BSc Thesis Plant Sciences
(YPS82318)

Study guide for students

Version: November 2014

Introduction

This study guide is meant for BSc students Plant Sciences that are starting their BSc thesis. In it, you can find all information you need to set up, execute and finish your BSc thesis. A teacher's manual is available in both English and Dutch for the supervisors. If your supervisor does not have one, you can refer them to Anja Kuipers to get one.
Read the study guide carefully before you start your thesis, so you know what you are doing. In case anything is unclear or if you have ideas to improve or supplement the study guide, you can contact Anja Kuipers. Have fun and good luck with your BSc thesis!

Contents

1. BSc thesis Plant Sciences: General affairs

1a. Objective and design
The intent of the BSc thesis Plant Sciences is to test whether you meet the learning outcomes of the BSc Plant Sciences. The main aim is showing your ability to prepare, execute and present a research project in both written and oral form, under guidance of your supervisor. The BSc thesis Plant Sciences is an individual project.

One component of the BSc thesis is the self-reflection. Its aim is to look back on your own capacities, skills, experiences and choices in the BSc, and look ahead to your learning needs and objectives for the BSc thesis Plant Sciences and your future study plan (choice of MSc, orientation on the job market)

1b. Extent
The standard extent of the BSc thesis Plant Sciences is 18 ECTS (3 months).

1c. Part in the program
The BSc is the final component of the major.

1d. Prerequisites
All courses of the first year of the BSc must be passed (60 ECTS). Besides that at least half (36 ECTS) of the B2-/B3-phase in the BPS-programme as described in the study guide must be finished. This excludes the courses that are part of your free choice or BSc minor.

1e. Approval by study counsellor
The study counsellor approves your start with the BSc thesis if your academic progress is sufficient. This approval will be signed in the BSc thesis contract (Appendix 1).

1f. Content
The BSc thesis Plant Sciences is the final component of the BSc Plant Sciences. In it, you focus on the planning, preparation and execution of a research project in the area of Plant Sciences.
A teacher of the chairgroup you are doing your thesis at will guide you through your BSc thesis. You will design your research based on a literature research, the formulation of the research question and the writing of a research proposal. This will include making a planning. Based on your research proposal, you will start with the execution of your research/experiments to collect data. In this phase you will also take part in meetings of the chairgroup. Processing and analysing your research data forms the basis of your thesis report, which you will also present orally. Furthermore, during your BSc thesis you will work on the reflection report on your personal capacities, skills, choices, learning objectives for the BSc thesis and plans for the MSc.

1g. Learning outcomes
After finishing the BSc thesis Plant Sciences you are expected to be able to:

- reflect on your own knowledge, skills, attitude and functioning;
- formulate your own learning objectives through personal reflection and process these learning objectives into a research proposal;
- execute literature research independently;
- develop a research proposal based on a research project (including theoretical background, research questions, research plan and planning of the project), as a result of an existing research question;
- execute research under guidance (including execution of methods and techniques, data processing, problem solving, active participation of discussion within the chairgroup);
- Summarize relevant scientific knowledge on a current topic in the area of Plant Science, apply this knowledge and integrate it. This is all done in consultation with and with feedback from your supervisor;
- Present a clear and understandable scientific report of the executed research, both written and in oral form.

1h. Activities

- Analysis of individual learning objectives and preferenfces for the BSc thesis and the rest of your studies (and career) by writing a self-reflection (Chapter 3);
- Doing literature research independently
- Designing and writing a detailed research proposal and research plan (Chapter 5);
- Doing practical research (Chapter 6);
- Analysing and discussing research data (Chapter 7);
- Written presentation (= writing a research report) (Chapter 7);
- Oral presentation (= a presentation and defense of your research) (Chapter 7).

1i. Dutch or English

The BSc thesis must be written in English. This enables you to train and get feedback on writing an English text. In case you have heavy objections against writing in English, or if you know from yourself this will cost a lot of extra time, don't hesitate to discuss it with your study counsellor. You can take a look at how to go about this together.
Due to the personal nature of the self-reflection it is encouraged to write it in whichever language you are most fluent in, whether that is Dutch or English.

1j. Differences BSc- and MSc-thesis

The BSc thesis is part of a different phase of your study and has a smaller extent than the MSc-thesis. The most important difference is the amount of guidance you get from your supervisor, which will be much larger for the BSc thesis than for the MSc thesis. The most important differences between the BSc thesis and the MSc thesis are summarised below:

	BSc thesis	*MSc-thesis*
Formulating the assignment	Student gets a mostly preconstructed assignment	Student has to construct the assignment mostly by himself
Theoretical	Student has to use and mention some theories	Student has to make his own list of theories, select some and correlate them by himself
Methodical	Student gets help with the choice of methods and techniques and will apply them	Student choses the methods and techniques independently and reflects on their application

1k. Division of roles

In the execution of the BSc thesis it is important to have clear who is supposed to do what and which responsibilities belong to whom. Therefore the below scheme of duties and roles of all parties involved is added.

Student

- Takes initiative in starting a BSc thesis;
- Approaches the contact person to inform about the possibilities in taking part in a project of choice;
- Is involved actively, communicates and takes care of matters such as the thesis contract in time.

Thesis supervisor(s)

- Is responsible for daily mentorship and assessment regarding the contents of the thesis;
- Arranges a workspace for the student;
- Decides over the quality of the research questions;
- Keeps an eye on the progress of the student;
- Delivers ideas for subjects to the education coordinator.

Programme director Plant Sciences (Anja Kuipers)

- Is examinator and contact person;
- Organises an information meeting prior to the start of the BSc thesis in which general points of attention are discussed;
- Is contact point for thesis supervisors;
- Sketches broad outlines, steers and evaluates

Education coordinator of the chairgroup

- Is first point of contact for students looking to do their BSc thesis at a chairgroup;
- Keeps track of subject suggestions and registrates these at http://tip.wur.nl;

Study advisors Plant Sciences (Jet Vervoort and Arjen Schots)

- Are point of contact for students;
- Offer suggestions for subjects to individual students;
- Give approval for starting the BSc thesis if study progress is sufficient (via the BSc thesis contract);
- Assess the self reflection.

1l. Examination

The BSc thesis Plant Sciences will be evaluated and assessed by the supervisor and the examinator following the assessment form (Appendix 2).

1m. Assessment

According to the assessment form (Appendix 2). The final mark is based on the research proposal, the final report, your presentation, your defense of the research, your reflection report, your practical skills and your acedemic skills. During the final interview your supervisor will explain your assessment and will let you know which points you should further improve upon.

1n. Plagiarism

Every research is directly or indirectly based on the intellectual work of others. This includes their theories, their models or the findings from their researches. In the report this must be clearly indicated, with correct citation in text and in the list of references at the end. If you fail to do this, this is a form of plagiarism and therefore fraud. Make sure to prevent any and all suspiction of plagiarism! If you, for example, have copied texts in your concept report, make this overly clear with a different colour, by writing next to it that you will rewrite it later, or any other indication to show you are conscious of the fact you cannot leave it like that. Always be careful with citing and keep to the rules for doing so. In case of doubt, ask your supervisor or have a look on the internet (for example http://library.wur.nl/infoboard/7_citing/).

In case of suspected plagiarism, "suspicious" papers can be screened electronically. When it is found you committed plagiarism, the exam commission will be informed about this. After hearing you they will decide whether there has truly and intentionally been a case of fraud. You can be expelled from the course for the duration of one year (see Rules and Regulations of the Examining Boards Wageningen University (2014-2015), Chapter 6: Interim examinations: Fraud).

1o. Timetable (these are indications, no deadlines)

Week 1 (1,5 ECTS)	Self-reflection, formulate learning objectives, arrange BSc thesis contract
Week 2 (1,5 ECTS)	Formulate research question, literature research, if necessary adjust research question
Week 3 (1,5 ECTS)	Write research proposal, planning of the research, discuss with thesis supervisor
Week 4-9 (9 ECTS)	Research/experiments/data analysis
Week 10-12 (4,5 ECTS)	Write thesis, oral presentation, final evaluation and assessment

1p. Identifying and solving problems

Even in case of a perfect preparation it is possible that unexpected troubles come up during your BSc thesis. First of all it is important to notice the problems, for example with a weekly check whether everything is going well and whether you will finish a good research at the end of the three months if you continue like this. You should think about constructive solutions. If you need your supervisor for these solutions or if you don't know how to go about solving the problem, do take initiative to make your problem known and discuss about it. In case of doubt, questions, or if you cannot solve it with your supervisor, contact your study advisor. Be critical and assertive and prevent problems from escalating or leading to study delay.

1q. Literature

For starting your research and the writing of the BSc thesis well prepared, the following two books and website of the first book can come in very handy:

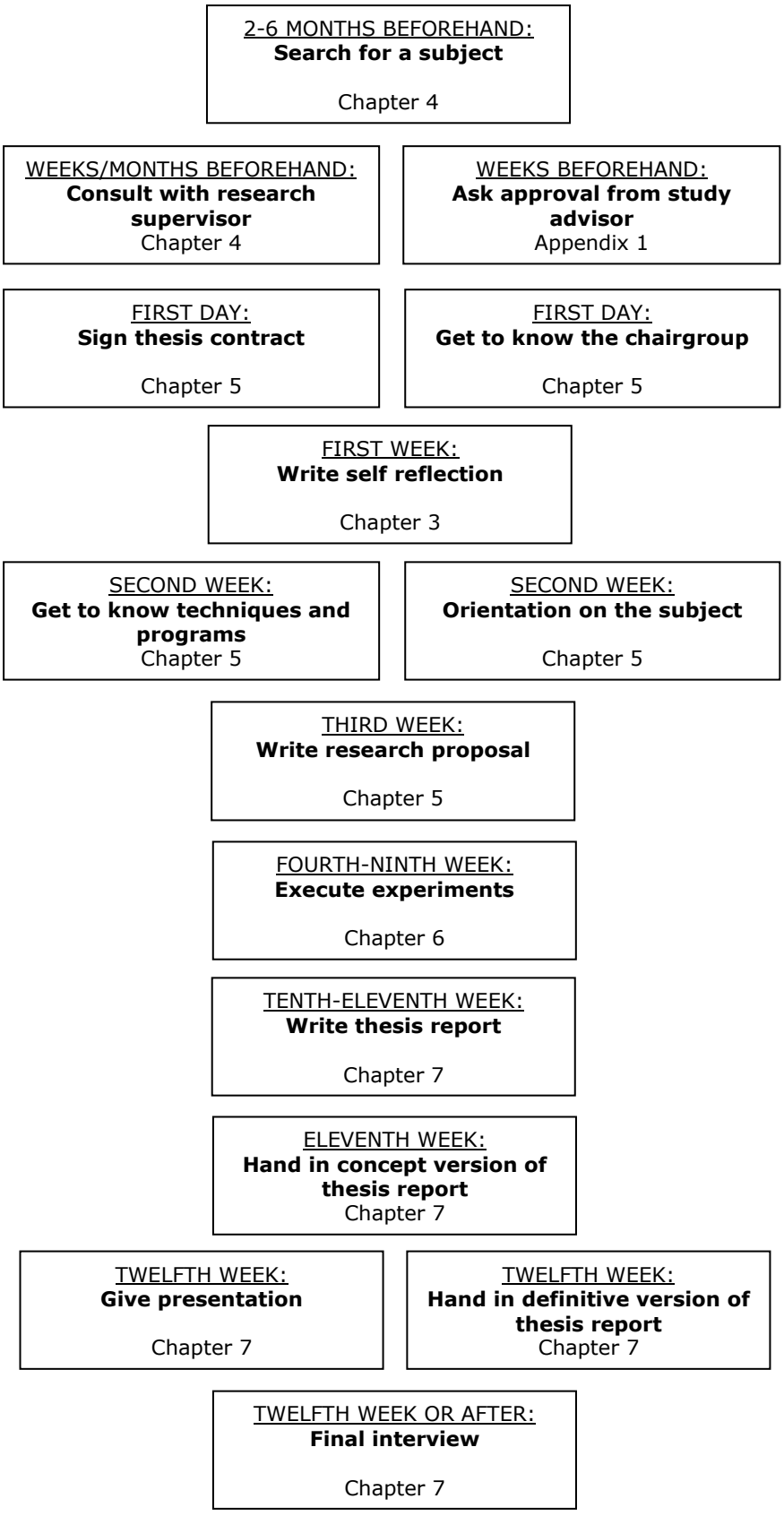
- Feijen, E., Trietsch, P., 2007. Snel Afstuderen! Stap voor stap naar een geslaagde scriptie. 1e druk, Uitgeverij Coutinho, Bussum, 171 pp. (http://www.snelafstuderen.nl/scriptietips/)
- Loon, J. van, Thüss, A., Schmidt, N., Haines, K., 2011. Academic Writing in English, a process-based approach. 1e druk, Uitgeverij Coutinho, Bussum, 237 pp.

If you need to know more we can also recommend these books:

- Miranda, M.J.A. & E. Wardenaar, 1997. Scriptieproblemen. 3e druk, Wolters-Noordhoff bv, Groningen, 120 pp.
- Oosterbaan, W., 2007. Een leesbare scriptie. 5e druk, Uitgave Prometheus, Amsterdam, 103 pp.
- Turabian, K.L., 2007. A Manual for Writers of Research Papers, Theses, and Dissertations. 7th edition, The University of Chicago Press, Chicago, 482 pp.

2. Overview

The scheme gives a good overview of the different activities and approximately when they will happen. Keep in mind: this is a guideline, no rule. In practise it is important to be flexible in your planning and to adapt it where possible, without forgetting the big picture of course.



3. Self-reflection: Looking back and looking ahead

Introduction

Goal of the self-reflection
If you want to get as much as possible out of your studies and make well-advised choices for the continuation of your study, you have to start with yourself and your own experiences. You need to find the answer to the following questions:
1. What am I good at already?
2. What am I not very good at yet?
3. How do I make choices?
4. What do I want to learn?

The first two questions challenge you to find out for yourself what your strengths and weaknesses are. Based on this, you can determine what knowledge, skills and attitude (see: Appendix 5) you have already developed sufficiently and which you want to develop further. For the self-analysis your first assignment (1a) is to make an overview of all you study and educational activities you have done. This will take some time, but it is necessary for getting a complete overview. It is smart to keep this overview, as you can use it well in writing a CV, for example.

For answering the question "how do I make choices?", you first need to check your considerations in making past choices. Most considerations are rational, emotional/intuitive, and sometimes opportunistic (determined by what crosses your path or what is convenient). When you tend to be very rational in your choices, it is good to become aware of this and ask yourself how important you think it is to let emotional considerations play a larger role in the future. If you made more intuitive choices up until now, it is good to know to which degree rational motives played a role and to which degree you would like to let those weigh heavier in the future.

The purpose of this is assignment is for you to become more aware of the way you make choices and to research which way of making choices you would like to employ in further choices in study and career, such as a topic for your MSc thesis. A good understanding of how you make choices (or how you would like to make them) is key to determining which information to collect for making a good choice. Furthermore, insight in your own way of making choices and whether you are content with it in hindsight can be a start in chosing your thesis (or your MSc, or your profession). It will help you make sure the (for you) most important factors will play a main role in the choice.

In answering "what do I want to lean?" you are encouraged to determine your own learning objectives. Most people learn most effectively when they set goals for themselves. The courses you have taken up until now, "curricular courses", had predetermined learning objectives set by the teachers. For thesis subjects and internships it is smart to set your own learning objectives and set up a research that will help you reach those goals.

Learning outcomes
After succesfully finishing the self-reflection you are expected to:
- Be capable of explaining in your own words that the responsibly of what you will learn in the rest of your studies lies, for a significant part, with yourself;
- Are able to identify, express in words and evaluate your own capacities, skills and characteristics;
- Are able to describe how you have made important choices up until now and how you want to make choices in the future;
- Be able to formulate your own learning objectives in terms of knowledge, skills and experiences

Assessment
The reflection report for the BSc thesis is composed of answers to the three self-reflection assignments described below. The reflection report has to be handed in to your study advisor **two weeks after starting your thesis**. Your study advisor will then read the report through, if necessary talk it over with you and assess the report. In the final interview you will discuss to which degree you attained your personal learning objectives for the BSc thesis and how you will continue with them in the MSc. The assessment will count for **10%** of the final grade for your BSc thesis and needs to be sufficient. The report needs to consist of **five to ten pages of text**.
In assessing your reflection report, the study advisor keeps three important points in mind.

- First of all they will take a look at the clarity and concreteness of your report, and whether it contains examples of your own attitude or behaviour. Do not write "that course was easy and boring" but rather write "I found the course easy because I only spent three hours on it every week and I still got a seven. During the lectures I fell asleep or started talking, so I only attended two lectures".
- After that the study advisor will look at the conclusions you draw and the learning objectives you set for yourself. It is important that the conclusions (at the end of assignment 1 and 2) are relevant, concrete, and that they follow logically from the information in your report. The learning objectives (assignment 3) need to be attainable and once again concrete. If you want to check whether your learning objectives are well-formulated, you can use the SMART-criterium. Have a look at the glossary in appendix 5 for explanation.
- In the third place the report will be assessed on appearance and completeness. This means complete answers to all assignment, but also correct language and a tidy layout.

Assignment 1: own capacities and skills.

1a. Make a general overview of your activities
Make an overview of your study- and education-related activities, that is as complete as possible. You can start with the last years of high school, followed by the first, second and third year of the BSc Pland Sciences. Add in any sorts of extracurricular activities related to the area of Plant Science, your education, work (whether or not it was paid) and hobby's.
Write down notes of your results along with all components: what is your general assessment, what grade did you get? For all parts that are important to you (whether positive or negative), or stayed with you for any reason you should write a little more about your experience. What did you find important or interesting about it? Were you good at it? Did you have to put in a lot of time?
This is about your own results and experiences, which is more than just a summation of courses and grades. You can start with the latter by making an organised list of your activities. You can then start writing more about the strong and weak points in those activities.

1b. Several successful activities
Based on the overview you just made, select at least three activities you look back on with satisfaction. You can be satisfied because you were good at something, but you can also be happy because you learned a lot from it, or because you attained a good result by working hard. Be concrete and give clear arguments with descriptions and examples.

1c. Several less successful activities
Subsequently, select at least three activities you weren't as successful at. Again try to give concrete reasons for the less successful result, for example: the subject was too difficult or too boring, you didn't spend enough time on it, the subject was not up your alley, etc. Be concrete and give clear arguments with descriptions and examples.

1d. Personal characteristics and skills
Next, try to figure out which personal characteristics and skills played an important role in both the successful and the less successful activities. For inspiration we have added a (far from complete!) list with keywords. We haven't distinguished between characteristics and skills.

- adaptability
- systematical thinking
- persuasion
- determination
- practicality
- logical thinking
- initiative
- working under pressure
- creative
- planning
- organising
- delegating
- motivating
- working fast
- discussing
- communicating
- self motivation
- loyality
- flexibility
- improvising
- educating
- transferring knowledge
- teamwork
- working with groups
- teaching
- explaining
- inventive
- innovation minded
- technical insight
- visual insight
- business insight
- administrative insight
- ambitious
- humble
- low key
- language skills
- open for critique
- realising ambitions
- etiquette
- learning how to learn
- relaxing
- parenthood
- productivity
- social resilience
- spirituality
- time management
- memory
- concentration

- exact working
- working carefully
- working independently
- articulate
- oral/in written form
- personal presentation
- stimulating colleagues
- analytical mindset
- critical thinking
- commercial insight
- negotiation
- decisive
- sense of humour
- bold
- patience
- sensitivity
- confidence
- self-control
- searching, processing and judging of relevant information
- learning ability
- judgement
- problem analysing
- performance-oriented

1e. Summary and conclusions
Finally, go over everything you wrote down in the previous steps once more. Now try to answer the following questions.

A. Up until now in your study, which strengths in characteristics and skills have helped you most in completing activities successfully? Mention at least five!
   1. I am, can or have ... and that is shown in ...
   2. I am, can or have … and that is shown in …
   Etc.
B. Which weaknesses in characteristics ans skills do you see as the cause of activities having been less successful for you? Again, mention at least five.
   1. I am not, cannot or have little ... and that is shown in …
   2. I am not, cannot or have little … and that is shown in …
   Etc.

Assignment 2: Making choices.

2a. Important choices in your study
Below several defining moments of choice in your studies are mentioned. For each of these points, consider on which information and motivations you based your choices. Also consider which alternatives there possibly were and which considerations made you not choose for them.

1. Chosing to study at Wageningen University
   - Information:
   - Motivation:
   - Alternatives:
   - Considerations:
2. Chosing to study Plant Sciences
   - Information:
   - Motivation:
   - Alternatives:
   - Considerations:
3. Chosing your major
   - Information:
   - Motivation:
   - Alternatives:
   - Considerations:
4. Choice for your BSc minor or use of the free choice space
   - Information:
   - Motivation:
   - Alternatives:
   - Considerations:

5, 6, etc. Other choices of importance to you: .....
   - Information:
   - Motivation:
   - Alternatives:
   - Considerations:

2b. Satisfaction with (your own part in) choices
Investigate for each of the below mentioned points for what part the choices were your own (rough percentage) and who advised you in making the choice (study advisor, teachers, friends, senior students). Looking back, are you satisfied with that choice? Why are you, or why are you not?

1. Keuze voor de WU
   - Was my own choice for ..... %.
   - I talked the decision over with .....
   - I am/am not satisfied with my choice because: .....
2. Choice for Plant Sciences
   - Was my own choice for ..... %.
   - I talked the decision over with ....
   - I am/am not satisfied with my choice because: .....
3. Choice for your major
   - ...

etc.
etc.

2c. Conclusions
You have collected some information about how you made choices at different moments in your study. You have also investigated which choices you are satisfied with and which you might be less satisfied with. Which patterns can you find in your way of choosing? To which degree do you decide your own path? Who gave you advise that really helped you and what effect did that advice have on the quality of your choices?
The question is whether you can get a better insight into a way of making choices that is inspiring to you. For example, would it help to take more time to collect information and talk it over more with other people (study advisor, teachers, friends, senior students)? Or should you maybe stop your endless search for more information and make your choices sooner on the basis of what you already know? Maybe letting yourself be inspired by certain people or examples has helped you in making your choices.

Describe which conclusions you draw for yourself.

Assignment 3: Formulating your own learning needs and learning objectives

What you will learn from your Bsc thesis depends on several factors. Chairgroup, thesis supervisor and subject are obvious factors. It is often forgotten that you as the student also play an important role. Not only do you play an important role through your choice of chairgroup, thesis supervisor and subject, but also with the interpretation and execution of the thesis research. Therefore, it is very useful to ask yourself beforehand what should be the most important learning objectives of your Bsc thesis, for yourself.
You can think of your own learning objectives in several ways. Maybe you already have clear learning needs or expectations regarding your Bsc thesis which you can convert to learning objectives. Another possibility is to take a look at your conclusions of assignment 1. You can further improve your strong characteristics and skills by formulating advancing learning objectives and you could also use your weaker characteristics and skills as a starting point for learning objectives. You can also start from a certain profession or function and formulate your learning objectives from the skills that match it, which you can then practise and realise in your thesis. Another approach is taking a look at what others expect from a graduated plant scientist. For this you can go to
(http://issuu.com/wageningenur/docs/brochure_plant_sciences_2014_en?e=5950684/7271853)

Aspects that can help you with setting up your learning objectives are:

1. Research skills such as executing research independently, professional knowledge, knowledge of methods and statistics, recent developments in the field of study, processing information, interpreting results and written reporting.
2. Attitude aspects such as independance, integrity, creativity, adaptability, resistance to workload and critical attitude
3. Professional knowlegde and skills such as commercial and social insight, insight in business decision making, diplomatic and management skills, business economics knowlegde, communicative skills and being able to present orally.

These skills and aspects of attitude will be dealt with extensively in Wageningen University's MScs. You get plenty of practise for your research skills in your MSc-thesis, professional skills can be practised in the internship and the Academic Consultancy Training (ACT) and you can work continuously on your attitude aspects.

Now try to set up five to eight concrete learning objectives with the use of the following four questions.

3a. What specific knowledge do you wish to improve on?
For example: 'I want to learn how plants react to pathogens on the molecular level'.

3b. Which specific skills do you want to train?
For example: 'I want to learn how I can analyse genetic variation with the use of statistical programs' or 'I want to learn to set up and give good PowerPoint presentations'.

3c. Which specific experiences do you want to get?
For example: 'I want to experience what it is like to do experiments with insects', or 'I want to experience what it is like to do research independently in a molecular labaratorium'.
The difference between experiences and skills is that an experience is something that happens to you, while a skills is something you train and use. An experience is 'done' when it is over, but a skill might need to be practised several times before you have mastered it. Skills like 'reporting methods and results in a log' or 'executing a PCR analysis', for example, can be practised. On the other hand 'doing research independently in a molecular lab' is something you just experience. After an experience you do not per definition have the skill that is related to it, while you always need the experience for the skills.

3d. Which other (personal) objectives or needs would you like to accomplish?
For example 'I would like to better handle my performance anxiety' or 'I would like to find out whether a job as plant breeder would suit me'. Try to set up attainable and measurable objectives.

4. Choice of Bsc thesis subject

4a. Preparations

Chosing a thesis subject may be very easy for one student, because he already knew what he wanted. It may be harder for another, because he is interested in too many things, or maybe he doesn't have anything that makes him really enthousiastic. Still, every student has to make a choice. Therefore, make sure to start thinking about what you would like to do well in advance (preferably half a year, but at least two months). Ask yourself what really interests you. You might want to brainstorm by writing down keywords on paper. Go by the courses you followed the past few years and remember which subjects (or which teachers!) really enthused you. You could even take a look on the internet or in other media at things you seem to like. Write down everything you find, so you have something to go with when you start looking for a research subject.

4b. Thesis-database and chairgroups

An overview of (Bsc-) thesis subjects is saved in a database you can reach with the following URL: http://tip.wur.nl. By chosing a chairgroup or a keyword you can select projects. Some keywords are more selective than others; you might need to try this out a little bit. Not all chairgroups have entered their graduation subjects in the TIP-database and the available information is not always completely up to date. Therefore you should always contact one of the contact persons/supervisors that are mentioned with a project for the most recent information. Information on possible graduation subjects can be found on the websites of the chairgroups within the department of Plant Sciences (http://www.wageningenur.nl/en/Expertise-Services/Chair-groups.htm).

4c. Method

1. Make a list of keywords that can compose a selection of subjects that interest you, or take a look at several chairgroups that interest you.
2. From the projects you found, select around five that think could make an interesting thesis subject for you. Study the available information accurately, and ask yourself for each subject:
    a. Is it sufficiently clear what the subjects include concretely? Write down which points need clarification or more information.
    b. Do you think there will be sufficient possibilities to realise your own learning objectives and needs? Write down critical points that you would like to have more clarity about.
3. Next, contact the supervisors that are involved with the subjects (e.g. per email) to make an appointment for more information and clarification.

When you experience problems in contacting supervisors it is important to report this immediately to your study advisor or the programme director. For supervisors there is a special guide about the background and intention of the BSc thesis. This information brochure will be provided electronically upon request by Anja Kuipers.

4d. The final choice

When you have gathered all information, the different possibilities need to be weighed against each other. Take your time for this and list the pros and the cons of the different options (personal report). Let yourself be lead by those things that matter to you in making the decision. Keep an eye on your learning objectives and needs. You can also think of, for example, things that would be interesting in the labor market. If necessary, go over the hard choices with your study advisor.

5. Design and planning (the first three weeks) of your BSc thesis

In the first week of your BSc thesis you will work on your self-reflection. In the second and third week you will work on writing a detailled research proposal for the project you chose. For writing the research proposal, 84 hours have been scheduled (= 3 ECTS), of which about 8-10 hours are available for contact with the supervisor(s).

Below follows a summation of the difference aspects that need to be addressed, from the very first start of your thesis until handing in your research proposal. Besides that there is a global time indication. The time you need can differ strongly per person, field or research question, so be flexible where needed.

5a. Introduction to the chairgroup (1st day)
On the first day you are supposed to meet the researchers and students that work at the chairgroup. Furthermore, your supervisor will inform you about the rights and duties at the chairgroup, which differ for each group. This includes workspace, computer facilities, laboratory rules, use of equipment and chemicals, amortizing of certain equipment, use of greenhouse, etc.

5b. Writing the self-reflection (1st week)
In order to map your own knowledge and skills and to set up your own needs and learning objectives for the BSc thesis, it is important to write the self-reflection before you start with your research. Therefore you have the first week to work on this. See Chapter 3 of this guide for writing the self-reflection.

5c. Orientation on the subject and introduction to relevant techniques and methods (2nd week)
The supervisor usually takes care of the necessary starting literature (articles, thesises, student reports) that relate to the subject of choice. You need to form an elaborate image of the scientific background of the research question by studying the current literature. Based on the starting literature you will start searching for other relevant literature, via the library or the computer. Reading is preferably done on location because in case of problems or ambiguities, you can get feedback from your supervisor shortly. It is wise to summarise the information in an organised manner from the very first start, keeping in mind the writing of your research proposal and eventually the thesis. When collecting literature, it is easy to end up in an excess of sources because every publication references other authors (the snowball effect). Therefore you must be critical and selective in what you do and do not consult.
Depending on the subject there might be several experimental methods and techniques that are necessary to execute a thesis project. Often these are existent techniques that are applied routinely in laboratory, greenhous or field. You could, for example, shadow post-docs, promovendi or analysts to gain some practical experience with the techniques you will probably use in your research. An important aspect in this is to get a feeling for how much time certain techniques cost and how routinely they can be applied. Some procedures seem simple but turn out to not go well in practise. You will need to take this into account in your final planning. It is important to realise that the BSc thesis has a limited scope and that you should plan experiments that are attainable within that limited time. If this is not possible, you should look for alternatives or even change the research question.
Another important moment is an introduction to the computer programs and statistical methods that are relevant to the subject. Learning to work with such processing methods also takes time, dependant on your own experience. Furthermore, a good understanding of the statistical methods you will apply is important in chosing a suitable experimental design and determining the amount of data to be collected.

5d. Writing and discussing the research proposal (3rd week)
When all required data is available, the definitive research proposal can be drafted. For a global design, see the scheme below (Box 1).
The scientific background and research question simultaneously form the basis for the introduction chapter of your final thesis. Mind you: a literature analysis entails more than just summing the information your found about a certain topic in literature. An important aspect is that the information is summarised and arranged in a structured way. There is no standard recipe for the presentation of the information you found in literature. Ideas about this will need to develop slowly as you start writing down and arranging the data in a draft. Try to recapitulate the data in your own words as much as possible. Try to keep the use of quotes to a minimum. An introduction that consists of 75% quoted material, even if it is referenced very neatly, is unacceptable.

Obviously it is important to include a detailed planning of the research activities you need to execute, of the processing of the data and of writing the report. You need to discuss this thoroughly with your main supervisor before potentially presenting it to the research group you have been working at. It is possible you get more suggestions on things you could include in the plan during this presentation. When writing, keep an eye on readability, design and layout.
NB: You need to hand in one copy of the written research proposal via email (pdf format) to the programme director.

Box 1: Research proposal, schematic design

(The layout needs to be taken care of, don't forget to add pagenumbers)

1. *Title page*
   - Title research, names (student + reg. nr., supervisor(s) with mention of the chairgroup/research group), date, course name + code, possibly an illustration that relates to the described research.

2. *Contents*

3. *Preface*
   - Here you need to make clear what the context of the thesis is in relation to your education (purpose, place and content of the thesis with regard to the study) and to yourself.

4. *Summary of research questions and -objectives (½ - 1 pages)*

5. *Introduction; elaborate explanation and background information (2 - 5 pages)*
   - Introduction of the subject
   - Further elaboration of research questions and -objectives
   - Scientific relevance
   - Experimental approach (methods, techniques)

6. *Processing of the data (1 - 2 pages)*
   - Nature of the data that are to be collected
   - Methods for analysis and processing
   - Ways to present the data

7. *Workplan (1 - 2 pages)*
   - Detailed program of activities (week to week)
   - Phasing of the different components
   - Planning of the activities on a week basis: graphical representation strongly increases readability

8. *Emergency scenario's*
   - What to do in case of adversities?

9. *Costs*
   - Estimation of costs that need to be made for execution of the activities (materials, devices, transport, travels, permits, etc.)

10. *References*

6. Execution of the experiments with the BCs thesis

For about six weeks you will be working on the execution of your research. In this time you will do the experiments and collect and analyse your research data. During this period you will be part of the daily business of the chairgroup/research group you are doing your thesis at. This means you will have regular contact with the researchers and analysts about the current research within the group.

In this phase of your BSc thesis the following points are of importance:

- Keeping a labjournal/log
    - In the log you will write down every day which experiments you execute and you also note all results/research data from your experiments.
- Partaking in meetings of the research group
    - You will discuss your own progress here and you can talk along about the current research in the group.
- Keeping an eye on the planning
    - You only have limited time available, so keep an eye on your planning. If necessary, adapt your research plan and planning, in consultation with your supervisor.
- Discussion with your supervisor
    - You are supposed to go over your progress very regularly with your supervisor.
- Recording results
    - Make sure you record all results of your experiments in a complete and organised manner. This will make it easier to analyse your data and it is a good starting point for writing your thesis report.

When you are doing your experiments there will probably be moments where you will not have anything to do. For example your bacteria culture might be incubating or your model has to run all afternoon. Use this time to make a start at writing your report. This prevents having to do a lot at the end of your thesis period, and helps your deliver a better final product.

7. Writing the BSc thesis

7a. Size and components of the thesis

When writing a thesis, choices have to be made regarding format and length of the different components. With regards to the readability of the final report you can use the following format as a global guideline (see also Box 2):

- Summary	100 - 200 words
- Introduction	2000 - 2500 words
- Material & Methods, results	3000 - 5000 words
- Discussion	1200 - 1500 words

7b. Formulating the research question

An important step with writing the thesis is the precise formulation of the research question. It is possible that the original research question from the research proposal needs to be slightly adapted. Potential reformulation of the research question can help you in writing the thesis.

7c. Processing the information

A thesis is more than just a summation of your results. An important aspect of the thesis is that the results must be ordered and displayed in a structured way. Most of all, the results must be analysed critically. This means that you have to develop your own ideas on how to best present the results and which new points of view, connections, conclusions and answers you were able to find. Often you will find contradictions or differences regarding available literature, which you can use for a critical discussion. See Box 2: Design and content of the thesis report.

7d. Writing problems and how to prevent them

In writing a thesis, several different problems can pop up. As usual, it rings true here that preventing problems is better than having to solve them. Therefore it is important to be aware of possible sources for problems during the different phases of chosing, working on and writing a thesis. An overview of potential problems and advice on how to best prevent them can be found in appendix 3.

7e. Concept version and feedback

Before handing in the definitive version of your thesis, you are given the opportunity for handing in a concept version to you thesis supervisor. Your supervisor will supply you with feedback and will offer you explanation on it, if needed. Then they will advise you on potentially desirably adaptations. After this you can rewrite your concept version into the definitive version of your thesis. Then you can hand it in for a definitive assessment. In principle, you hand in one concept version to your supervisor for feedback. However, of course you can always ask questions while writing the thesis whenever you cannot solve something on your own. It can be very useful to ask direct feedback when you finish a piece of text, such as a chapter.

7f. Oral presentation

At the end of your research you are expected to give an oral PowerPoint presentation for the fellow students doing their BSc thesis and your supervisors. The presentation should take about 15 minutes, plus 5 minutes for questions. You need to go over the relevance of your research, give your research a short introduction, discuss the applied methods, the results, conclusions and points of discussion. The presentation will be 5% of your final grade.

In the assessment of your presentation, the structure and format, overview, clarity and appeal of your presentation will be looked at first. You can attain a good structure by sticking with the introduction-methods-results-conclusion/discussion order of your report and by indicating where in that order you are during the presentation. You can attain a good overview, clarity and appeal by using more figures with small portions of information each. Make sure the figures have clear labels, don't put too much text on the slides and take care of the layout.

Secondly, your oral presentation skills will be considered. You are expected to speak calmly and clearly, to keep your audience in mind, to make sure your presentation is neither too long nor too short, and that you can answer the questions as clearly as possible. Keeping your audience in mind means for example explaining a certain aspect some more when you know part of your audience knows nothing about that. Furthermore, there are the standard comments such as "look into the room", "don't read from your paper or from the slides", etc.

7g. Final interview and assessment

Your thesis supervisor and the examinator will assess the definitive version of your BSc thesis with reference to an assessment form (see: Appendix 2). Along with the assessment form there is a Rubric available which elaborates the assessment per criterium.

In the final interview both your supervisor and your examinator will be present and you are expected to "defend" your thesis. You will do this by answering several critical questions from your supervisor and the examinator, clearly indicating why you chose for a certain way of doing research, how you obtained your results (and what makes them reliable), and how you got to your conclusions. Furthermore you will go over your personal learning objectives and how well you obtained those during your BSc thesis.

After the defence, your thesis will be assessed by your supervisor and the examinator together. You will be informed of your grade after which you get an explanation on the different grading aspects and your score. In response to this, your thesis supervisor will advise you on which aspects of knowledge and skills were (very) good and which could use further improvement. To conclude, you can indicate what you liked about the thesis, what you learned from it and which problems you encountered. Your supervisor and examinator can use this information to further improve the course.

Box 2: Design and content of the thesis report

When you have finished the planned experiments and your ideas on the format of your thesis have started to materialize, you can start writing the concept version of the thesis. For the readability it is important to realise who the thesis should be interesting for. Don't aim at an imaginary expert in the subject field (who will understand what you mean anyway). Rather, aim at an intersted classmate, having the same basic knowledge of the subject field as you do. Present your information as clearly as possible to them.

a. Writing the (intent of the) introduction

For most of the introduction you can use the introduction you wrote for your research proposal. Regarding the components 'research questions' and 'aim', only make a global setup. You will write the definitive text of these parts of the introduction after finishing the conclusion and discussion. When the time is there, first of all write a further explanation and motivation for the chosen subject and the specific research question you have tried to answer. Subsequently, describe in short how you have done your research, so which methods you have used to answer your research questions.

A good 'thread' to follow when writing an introduction is as follows:

a) Motivation (in the context of society)
b) Background
    i. What is known?
    ii. What is not known yet?
    iii. Which unclarities or controversies will this research examine?
c) Aim of the research
d) Research questions and hypotheses
e) Short description of the research (how and what the research involves)

b. Methods and materials

Although reporting your results is more important than reporting your methods, you can start with this quite early on. You can start elaborating your methods while you are still executing your research, for example when you have nothing to do for a moment. You must report your methods in such detail that another researcher can repeat the experiment. Therefore you must describe the conditions under wchich you did your research exactly. Conditions could be temperature in your greenhouse, company where the enzymes were bought, etc. You have to completely transcribe protocols for new methods. For 'daily' protocols it is enough to summarize and refer to the source. Under methods you should also give a description of the (statistical) analysis of the data.

c. Presentation of the results

In this chapter you show your research results with the aid of figures and tables. If you use statistical analysis on your results, the outcomes of this will be mentioned below the results. The figures and tables need to have captions that you can read separately because they contain all information needed. Use the articles you have read and take a look at the formulation of the captions of the tables and figures.

With the text you bring forward the most important results from the figures and tables and you focus the reader's attention on it. Besides that, the text can be used to place results in the context of the prevailing conditions and to compare with other results. However, do pay attention to keep the interpretations and discussion of the research results for the discussion.

d. Discussion and conclusions

This chapter should be a logical follow-up to the original research question in the introduction. Therefore it can be useful to start with a short repetition or summary of the research question. The most important elements of the discussion and conclusions should already have come up in the presentation of the results. In the discussion you will compare the (dry) results and analyses with available literature and add conclusions, solutions, your own vision or expectations for the future to this. You should not add new results here, but you should focus on a concluding discussion of your data and analyses. Usually you finish this discussion with several conclusions you think you can draw from your data and the data you attained in the literature. This also includes recommendations, for example what you think would be a logical way to follow up on the research.

e. Summary

As a last component you will write a summary of the thesis, which sums the most important elements in short. These elements are the research question, the results, analysis and conclusions. Put this abstract in front of your report.

f. References

In the references, the complete details of all used literature sources are mentioned. Try to mainly use information from articles published in 'peer-reviewed journals'. Use a uniform format to cite the references that fits the customs of the field of study. For this you can take a look at references in some articles you use in your thesis, or use the examples below.

References to articles can be written as follows:

- Sanger, F., Nicklen, S., Coulson, A.R. **DNA sequencing with chain-terminating inhibitors** (1977) *Proc Natl Acad Sci* 12(74), pp. 5463-5467.

References to chapters from books can be written as follows:

- Hansen, B. **New York City epidemics and history for the public**. In: Harden, V.A., Risse, G.B., editors. **AIDS and the historian** (1991) *Bethesda: National Institutes of Health*, pp. 21-28.

Keep in mind: we recommend using EndNote for archiving your literature and making and refering to your literature references. If you do not know how to use EndNote, you can follow a course yourself or follow a (monthly) demonstration in the library (see: http://www.wageningenur.nl/en/Expertise-Services/Facilities/Library/Expertise/Support-training.htm).

g. Finishing and layout

The final report needs to look neat. Clarity and lay-out are important for the readability. Do not forget to add a table of contents, a title page (for information see the manual for the research proposal), a foreword and, if you want, acknowledgements (in which you mention people/organisations who have contributed to your research and are not mentioned in any other part) at the end. Also remember the page numbers and (very important!) the captions of the tables and figures, including numbering.

8. Conclusion & afterword

When all components are finished, you can take the final stock for your own BSc thesis. It is possible that aspects came up that you, in hindsight, aren't very content with. It can be useful to discuss this further with your thesis supervisors, so you can learn from it and consider ideas for solutions. In any case, it is important to clear up any potential problems or bottlenecks before starting your MSc thesis. In case any bottlenecks, doubts or questions remain, contact your study advisor and discuss these matters.

Although it will not be taken into account for the assessment, it is useful for yourself to take half an hour after finishing your thesis to evaluate. For the evaluation you can use the learning objectives of the course and most of all the learning objectives you set for yourself, as a starting point. Have you attained your learning objectives? If so, what will your next objective be? It not, why not? Was the objective realistic? If not, how can you adapt it to make it realistic next time?
Furthermore it is useful to write down what you liked, what you did not like as much, what you found hard, what you found easier, what important things you learned/experienced, etc. At this moment it is still fresh in your memory. By listing these things you have a nice starting point for you MSc thesis. It is also a good way to finish everything.

If you have feedback on the course or on this study guide, you can contact Anja Kuipers.

Have fun and good luck in the next phase of your studies!

Appendix 1: BSc-thesis contract

Student information:

Name: ..... Reg. nr.: .....

Address: ....

Tel.: ....

Statement study adviser:

Name: ..... , study adviser Plant Sciences, has checked the study progress of the student mentioned above, and approves the plans to start the BSc Thesis Plant Sciences.

Date:..... Signature: .....

Information BSc thesis supervisor:

Name: ....

Chair group: ....

Tel.: ....

Agreements on the BSc thesis:

Subject / title: .....

.....

.....

ECTS credits: 18

Target dates: 1. Start thesis work: .....

2. Hand in self-reflection:

.....

3. Hand in concept research plan: .....

3. Discuss concept research plan: .....

4. Hand in concept thesis report: .....

5. Discuss concept thesis report: .....

6. Hand in final thesis report: .....

7. Oral presentation: .....

Additional agreements: .....

.....

.....

Signatures:

BSc thesis supervisor:..... Student:.....

date: ..... date:.....

NB: A copy of the signed form should be handed in at the Student Desk Plant Sciences

Appendix 2: Assessment form

Assessment BSc thesis Wageningen University			
v1.6 Sonja Isken on basis of work from Jan Philipsen, Maria Smetsers, 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			
Assessment criteria		Grading Mark 1-10	Relative weight *
A1 Research competencies (20-55%)*			35%
1 Initiative, pro-activity and creativity			
2 Commitment and perseverance			
3 Proposal			
4 Time management			
5 Critical and self reflective capacity			0.0
6 Handling supervisors comments			
7 Analysis and processing (literature) data			
A2 Experimental skills (0-50%)			10%
1 Technical skills			
2 Accuracy			0.0
3 Lab journal, logbook			
A3 Programme specific qualification (0-70%)			5%
BPW: Self reflection report			0.0
B Report (10-60%) *			40%
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			
C Presentation (0-15) *			5%
1 Graphical presentation			0.0
2 Verbal and non-verbal presentation			
D Final discussion (0-10%) *			5%
1 Knowledge study domain			0.0
2 Defence of thesis			
* Choose rel. weights to a total of 100%			
	TOTAL		**0.0**
	FINAL GRADE		
Comments			

Appendix 3: Thesis problems

Problem stems from:	**Advice:**
Subject choice	
1. Insufficient prior knowledge on the subject.	1. Make sure you have sufficient prior knowledge on the subject you are going to choose, or that you can obtain the required prior knowledge within a reasonable period of time.
2. Insufficient motivation regarding the subject.	2. Make clear for yourself why you are chosing a certain subject. Don't start on a subject you doubt will stay interesting to you.
Definition subject/research question	
3. Overambitious research question.	3. Do not take on too much work! Choose a thesis subject that can reasonably be executed within the available time.
4. Insufficiently accurate research question; insufficient definition of the subject.	4. Formulate a clear research question for your thesis, define the subject as sharply as possible. Prevent 'drowning' in the amount of aspects you deal with in your subject.
Selection and organisation of data	
5. Insufficiently selective collection of literature data.	5. Know what precisely you have to search for; prevent having to sort through an overflow of literary data afterwards.
6. Insufficient view on coherence of data and complexity of the subject.	6. Prevent looking for all kinds of literary data first and only questioning the coherence between them afterwards.
Reporting in written form	
7. Lack of a proper structure for the thesis	7. First try to make a good division in chapters and paragraphs. If you get stuck with this, as for help from your supervisor or have a look on the internet.
8. Having trouble writing down a comprehensible text (several causes possible)	8. Prevent reaching a dead end in your writing process: consult one of the books from the literature references or ask advice from your thesis supervisor if you need it.
9. Having trouble with critical feedback on concept texts	9. Try not to see comments/feedback on the first version as a sign of failure, but as a normal step to get to a readable text.
Execution and control over activities	
10. Insufficient self discipline; procrastination.	10. Make a realistic planning, with space for other activities you find important. Check weekly whether you are making enough progress, prevent being frustrated by your (lack of) progress by not sticking to your planning.
11. Being insufficiently critical on the quality of your own work.	11. Ask yourself regularly whether the results of your work are meeting the requirements of relevance and quality.

Appendix 4: Skills for making a thesis

(based on: Miranda & Wardenaar, 1997)

I. Being able to work individually and independently
1. Being able to engage in a task for several weeks
2. Being able to work completely individually
3. Knowing what you want
4. Being able to organize and plan your own work
5. Persevering and enduring
6. Keeping yourself in check
7. Contacting your supervisor on your own
8. Knowing your own restrictions
9. Being able to correct your own mistakes
10. Being motivated

II. Having overview over the task
11. Being able to oversee the relation between the task and the available time
12. Planning of activities
13. Watching over the time per component or phase
14. Looking ahead and anticipating on what is to come
15. Watching over the extent of the activities

III. Being able to do literature research
16. Chosing a suitable thesis subject by yourself
17. Being able to estimate the researchability of a subject
18. Further delimiting a subject and being able to formulate a concrete research question
19. Being able to search and find relevant literature sources
20. Selecting and using relevant literature sources
21. Being able to summarize and display literary data in an organised way (not by copy/pasting)
22. Being able to interpret literary data in the context of the research question
23. Being able to draw conclusions based on the data in relation to the research question
24. Being able to relate conclusions to a theoretical framework
25. Motivating and justifying choices you made

IV. Reporting in written form
26. Knowing and applying design aspects
27. Applying a logical structure
28. Dividing the thesis into chapters, sections, paragraphs and the titles that belong to them
29. Managing the lay-out of text, tables and figures
30. Correctly processing special sections of text (preface, appendices, notes, list of references, references, quotes, summary/abstract)
31. Formulating clearly
32. Defining unambiguously
33. Writing consistently
34. Using a correct style
35. Spelling flawlessly
36. Writing a summary/abstract

V. Mastery of the subject
37. Possessing or obtaining a thorough knowledge of the thesis subject
38. Possessing and applying general discipline-specific (basic) knowledge
39. Applying the discipline-specific mindset
40. Applying discipline-specific frameworks and concepts
41. Applying methodological knowledge
42. Applying statistical knowledge
43. Having an overview of (developments in) your own field of study
44. Having your own vision on or engaging creativity regarding the field of study

Appendix 5: Supplementary information for the self-reflection assignment.

Wordlist
From the Collins' Dictionary for Advanced Learners (2001), *HarperCollins Publishers*, Glasgow.

- Knowledge: information and understanding about a subject which a person has, or which all people have.
- Skill: a type of work or activity which requires special training and knowledge, OR the knowledge and ability that enables you to do something well.
- Attitude the way that you think and feel about something, especially when this shows in the way you behave.
- SMART: Specific, Measurable, Acceptable, Realistic , Time-related

Learning outcomes BSc Plant Sciences

After successful completion of the BSc programme Plant Sciences students are expected to be able to:

1. Explain the biology of plants in their environment, both at a fundamental level and in terms of the various functions of plants for people and animals, based on knowledge of plant physiology, morphology and taxonomy, biochemistry, organic and physical chemistry, molecular and cell biology, mathematics, statistics, genetics and ecology
2. Major-specific learning outcomes:
    a. Apply the knowledge of fundamental processes in plants at the molecular and cellular level in order to analyse the development of novel varieties, the interactions between plants and their pests and pathogens, and the use of plants and plant products for food and health purposes (Major Plant Genomics and Health)
    b. Apply the knowledge of the role of natural resources and environmental factors on plant and (agro-)system development in order to analyse open and protected plant production systems, and the interactions between agriculture and its environment in a wide range of agro-ecological systems (Major Plant Production and Ecology)
3. Apply laboratory techniques, analytical measurements, mathematical and statistical methods for the collection, processing and analysis of experimental data in plant science, and to judge their suitability in solving specific research questions
4. Resolve a scientific problem in plant sciences into research questions and develop a scientifically relevant research plan in which problem definition, hypothesis, experimental set-up and data analysis are described in relation to existing literature (under supervision)
5. Perform (under supervision) simple scientific experiments and analyse and interpret experimental data, in order to develop or design a novel solution, system, model or product
6. Demonstrate a scientific approach by:
    - retrieving and critically selecting relevant literature from bibliographic databases
    - combining new knowledge with previously obtained knowledge
    - understanding of the process of testing hypotheses, theories and models through experiments
7. Communicate verbally and in writing about the results of learning, experiments and project work with specialists and non-specialists, both in Dutch and in English
8. Co-operate in a team of students to perform project-based work
9. Understand the international, socio-economical, ethical, cultural and temporal context of new developments in plant sciences
10. Reflect (under supervision) upon personal knowledge, skills, attitudes and functioning, both individually and in discussions with others and design and plan their own learning path

Intermezzo 1: about what you can learn

Up until now you have followed many courses in which the teacher determined what you had to learn. Put differently, the teacher determined your learning objectives. During an internship and thesis there is much more space for incidental learning besides the learning objectives. It is up to you to structure that incidental learning and to not just leave it to coincidence whether you learn anything and what you will learn.
De Groot (1980) has made a two-by-two classification of learning objectives, meaning of anything you could be learning. In the first partition, De Groot distinguishes between learning from rules and learning from exceptions. In the second partition he differentiates between learning about the world (field of study, profession and tasks) and learning about yourself (self-knowledge). In a scheme:

	Rules	**Exceptions**
World	A	B
Self	C	D

De Groot's statement is that, regardless of what someone learns, that specific learning experience can be put in one of the four categories. The courses you have followed up until now will mostly have had the objectives of teaching you (profession-bound) rules. Besides that, it is of importance for your future professional functioning to also learn about the exceptions of the rules about the world. It is particularly important to learn rules and exceptions on those rules about yourself: your own capacities, skills and characteristics. Internships and thesises are suitable learning environments to attain learning objectives in the areas B, C and D.

(Groot, A.D. de (1980). Over leerervaringen en leerdoelen. Handboek voor de onderwijspraktijk afl. 10. Deventer: Van Loghum Slaterus)

OLD REFERENCE, THIS LINK IS POSSIBLE AS WELL:
http://pagesperso-orange.fr/gerard.van-eyk/biblio/leererva.htm

Intermezzo 2: about how you can learn skills

In acquiring skills it is necessary to become conscious of a lack in a certain (part of a) skill. Once it is clear which (part of a) skill is lacking, the next step is to learn this (part of a) skill or unlearning wrong behaviours and/or attitudes. At the start a new skill feels unnatural and awkward; only after a lot of practice the new skill will be integrated in the personal functioning. You have mastered a new skill.
The phases in developing new skills are:

1 *Subconsciously incompetent*
Students don't know they are doing or seeing something not right or wrong;
2 *Consciously incompetent*
Students know they are not doing or seeing something right, but are not able to do it better yet;
3 *Consciously competent*
When students think about it carefully and take their time they are capable of applying the skill (= behaviour or attitude);
4 *Subconsciously competent*
Students no longer need to think about it and automatically do it right. The new behaviour or attitude has become normal.

Therefore it is important to discover there is something that needs improving in the first phase. In the second phase you require study material or teachers that clarify how you need to do it. In the third phase it is key to practise and get feedback on this practise from classmates and the teacher.