant authors. Preferably use peer reviewed scientific papers. Keep the amount of references to books or book chapters to a minimum.

For documenting your sources you can use the Citation–Sequence system or the Name–Year system (see Knisely, 2013 page 81 and further for more information).

Abbreviations

Please keep abbreviations to a minimum. List all non-standard abbreviations in alphabetical order, along with their expanded form. Define them as well upon first use in the text. Non-standard abbreviations should not be used unless they appear at least three times in the text.

Priority Claims

Manuscripts should not include priority claims. For example, "the first demonstration of this" should be changed to "the first demonstration, to our knowledge, of this."

Nomenclature

The use of standardized nomenclature in all fields of science and medicine is an essential step toward the integration and linking of scientific information reported in published literature. We will enforce the use of correct and established nomenclature wherever possible:

We strongly encourage the use of SI units. If you do not use these exclusively, please provide the SI value in parentheses after each value.

Species names should be italicized (e.g., Homo sapiens) and the genus- and species names must be written out in full, both in the title of the manuscript and at the first mention of an organism in a paper; after that, the first letter of the genus name, followed by the full species name may be used.

Genes, mutations, genotypes, and alleles should be indicated in italics. Use the recommended name by consulting the appropriate genetic nomenclature database, e.g., HUGO for human genes, TIAR for Arabidopsis genes, MGI for mouse genes. It is sometimes advisable to indicate the synonyms for the gene the first time it appears in the text. Gene prefixes such as those used for oncogenes or cellular localization should be shown in roman: v-fes, c-MYC, etc.

The Recommended International Non-Proprietary Name (rINN) of drugs should be provided.

7 Oral presentation

You have to give an oral presentation about the research plan and the results of your research projects. The presentations of the research plan should take 10 minutes. The presentation of the results should take 15 minutes. The presentation of your research plan will not be assessed with a grade, but you will get feedback of the teacher and your fellow students. The presentation about the results of your research project will be evaluated with a grade. In addition, you will get feedback of your fellow students and the teacher.

Content

The introduction of your presentation should raise the interest of the audience and give a clear idea of the objectives of the whole presentation. Make sure that there is a good balance between main and minor issues. Minor issues can clarify and support the main issue, but should not distract from the main objective of the presentation. It is important that the main issue is put in a broader perspective, but sufficient attention should be given to in–dept discussion of relevant matters. Especially for the presentation of the results it is important to keep in mind that it is not necessary to discuss all the obtained results; discuss only the results that are interesting for your audience.

Form

The presentation should be aimed at an audience of fellow BSc students with a general background in Biology. It is essential that your presentation has a clear and consistent structure which helps in following the matters presented.
Media should be used in a correct and supportive manner. Do not put too much text on your slides and make use of pictures. A picture can say more than a 1000 words, and can keep people motivated to listen. Illustrations and slides should be well readable, relevant and informative and help to clarify the issue.

Verbal communication

During the presentation speech should be calm but fluent. Frequent interruptions (searching for words, use of 'eh' or 'er') should be avoided. Sentences should be completed properly. Language should be used in a grammatically correct way.
Uncommon or specialist scientific terms should be explained adequately. Use of scientific terms should be well dosed.

It is allowed to do your oral presentations in Dutch, if there are no international students in the audience. Make sure that your PowerPoint slides are in the same language as your oral presentation.

Non verbal communication

During speaking the face should be primarily directed towards the audience and there should be regular eye contact with various groups in the audience.
The presentation should be given in a lively and enthusiastic way. This can be achieved by using gestures and speech in an adequate way. Posture and gestures should be supportive to the presentation. Speech should be sufficiently loud and well articulated.

Intonation should be varied in a well dosed way. Speech should have a correct tempo with sufficient variation and pauses.

Timing and planning

You should make optimal use of the time available. Sufficient time should be given to various parts. The presentation should finish in time.

Adequate dealing with questions

It should be made clear to the audience when opportunity for questions is given. Especially in a large audience it is good to repeat or rephrase the question. In this way you make sure that everybody has heard the question and in case you rephrase the question you are making sure that you understand the question correctly. Of course, answers to questions should be to the point and formulated in a clear way.

References

Knisely, K., 2013. A student handbook for writing in biology. Fourth Edition. Gordonsville: W.H. Freeman. 318p.

PLOS Biology [internet]. C2013. Cambridge (UK), San Fransisco (US): PLOS; [cited 2013 Aug 31]. Available from: http://www.plosbiology.org/static/guidelines

Appendix 1: Evaluation form

Assessment BSc thesis Wageningen University			
v1.2 Jan Philipsen, Maria Smetser, Marjolijn Coppens, Pim Brascamp			
Complete the single lined fields (use decimal point or comma, depending on the language setting)			
Name chairgroup (three letter code)			
Name student			
Registration number			
BSc programme			
Major/ Specialisation			
Course code BSc thesis			
Short title BSc thesis			
Date BSc thesis contract			
Date examination		Signature	
Supervisor chair group			
BSc thesis examinor			
Evaluation criteria		Grading Mark 1-10	Relative weight *
A1 Research competencies (30-40%)*			30%
1 Initiative, pro-activity and creativity			
2 Commitment and perseverance			
3 Time management			
4 Critical and self reflective capacity			0.0
5 Handeling supervisors comments			
6 Analysis and processing (literature) data			
A2 Laboratory skills (0-10%)*			10%
1 Technical skills			
2 Accuracy			0.0
3 Lab journal, logbook			
B Report (50%)			50%
1 Problem definition & research set-up			
2 Theoretical underpinning and use of literature			
3 Description methods and analysis (literature) data			0.0
4 Clarity of argumentation and conclusions			
5 Critical discussion			
6 Writing skills incl. correct quoting			
Percentage overlap in Plagiarism Checker (without reference list)			
C Presentation (10%)			10%
1 Graphical presentation			0.0
2 Verbal and non-verbal presentation			
* Choose rel. weights to a total of 100%			
	TOTAL GRADE		**0.0**
Comments			

Appendix 2: BSc thesis assessment rubric

Manual for use of BSc thesis assessment rubric to be used in conjunction with the BSc thesis evaluation form in appendix 1
Author of the rubric: Marjolijn Coppens, with valuable contributions from Arnold F. Moene, Judith Gulikers, Anja Kuipers, Sonja Isken and Lotte Woittiez, 16-11-2010.

User instructions

In the BSc-thesis assessment form, a number of criteria for the assessment of the BSc-thesis are mentioned. The rubric can be used as a tool to determine the appropriate mark for each criterion. In the rubric, which has the form of a table, each line discusses one criterion for assessment, each column gives a level for the grading, and each cell contains the descriptor of the level for that criterion. The criteria in the rubric follow the order of the criteria in the assessment form for the BSc thesis of BPW, BBI, BBT and BML. For more information on the analytic rubric, see e.g. Andrade (2005), Reynolds et al. (2009), URL1, URL2.

The main intention of using a rubric is to enhance the homogeneity of assessments and the ability to communicate about assessments both with students and with colleagues. Furthermore, it clarifies to students the expectations of the supervisor and helps the supervisor to structure feedback during the process of thesis research. However, it should be noted that even with the use of a rubric some arbitrariness will remain.

In a few cases the criteria were split into two or more parts because the description of the criteria clearly covered different subjects. The mark for the criterion should in such a case consist of the average mark for the different subjects or if one criteria is far more important for that particular thesis, that criteria should be should be weighted more.

When determining the mark of a certain criterion, always start at the lowest level and test if the student should be awarded the next higher mark. Note that in some cases achievements of a lower level are not repeated at the higher level because the lower level achievements are implicit in the higher levels. If a level has a range of marks, choose the most appropriate one (consider the description of the level of performance as a continuum, rather than a discrete description). Since the final marks of a thesis usually range between 6 and 9, individual levels have been established for the marks of 6, 7 and 8. When performance is at the 9-10 level, it is necessary to decide whether the student is on the low edge (9) or high edge (10) of this level. Descriptions at the 9-10 level tend to describe the ultimate performance (10). Hence, if a student performs well above 8, but below the description at the 9-10 level, a 9 would be the appropriate mark. Keep in mind that each line in the rubric should be read independently: it could be that a student scores a 1-3 on one criterion and a 9-10 on another.
The final mark of the thesis is determined using the BSc-thesis assessment form. The main categories (groups of criteria: research competence, research plan, execution research, report, presentation, examination) should have an assessment of 'sufficient'

(>5.5) before the total thesis work can be considered as sufficient. So, no compensation between main categories is possible to obtain a final mark of 5.5.
Keep in mind that the difference between a BSc and MSc thesis is that a BSc thesis is more intensely supervised than an MSc thesis and/or a BSc thesis project is shorter and less complex project than an MSc thesis project.

Please report any positive or negative experiences and suggestions to marjolijn.coppens@wur.nl.

References

Andrade, H.G, 2005. Teaching With Rubrics: The Good, the Bad, and the Ugly. College Teaching 53, p. 27–31.
Reynolds, J., R. Smith, C. Moskovitz and A. Sayle, 2009. BioTAP: A Systematic Approach to Teaching Scientific Writing and Evaluating Undergraduate Theses. Bioscience 59, p. 896–903.
URL1: http://jonathan.mueller.faculty.noctrl.edu/toolbox/rubrics.htm Jon Mueller (2010) North Central College, Naperville, IL.
URL2: http://en.wikipedia.org/wiki/Rubric_(academic) Wikipedia, 7–11–2010.

A1) Research competence (30–40%)					
1. Initiative, pro-activity and creativity					
1–3	4–5	6	7	8	9–10
Student shows no initiative or ideas at all.	Student picks up some initiatives and/or ideas suggested by others (e.g. supervisor), but the selection is not motivated.	Student shows some initiative and/or together with the supervisor develops one or two ideas on minor parts of the research.	Student initiates discussions on ideas with supervisor and develops one or two own ideas on minor parts of the research.	Student has his own creative ideas on hypothesis formulation, design or data processing.	Student develops innovative hypotheses, research methods and/or data-analysis methods.
2. Commitment and perseverance					
1–3	4–5	6	7	8	9–10
Student is not motivated. Student escapes work and gives up regularly.	Student has little motivation. Tends to be distracted easily. Has given up once or twice.	Student is motivated at times, but often, sees the work as a compulsory task. Is distracted from thesis work now and then.	The student is motivated. Overcomes an occasional setback with help of the supervisor.	The student is motivated and/or overcomes an occasional setback on his own and considers the work as his "own" project.	The student is very motivated, goes at length to get the most out of the project.
3. Time management					
1–3	4–5	6	7	8	9–10
No planning is made.	Planning is without any detail, not feasible and backup strategies are lacking.	Planning is somewhat concrete but not feasible and backup strategies are lacking.	Planning is quite concrete, but some aspects of the planning are not feasible and backup strategies are insufficient.	Planning is quite concrete and feasible, but backup strategies are insufficient.	Planning is concrete and feasible and backup strategies are sufficient.
Deadlines exceeded hugely (without a valid reason).	Deadlines exceeded at most with cumulative one–two weeks (without a valid reason).	Deadlines exceeded with at most a cumulative week (without valid reason).	Deadlines exceeded at most with two cumulative days (without valid reasons).	Deadlines exceeded at most with cumulative one Day (without valid reasons).	Deadlines met within planned period.
4. Critical and self-reflective capacity					
1–3	4–5	6	7	8	9–10
Student doesn't realize the occurrence of strengths and weaknesses of the research	Student is not able to point out strengths and weaknesses of the research (plan).	Student is able to point out some strengths and weaknesses of the research	Student is able to point out many of the strengths and weaknesses of the research	Student is able to point out most of the strengths and weaknesses of the research	Student is able to point out most of the strengths and weaknesses of the research

(plan).		(plan).	(plan).	(plan).	(plan) and is able to give some constructive suggestions for improvement.
5. Handling supervisor's comments					
1–3	4–5	6	7	8	9–10
Student does not pick up suggestions and ideas of the supervisor.	The supervisor needs to act as an instructor and constantly needs to suggest solutions for problems.	Student incorporates some of the comments of the supervisor, but ignores others without arguments.	Student incorporates most or all of the supervisor's comments.	Supervisor's comments are weighed by the student and asked for when needed.	Supervisor's comments are critically weighed by the student and asked for when needed, also from other staff members or students.
6. Analysis and processing (literature) data: a) experimental work, b) data analysis, c) model development, d) literature analysis. Only assess those criteria that are relevant for the BSc–thesis of the student.					
1–3	4–5	6	7	8	9–10
a) Experimental work Student is not able to setup and/or execute an experiment.	Student is able to execute detailed instructions to some extent, but errors are made often, invalidating (part of) the experiment. Every single step has to be supervised.	Student is able to execute an experiment that has been designed by someone else (without critical assessment of sources of error and uncertainty). Check of supervisor is necessary.	Student is able to execute an experiment that has been designed by someone else. Takes sources of error and uncertainty into account in a qualitative sense.	Student is able to judge the setup of an existing experiment and to include modifications if needed. Takes into account sources of error and uncertainty quantitatively.	Student is able to setup or modify an experiment exactly tailored to answering the research questions. Quantitative consideration of sources of error and uncertainty. Execution of the experiment is flawless.
b) Data analysis Student is lost when using data. Is not able to use a spreadsheet program or any other appropriate data–processing program.	Student is able to organize the data, but is not able to perform checks and/or simple analyses.	Student is able to organize data and perform some simple checks; but the way the data are used does not clearly contribute to answering of the research questions and/or he is unable to analyse the data independently.	Student is able to organize the data, perform some basic checks and perform basic analyses that contribute to the research question.	Student is able to organize the data, perform commonly used checks and perform some advanced analyses on the data.	Student is able to organize the data, perform thorough checks and perform advanced and original analyses on the data.
c) Model development Student is not able to make any modification/addition to an existing model.	Student is able to make minor modifications to an existing model, but errors occur and persist. No validation.	Student is able to make minor modifications (e.g. a single formula) to an existing model. Superficial validation.	Student is able to make major modifications to an existing model, based on literature. Validation using some basic measures of quality.	Student is able to make major modifications to an existing model, based on literature or own analyses. Validation using appropriate statistical measures.	Student is able to develop a model from scratch, or add an important new part to an existing model. Excellent theoretical basis for modeling as well as use of advanced

					validation methods.
d) Literature analysis Student is not able to organize literature and come to a synthesis.	Student is able to organize the literature, but is not able come to a synthesis that results in own insights, hypotheses or conclusions independently.	Student is able to organize literature and comes to a synthesis that results in own insights, hypotheses or conclusions; but the way the literature is used does not clearly contribute to answering of the research questions	Student is able to organize literature and comes to a synthesis that results in own insights, hypotheses or conclusions which contribute to the research question.	Student is able to organize literature and critically evaluates the quality of his literature sources. He comes to a synthesis that results in own insights, hypotheses or conclusions which contribute to the research question.	Student is able to organize literature and critically evaluates the quality of his literature sources. He comes to an original synthesis that results in own original insights, hypotheses or conclusions which contribute to the research question.

A2) Laboratory skills (10%)					
Technical skills					
1–3	4–5	6	7	8	9–10
Not able to perform any technical handling.	Performs technical handling but makes errors even with direct help of supervisor.	Performs technical handling correctly with direct help of supervisor.	Performs most technical handlings correctly after detailed instruction by supervisor.	Performs most technical handlings correctly after global instruction by supervisor.	Performs technical handlings correctly, and suggests useful modifications.
Accuracy					
1–3	4–5	6	7	8	9–10
Not able to execute experiment set up by supervisor and/or lost when using data; makes no notes.	Makes many errors when executing detailed instructions even with help of supervisor; notes not understandable.	Executes detailed instructions to some extend and avoids errors as long as direct help is present; student can work.	Executes detailed instructions but does not take sources of error and uncertainty into account; notes understandable with explanations.	Executes detailed instructions and takes sources of error and uncertainty into account; notes understandable for supervisor.	Able to judge set up of existing experiment, includes modifications if needed and executes it. Takes sources of error and uncertainty into account; notes understandable for others.
Lab journal, logbook					
1–3	4–5	6	7	8	9–10
No description of methods and recording of the information/data.	Insufficient description of methods and insufficient recording of the information/data.	Some descriptions of methods. Recordings of the information/data are present but not always sufficient.	Most methods are described. Recordings of the information/data are present and mostly sufficient.	Methods are described but details are sometimes lacking. Recordings of the information/data are present and sufficient.	Descriptions of methods and recordings of the information/data are appropriate, complete and clear.

D) Report (50%)					
Problem definition & research set-up					
1-3	4-5	6	7	8	9-10
There is no researchable research question and the delineation of the research is absent.	Most research questions are unclear, or not researchable and the delineation of the research is weak..	The research questions are mostly clear but could have been defined sharper at some points.	The research questions and the delineation are mostly clear but could have been defined sharper at some points.	The research questions are clear and researchable and the delineation is clear..	The research questions are clear and formulated to-the-point and limits of the research are well-defined.
No link is made to existing research on the topic. No research context is described.	The context of the topic at hand is described in broad terms but there is no link between what is known and what will be researched.	The link between the thesis research and existing research does not go beyond the information provided by the supervisor.	Context of the research is defined well, with input from the student. There is a link between the context and research questions.	Context of the research is defined sharply and to-the-point. Research questions emerge directly from the described context.	Research is positioned sharply in the relevant scientific field. Student is able to indicate the novelty and innovation of the research.
Theoretical underpinning and use of literature					
1-3	4-5	6	7	8	9-10
No discussion of underlying theories.	There is some discussion of underlying theories, but the description shows serious errors.	Student has found the relevant theories, but the description has not been tailored to the project at hand or shows occasional errors.	Student has found the relevant theories, and has been partially successful in tailoring the description to the project at hand. Few errors occur.	Student has found the relevant theories, makes a synthesis of those, and has been successful in tailoring the description to the project at hand.	Clear, complete and coherent overview of relevant theories. Exactly tailored to the project at hand.
No peer-reviewed/primary scientific papers in reference list except for those already suggested by the supervisor	Only a couple of peer-reviewed papers in reference list.	Some peer-reviewed papers in reference list but also a significant body of gray literature.	Relevant peer-reviewed papers in reference list but also some gray literature or text books. Some included references less relevant.	Mostly peer-reviewed papers or specialized monographs in reference list. An occasional reference may be less relevant.	Almost exclusively peer-reviewed papers in reference list or specialized monographs All papers included are relevant.
Description methods and analysis (literature) data					
1-3	4-5	6	7	8	9-10
No description of methods and analysis of the information/data.	Insufficient information on methods and insufficient analysis of the information.	Some aspects of the project regarding methods and analysis of information are	Description of methods and analysis of information/data is lacking in a number of places.	Description of methods and analysis of information/data is mostly complete, but there are	Description of methods used and analysis of the information is appropriate, complete and

		described insufficiently. Used methods and analysis of data/information are not always appropriate.	Used methods and analysis of data/information mostly appropriate.	lacking some details. Used methods and analysis of data/information are appropriate.	clear.
Clarity of argumentation and conclusions					
1–3	4–5	6	7	8	9–10
No link between research questions, results and conclusions.	Conclusions are drawn, but in many cases these are only partial answers to the research question. Conclusions merely repeat results or conclusions are not substantiated by results.	Conclusions are linked to the research questions, but not all questions are addressed. Some conclusions are not substantiated by results or merely repeat results.	Most conclusions well-linked to research questions and substantiated by results. Conclusions mostly formulated clearly but some vagueness in wording.	Clear link between research questions and conclusions. All conclusions substantiated by results. Conclusions are formulated exact.	Clear link between research questions and conclusions. Conclusions substantiated by results. Conclusions are formulated exact and concise. Conclusions are grouped/ordered in a logical way.
No recommendations given.	Recommendations are absent or trivial.	Some recommendations are given, but the link of those to the conclusions is not always clear.	Recommendations are well-linked to the conclusions.	Recommendations are to-the-point, well-linked to the conclusions and original.	Recommendations are to-the-point, well-linked to the conclusions, original and are extensive enough to serve as project description for a new thesis project.
Critical discussion					
1–3	4–5	6	7	8	9–10
No discussion and/or reflection on the research. Discussion only touches trivial or very general points of criticism.	Student identifies only some possible weaknesses and/or points at weaknesses which are in reality irrelevant or non-existent.	Student indicates most weaknesses in the research, but does not weigh their impact on the main results relative to each other.	Student indicates most weaknesses in the research and is able to weigh their impact on the main results relative to each other.	Student indicates all weaknesses in the research and weighs them relative to each other. Furthermore, (better) alternatives for the methods used are indicated.	Student is able to identify all possible weaknesses in the research and to indicate which weaknesses affect the conclusions most.
No confrontation with existing literature.	Some confrontation with existing literature but incomplete and irrelevant.	Some confrontation with existing literature, some relevance.	Student identifies only most obvious conflicts and correspondences with existing literature. Student tries to describe the added value of	Student shows minor and major conflicts and correspondences with literature and can identify the added value of his research	Student critically confronts results to existing literature and in case of conflicts is able to weigh own results relative to existing literature.

			his study but does not relate this to existing research.	relative to existing literature.	Student is able to identify the contribution of his work to the development of scientific concepts
Writing skills including correct quoting					
1–3	4–5	6	7	8	9–10
BSc thesis badly structured. In many cases information appears in wrong locations. Level of detail is inappropriate throughout.	Main structure incorrect in some places, and placement of material in different chapters illogical in many places. Level of detail varies widely (information missing, or irrelevant information given).	Main structure is correct, but lower level hierarchy of sections is not logical in places. Some sections have overlapping functions leading to ambiguity in placement of information. Level of detail varies widely (information missing, or irrelevant information given).	Main structure correct, but placement of material in different chapters illogical in places. Level of detail inappropriate in a number of places (irrelevant information given).	Most sections have a clear and unique function. Hierarchy of sections is mostly correct. Ordering of sections is mostly logical. All information occurs at the correct place, with few exceptions. In most places level of detail is appropriate.	Well-structured: each section has a clear and unique function. Hierarchy of sections is correct. Ordering of sections is logical. All information occurs at the correct place. Level of detail is appropriate throughout.
Formulations in the text are often incorrect/inexact inhibiting a correct interpretation of the text.	Vagueness and/or inexactness in wording occurs regularly and it affects the interpretation of the text.	The text is ambiguous in some places but this does not always inhibit a correct interpretation of the text.	Formulations in text are predominantly clear and exact. BSc thesis report could have been written more concisely.	Formulations in text are clear and exact, as well as concise.	*Textual* quality of thesis is such that it could be acceptable for a peer-reviewed journal.
English incorrect and unreadable. Spelling and grammar errors too many to count.	English incorrect and very hard to read. Spelling and grammar errors so numerous that they make the thesis almost impossible to understand.	English somehow correct but not pleasant to read. Spelling and grammar errors numerous.	English basically correct and readable. Spelling and grammar errors present but at acceptable quantities.	English correct and pleasant to read. Some spelling and grammar errors.	English fluent and pleasant to read. Few spelling and grammar errors. English is (almost) at the level of what is written in peer-reviewed journals.
Student is often inconsequent in references in the text and/or reference list or often references are lacking.	Student is often inconsequent in references in the text and/or reference list or often references are lacking.	Student is sometimes inconsequent in references in the text and/or reference list or sometimes references are lacking.	Student is sometimes inconsequent in references in the text and/or reference list.	Student uses one format for references in the text and reference list.	Student uses one format for references in the text and reference list.

C) PRESENTATION (10%)

1. Graphical presentation					
1–3	4–5	6	7	8	9–10
Presentation has no structure.	Presentation has unclear structure.	Presentation is structured, though the audience gets lost in some places.	Presentation has a clear structure with only few exceptions.	Presentation has a clear structure. Mostly a good separation between the main message and side-steps.	Presentation clearly structured, concise and to-the-point. Good separation between the main message and side-steps.
Unclear lay-out. Unbalanced use of text, graphs, tables or graphics throughout. Too small font size, too many slides.	Lay-out in many places insufficient: too much text and too few graphics (or graphs, tables) or vice versa.	Quality of the layout of the slides is mixed. Inappropriate use of text, tables, graphs and graphics in some places.	Lay-out is mostly clear, with unbalanced use of text, tables, graphs and graphics in few places only.	Lay-out is clear. Appropriate use of text, tables, graphs and graphics.	Lay-out is functional and clear. Clever use of graphs and graphics.
2. Verbal and non-verbal presentation, and defense					
1–3	4–5	6	7	8	9–10
Spoken in such a way that majority of audience could not follow the presentation.	Presentation is uninspired and/or monotonous and/or student reads from slides: attention of audience not captured	Quality of presentation is mixed: sometimes clear, sometimes hard to follow.	Mostly clearly spoken. Sometimes monotonous or difficult to follow.	Clearly spoken in such a way that it keeps audience's attention.	Relaxed and lively though concentrated presentation. Clearly spoken in such a way that it keeps audience's attention.
Student does not make eye-contact, moves in a very restless way or is completely frozen, does not support his words with gestures.	Student hardly makes eye-contact, moves too much or is almost frozen, hardly supports his words with gestures.	Student sometimes makes eye-contact, moves in a way that is not very annoying or distracting, makes some useful supporting gestures.	Student regularly makes eye-contact, moves rather naturally, makes some supporting gestures.	Student makes eye-contact, moves naturally, makes supporting gestures.	Student constantly makes eye-contact, moves naturally, is lively and relaxed and makes supporting gestures.
Language and interest of audience not taken into consideration at all.	Language and interest of audience hardly taken into consideration.	Language and interest of presentation at a couple of points not appropriately targeted at audience.	Language and interest of presentation mostly targeted at audience.	Language and interest of presentation well-targeted at audience. Student is able to adjust to some extent to signals from audience that certain parts are not understood.	Take-home message is clear to the audience. Language and interest of presentation well-targeted at audience. Student is able to adjust to signals from audience that certain parts are not understood.
Bad timing (way too short or going on and on till stopped by supervisor or chairman).	Bad timing (way too short or at least twice as long as planned).	Timing marginally okay but rushing or killing time in the end.	Timing more or less okay, no rushing or killing time.	Presentation finished well in time.	Presentation finished well in time.

Student is not able to answer questions.	Student is able to answer only the simplest questions	Student answers some of the relevant questions appropriately and deals in an acceptable way with the questions he cannot answer.	Student is able to answer many relevant questions in an appropriate way, although not to-the-point in some cases.	Student is able to answer most of the relevant questions in an appropriate way.	Student is able to give appropriate, clear and to-the-point answers to all relevant questions.

Appendix 3: Guidelines for keeping a lab journal

In the laboratory notebook the aim, practical performance and results of your experiments are recorded and the results are processed and analysed. The laboratory notebook enables you to report your work at a later stage. The laboratory notebook is also useful in the communication with your instructors, superiors and colleagues. You should be able to discuss the experiments with them based on how you did the experiments and your original observations and data. It is also important that someone else can repeat the experiment based on the descriptions in your laboratory notebook. Therefore, it is of utmost importance that you train yourself in setting up and keeping a laboratory notebook. Sometimes it is even obligatory to follow strict international guidelines for keeping a laboratory notebook, for example with companies that may want to patent your findings. All pages of such a notebook have to be signed daily by an independent observer in order to prevent observations from being changed at a later time (fraud). This will not be discussed here. However, the guidelines for keeping a laboratory notebook that are presented below are based on these international guidelines. It is important that you store your extended notebooks 'under lock and key' to prevent them from getting lost or because they contain personal data, e.g. obtained in nutrition research.

General guidelines for keeping a lab journal

A laboratory notebook should be bound (so do not use a loose-leaf ring binder), preferably A4-format with a hard cover. For keeping a laboratory notebook the following general guidelines apply:
note your personal data on the cover, including name, address, and telephone number;
number the pages of the notebook;

- Use a pen (not a pencil) in writing.
- During the experiment you should keep a detailed account of your work, reporting everything of importance that you actually did and saw. Write this down in the notebook during the experiments or as shortly afterwards as possible.
- Do not remove pages from the notebook.
- Start a new page for every new experiment you perform.
- Start the description of each experiment with a heading i.e. a short title and the date.
- In the first instance only use the right pages of the notebook to describe the aim and set-up and to record the observations of an experiment. The elaboration of the results is also done on the right pages. The left pages can be used for corrections, additional notes, etc. It can also be used for drawings or pictures of gels, thin layer chromatograms, graphs made on the basis of results, etc.
- Data from measurements should be presented in an orderly manner, for example in a table or a graph. Clearly indicate what quantity you give and the corresponding units. Label axes in graphs accordingly.
- Use a single stroke to correct wrong observations (so it can still be read). Also note if something goes wrong (and why, if possible). Do not remove pages from experiments that went wrong.
- Make sure you use cross-references when you need more than one page for an experiment. Use descriptions like "continued on page "and "continuation from page ".

- Write down the aim: why is the experiment performed; what do you want to demonstrate or prove. Add additional text if necessary, so you are not puzzled later (it is good to realize that you might need the results of a certain experiment again after several years).
- Note the used materials (chemicals, used solutions, concentrations, apparatus) and methods (set-up, conditions including temperature, adjustments of apparatus like wavelengths, method of execution). If you do an experiment for the first time, completely write down everything, or give a clear reference to a description of a similar experiment from the literature or manual. Give sufficient details so that another person can repeat the experiment solely using the record in your laboratory notebook.
- Address the necessary data for processing the results (for example formulas or computer programs that have been used).
- Write down the tentative conclusions that follow from the results and possibly a hypothesis and proposals for future research.
- Put a serial number and the initial and final dates on the cover of your notebooks when you do a large series of experiments and need more than one laboratory notebook.
- The last pages of your notebook are intended for a table of contents. Note here the page, title and date of the experiments.

Lab journal as 'organizer'

Experiments can produce all kinds of data. Nowadays many data are in electronic format (data files) and are not noted in a laboratory notebook anymore. It is therefore important to give attention to a systematic recording of these data, so they can be easily retrieved later. In that case your notebook is used as an organizer in which you record the data file(s) that belong(s) to a certain experiment. The following guidelines can be given:

- Separate observations, for example readings from a spectrophotometer can be noted directly in your notebook.
- Data that are obtained on paper, for example printouts of spectra, can be glued in a laboratory notebook. However, if they are obtained regularly or in large quantities, it is better to store them in for example binders for document files. They should be sorted by date or experiment number. Make sure each print is labelled by date, type and details of the experiment, reference to the correct page in your notebook, other details you might need later, etc. Write in your notebook what plots or prints that you have made and where they can be found. Mark the binders in a logical manner.
- Electronic data files (for example data files from mass spectrometry and NMR). These are usually first produced on a hard disk of a PC that is coupled to the apparatus. Always store the crude data on your own computer, USB or a CD. It is important to systematically label both the files and the media. In the notebook you should write down which files belong to which experiment and where they are stored. Make sure you store USB or CD's systematically.