

# Department of Soil Science

## Graduate Program Handbook

---

### Table of Contents

|                                                                      |          |
|----------------------------------------------------------------------|----------|
| Preamble.....                                                        | 4        |
| 1. Introduction.....                                                 | 4        |
| 1.1 Mission of the Graduate Program in Soil Science .....            | 4        |
| 1.2 Graduate Degrees Obtainable .....                                | 4        |
| 1.2.1 Master of Science (M.Sc.) .....                                | 4        |
| <b>1.2.2 Doctor of Philosophy (Ph.D.) .....</b>                      | <b>4</b> |
| 1.3 Administration of the Graduate Program .....                     | 5        |
| 1.3.1 Applications and Admissions .....                              | 5        |
| 1.3.2 Soil Science Graduate Committee .....                          | 5        |
| 1.3.3 Graduate Program Administrators .....                          | 6        |
| 2. Programs and Supervision .....                                    | 6        |
| 2.1 Supervisors and Graduate Advisory Committees .....               | 6        |
| 2.1.1 Appointment of a Supervisor.....                               | 6        |
| 2.1.2 <i>Appointment of an Advisory Committee.....</i>               | <i>6</i> |
| 2.1.3 Role and responsibilities of student .....                     | 7        |
| 2.1.4 Role and responsibilities of supervisor(s).....                | 8        |
| 2.1.5 Role and responsibilities of graduate advisory committee ..... | 8        |
| 2.1.6 Student Supervisor Agreement .....                             | 9        |
| 2.2 Graduate Committee Meetings .....                                | 9        |
| 2.3 Chairing Graduate Advisory Committees.....                       | 9        |
| 3. Program Requirements .....                                        | 10       |
| 3.1 Course work .....                                                | 11       |
| 3.1.1 M.Sc. ....                                                     | 11       |
| 3.1.2 Ph.D.....                                                      | 11       |
| 3.2 Research Proposals: Mini-proposals and Full Proposals.....       | 11       |
| 3.2.1 Mini-proposal.....                                             | 11       |
| 3.2.2 Full Proposal.....                                             | 12       |



|       |                                                           |    |
|-------|-----------------------------------------------------------|----|
| 3.3   | Progress Reports and Permission to Write Report .....     | 13 |
| 3.4   | Seminars.....                                             | 14 |
| 3.5   | Candidacy Examination .....                               | 14 |
| 3.5.1 | Ph.D. Candidacy Exam Part I: .....                        | 14 |
| 3.5.2 | Ph.D. Candidacy Exam Part II: .....                       | 15 |
| 3.6   | Thesis/Dissertation.....                                  | 16 |
| 3.6.1 | Permission to Write .....                                 | 16 |
| 3.6.2 | Thesis/Dissertation Preparation .....                     | 16 |
| 3.6.3 | Dissertation Summary: .....                               | 17 |
| 3.6.4 | Electronic Theses and Dissertations (ETD).....            | 17 |
| 3.7   | Oral Defense.....                                         | 17 |
| 3.8   | Generative Artificial Intelligence Tools Policy.....      | 18 |
| 3.9   | Time in Program .....                                     | 19 |
| 3.9.1 | Time Extensions .....                                     | 19 |
| 4.    | Funding .....                                             | 20 |
| 4.1   | Stipends.....                                             | 20 |
| 4.2   | Soil Science Graduate Scholarship Fund .....              | 20 |
| 4.2.1 | Types of Scholarship Support .....                        | 20 |
| 4.2.2 | Administration of Student Support Fund Scholarships ..... | 23 |
| 4.3   | Other Scholarships .....                                  | 23 |
| 4.3.1 | Rhizosphere 5 Student Travel Award .....                  | 23 |
| 4.3.2 | College of Agriculture and Bioresources .....             | 24 |
| 4.3.3 | College of Graduate Studies and Research.....             | 24 |
| 4.3.4 | Department Teaching Assistantships .....                  | 24 |
| 4.4   | Research Project Funding.....                             | 25 |
| 4.5   | Volunteer Research Assistants.....                        | 25 |
| 4.6   | Travel Funds .....                                        | 25 |
| 5.    | Vacation, Leaves of Absence, Transfers, Withdrawals.....  | 26 |
| 5.1   | Vacation and Leaves.....                                  | 26 |
| 5.1.1 | Vacation .....                                            | 26 |
| 5.1.2 | Leaves of Absence.....                                    | 26 |
| 5.2   | Program Transfers.....                                    | 26 |
| 5.2.1 | Transfer from One Academic Unit to Another .....          | 26 |



|       |                                                        |    |
|-------|--------------------------------------------------------|----|
| 5.2.2 | Transfer from Ph.D. Program to M.Sc. Program.....      | 26 |
| 5.2.3 | Transfer from M.Sc. Program to Ph.D. program.....      | 26 |
| 5.3   | Withdrawals and Requirement to Discontinue (RTD).....  | 27 |
| 5.3.1 | Voluntary Withdrawal.....                              | 27 |
| 5.3.2 | RTD for Lack of Registration .....                     | 27 |
| 5.3.3 | RTD for Unsatisfactory Progress in Program .....       | 27 |
| 5.3.4 | Readmission After Withdrawal or RTD from Program ..... | 27 |
| 6.    | Grievances and Appeals .....                           | 28 |
| 6.1   | Appeals With Respect to Academic Standing .....        | 28 |
| 6.2   | Appeals With Respect to Academic Unit RTD .....        | 29 |
| 7.    | Student Representation .....                           | 29 |
| 7.1   | Soil Science Graduate Students' Association .....      | 29 |
| 7.1.1 | Purpose of the Association .....                       | 29 |
| 7.1.2 | Membership.....                                        | 29 |
| 7.2   | Representation at Departmental Meetings .....          | 29 |
| 8.    | Appendix A –Soil Science Roadmap .....                 | 30 |
| 9.    | Appendix B Mini-proposal outline.....                  | 32 |
| 10.   | Appendix C Soil Science Education Equity Plan.....     | 36 |
| 11.   | Appendix D: Example Ph.D. Candidacy Exam Part I.....   | 37 |



# Department of Soil Science

## Graduate Program Handbook

---

### Preamble

The Department of Soil Science Graduate Program Handbook is the rulebook for graduate study in our Department. It presents and discusses briefly the policies, procedures and guidelines of the graduate program. The Handbook is complementary to the Policy and Procedures Manual of the College of Graduate and Postdoctoral Studies (CGPS), plus certain aspects that are unique to the Department. The Handbook is a living document, reflecting changes that are brought forward by the Graduate Committee and approved by the Department at Staff Meetings from time to time. Graduate students at the University of Saskatchewan are members of the Public Service Alliance of Canada (PSAC). The current collective agreement can be found at: <https://working.usask.ca/agreements/psac/agreements/graduate-students/index.php>.

## 1. Introduction

### 1.1 Mission of the Graduate Program in Soil Science

“To provide a stimulating and challenging environment where students have the opportunity to learn, exchange ideas and acquire research skills.”

### 1.2 Graduate Degrees Obtainable

#### 1.2.1 Master of Science (M.Sc.)

The primary objective of the M.Sc. program is to provide students with advanced training in Soil Science, utilizing a combination of in-depth courses and supervised research. A secondary objective is to give students the opportunity to develop communication skills (oral and written) important to those anticipating a career in industry, government or academia.

Many students complete the M.Sc. program and move on to careers in agriculture, environmental consulting and related fields, and benefit from the additional training the program provides. For others, the M.Sc. is a transition to a Ph.D. program, which is oriented toward less-supervised research.

#### 1.2.2 Doctor of Philosophy (Ph.D.)

The primary objective of the Ph.D. program is to prepare students for careers in research, with an emphasis on basic or fundamental research. A secondary objective is to develop instructional and communication skills (oral and written) particularly important to those anticipating an academic career. It is our goal for students to become specialists in a certain area of research, but also to be exposed to the broader field of soil science, and be at least familiar with related disciplines.



## 1.3 Administration of the Graduate Program

### 1.3.1 Applications and Admissions

Applications are submitted online through the College of Graduate and Postdoctoral Studies website at: <https://grad.usask.ca/admissions/how-to-apply.php>. Applicants must meet all of the CGPS guidelines for admission in order to be considered for a graduate program in Soil Science. Information pertaining to application procedures and admission requirements is available through the CGPS and the College of Agriculture and Bioresources websites at: <https://cgps.usask.ca/> and <http://agbio.usask.ca/students/graduate/index.php>.

Students will be admitted only upon the recommendation of the Department of Soil Science. Recommendations are based on the evaluation of academic ability, availability of an appropriate supervisor, and establishment of suitable financial arrangements. To be admitted into a M.Sc. program, students must have an undergraduate degree comparable to a B.S.A. from the University of Saskatchewan. To be admitted into a Ph.D. program, students must have a M.Sc. from a university recognized as having standards comparable to those of the University of Saskatchewan. The option to transfer from a M.Sc. program into a Ph.D. program may be possible, but only when a student demonstrates outstanding performance during the first year of their M.Sc. program (see Section 5.2 Transfers).

Potential students *must* identify a research/academic supervisor in order to be granted admission in a Soil Science graduate program. Once this is done, the faculty member must provide a letter or email indicating: a) that the faculty are willing to supervise or co-supervise the student, and in the case of co-supervision, with whom, b) indicate which grant will support the student, at what level and for how long and c) what program the faculty are willing to accept the student for, M.Sc., or Ph.D. This package is now considered a ‘complete application’ and will be forwarded to the graduate chair.

The graduate committee will review all completed applications and make a decision as to a) whether the student should be recommended to CGPS for admission into the program and b) whether any additional undergraduate course(s) are required as a condition of admission.

Once the Department recommendation has been approved by the CGPS, that office will process an acceptance letter and the required steps in order for a student to begin the registration process. They will also provide a letter to international candidates that must be submitted when applying for a student travel visa and study permit.

For detailed information on graduate programs and for the CGPS Policies and Procedures manual, please refer to the College website links at: <https://cgps.usask.ca/> and <https://cgps.usask.ca/policy-and-procedure//index.php>.

### 1.3.2 Soil Science Graduate Committee

A single Graduate Committee exists to oversee all aspects of the Soil Science Graduate Program, such as admissions, scholarships, qualifying and comprehensive exams, as well as changes to this Handbook. The committee consists of four members of the faculty, one of whom is the chairperson.



### **1.3.3 Graduate Program Administrators**

The Graduate Program Administrator (GPA) for Soil Science is located in the Graduate Programs Office in the College of Agriculture and Bioresources, Agriculture 2D14. The GPA assists students with the administrative aspects of the graduate program, from processing the original application to initiating and maintaining the course program planner, and submitting advisory committee minutes, progress reports and examination results into the student's online record. If a student is experiencing registration difficulties, the GPA may be able to assist. Generally this may be the case of a required override for an undergraduate course being added to the program planner and a tuition waiver request being submitted. Towards the end of a student's program, the GPA will prepare documents for the thesis defense and all administrative details for completion of the program will be submitted to the CGPS through this office.

At the start of the graduate program, the GPA will provide a student with the letter of offer and payroll forms. At any time in a program, a student may request a letter of confirmation of enrollment in order to have a study permit, visa or SIN renewed.

While the Graduate Programs Office cannot provide student advising, it will provide assistance in administrative issues wherever possible. Assistance with advising issues should be dealt with through the student's supervisor, the Department Graduate Chair, the CGPS, Student Central or the International Students' Office.

## **2. Programs and Supervision**

### **2.1 Supervisors and Graduate Advisory Committees**

#### **2.1.1 Appointment of a Supervisor**

To be eligible to supervise a graduate student at the MSc or PhD level in the Department of Soil Science, the supervisor must be a member of the Soil Science faculty and the College of Graduate and Postdoctoral Studies (CGPS). Adjunct faculty members are not permitted to sole supervise graduate students, but may co-supervise at the MSc or PhD level. Other co-supervision arrangements may be made, subject to the approval of the department and CGPS.

All supervisors must be approved by the Graduate Committee. During a leave of absence, the supervisor is expected to ensure that adequate provision has been made for continued supervision of the student.

#### **2.1.2 Appointment of an Advisory Committee**

To serve on a graduate Advisory Committee, potential committee members must be a member of CGPS (regular or adjunct) or have received special approval from the department and CGPS.

The supervisor and the Graduate Chair, in consultation with the student, will select qualified members for the Advisory Committee, usually within the first four months of the student's program.

At the Master's level, the Advisory Committee consists of at least three members: the Graduate Chair (Ex-officio member) or designate assigned by the Graduate Chair, the supervisor and one other member of the faculty (Soil Science or other Department). At the final defense, one person



from outside the Department, and not a member of the Advisory Committee, must also be in attendance, acting as external examiner for the thesis.

At the Doctoral level, the Advisory Committee consists of at least four members: the Graduate Chair or designate assigned by the Graduate Chair, the supervisor and two other members of the faculty, one of whom is from outside the Department of Soil Science (cognate member). At the Doctoral student's Ph.D. defense, there must be a minimum of six members that include the non-voting Chair and two non-regular members: a University internal examiner and an External Examiner of the thesis. The University Examiner must be a member of CGPS (Adjunct professors are permitted), will normally have a Ph.D., have suitable knowledge in the dissertation area of research and will have previous experience supervising graduate students. The University examiner is approved by Graduate Chair or Head and must be at arm's length from the dissertation research. The External Examiner must be from outside the University of Saskatchewan and be approved by the College of Graduate and Postdoctoral Studies. The committee and external examiner are selected because of their knowledge of the proposed research field. The complete guidelines for examining committee structure are found here: <https://cgps.usask.ca/policy-and-procedure/Academics/defence.php#82EXAMININGCOMMITTEE>.

Although the committee is appointed for the duration of the student's program, the Graduate Committee, after consultation with the student and their supervisor, may replace or add member(s) to the committee. Students should note that the SLSC committee structures listed above are the standard for the Department of Soil Science and differ from the *minimum* standards of the CGPS.

### 2.1.3 Role and responsibilities of student

The student entering a graduate program is a junior partner and colleague in a relationship of mutual respect with the supervisor and Advisory Committee. The student makes a commitment to the program, dedicating them self to completion within an acceptable timeframe and in accordance with policies in regulation at the department and University level. The student is entitled to mentorship, advice, guidance, monitoring and yearly evaluation of progress by the Advisory Committee.

*The graduate student has a responsibility:*

- to be accessible for and maintain regular and frequent communication with supervisor and Advisory Committee;
- to know and adhere to policies, regulations, expectations and standards of the department, CGPS and University with respect to coursework, research, scholarship, intellectual property, academic integrity, safety, ethics, thesis, collaborative work, authorship, acknowledgements, conference presentations, professionalism, obligations tied to funding;
- to be aware of and meet deadlines for registration, coursework, research, applications, reporting, defense, convocation preparations;
- to strive for excellence in and take full responsibility for coursework and research;
- to establish and adhere to a timeline and milestones for completion;
- to record research systematically, completely and honestly;
- to report on progress and prepare a yearly report for the Advisory Committee;
- to submit work for evaluation, allowing reasonable time for review, and to give consideration to advice from the supervisor and Advisory Committee;



- to make thoughtful, considerate, frugal and responsible use of resources;
- to maintain, keep clean and return to order the workplace and laboratory.

#### **2.1.4 Role and responsibilities of supervisor(s)**

The supervisor is a mentor, advisor, and senior colleague who—in an atmosphere of respect for the student and the critical role of the supervisor/student relationship—monitors the evolution of the graduate program. As the senior partner, the supervisor must encourage commitment, but never exploit or indoctrinate the student.

*The supervisor has a responsibility towards the student:*

- to guide the choice of the Advisory Committee, Program of Studies, research project, timeline to completion, milestones;
- to be accessible for and encourage regular meetings with the student;
- to ensure timely scheduling of qualifying and comprehensive examinations, outline expectations and prepare the student for examination;
- to provide expectations, criteria and evaluation for written work, including the thesis, in a timely fashion;
- to explore, inform about and provide funding opportunities;
- to inform of policies, regulations, expectations and standards of the department, CGPS and University with respect to coursework, research, scholarship, intellectual property, academic integrity, safety, ethics, thesis, collaborative work, authorship, acknowledgements, conference presentations, professionalism;
- to convene the Advisory Committee at least once yearly;
- to provide the student with an opportunity to present research at a national or international conference;
- to ensure the eligibility of the thesis for examination, provide the names of potential suitable external examiners, and prepare the student for the defense;
- to provide letters of recommendation on request, in a timely fashion;
- to arrange for suitable supervision during absences.

#### **2.1.5 Role and responsibilities of graduate advisory committee**

The role of the Advisory Committee is to provide the student with mentorship, guidance, advice, evaluation and feedback in an atmosphere of mutual respect. The Advisory Committee should be chosen early in the program by the student and the supervisor, in consultation, to reflect diverse expertise in the chosen field of research.

*The Advisory Committee has a responsibility towards the student:*

- to establish a Program of Studies in consultation with the student, at the beginning of the program, with clear course requirements, expectations, and a projected timeline with milestones;
- to remain familiar with the research project and the student's progress;
- meet with the student at least once yearly to review and report to the CGPS the student's progress;
- to be prepared to recommend withdrawal or alternatives if progress is unsatisfactory;
- to be available for consultation with the student on academic, research-related, or other matters such as might arise, including, but not limited to supervision, intellectual property, ethics,



- authorship, best practices, academic integrity, acknowledgement, medical or compassionate situations, conflict, disputes, harassment, discrimination;
- to provide feedback on suitability of material for publication, suggest relevant journals for submissions;
- to examine the thesis for defense in a timely manner;
- to provide opportunities for the student to present the research at a conference;
- be willing to provide letters of reference upon request.

### 2.1.6 Student Supervisor Agreement

The student and the supervisor are required to review, complete and sign the Student-Supervisor agreement (<https://students.usask.ca/documents/graduate/student-supervisor-agreement.pdf>) ideally within the first month, but no later than the first 12 months of the student's program. When the Student-Supervisor Agreement has been completed and signed by the supervisor and student, it should be submitted to the Graduate Administrator in the academic unit. This agreement is intended to provide the basis for clear and common expectations early in the students program. Failure to complete the Student-Supervisor agreement will render the student ineligible for internal scholarship opportunities.

## 2.2 Graduate Committee Meetings

Within two to three months of entering the program, the student will meet with the Advisory Committee to plan and recommend courses, and to present a mini-proposal, a brief synopsis of the proposed research. The student will receive feedback from the committee during the meeting and the student will then prepare a full research proposal for the committee to be presented at a later date. This meeting usually occurs six to nine months after entering the program and before the first field season begins or laboratory experiments start. To facilitate the review process, the student must submit the proposal or progress reports to their research supervisor for comments and approval before distributing it to the other Advisory members one week prior to the meeting. Failure to provide these reports at least one week prior to the meeting could result in the cancellation of the meeting. More details on proposals and progress reports are provided below.

At the beginning of all committee meetings, the student is required to present a 10 to 15 minute talk outlining their proposal or research progress and a time-line for completion. The committee may recommend changes and additions to the student's program at that time. At the end of the committee meeting, progress is discussed by the advisory committee members without the student present in the room. The student is invited back into the room, and the chair of the Advisory Committee will verbally inform the student of their progress.

It is the responsibility of the student, in consultation with their supervisor, to arrange a committee meeting at least once in a calendar year. Key meetings to be scheduled during the term of the graduate program are: mini-proposal, full proposal, permission to write, permission to defend, plus the annual progress meetings (see Soil Science Roadmap, Appendix A).

## 2.3 Chairing Graduate Advisory Committees

All tenured faculty will be responsible, on a rotating basis, for serving as Chair for M.Sc. and Ph.D. graduate student committees. The Graduate Chair can, at their discretion, chair any individual committee meeting or committee, for any reason.



1. Committee composed of no tenured faculty – the graduate chair will chair the committee
2. Committee composed of non-tenured supervisor and another tenured member from the Department of Soil Science, the tenured member will chair the committee
3. Committee composed of tenured supervisor and another tenured member from the Department of Soil Science, the tenured member other than the supervisor will chair the committee
4. Committee composed of tenured supervisor, no other tenured members from the Department of Soil Science – the supervisor will chair the committee

Within two weeks of the meeting, the supervisor will be responsible for submitting detailed minutes of the meeting to all committee members for approval. Once approved by the committee, the minutes will be forwarded to the Department Graduate Administrator. A formal Progress Report that includes the minutes of the meeting will then be submitted online to the CGPS. The student will have access to view the report through their PAWS student account.

***Minutes will include:***

1. Date and time of meeting,
2. Names and affiliations of all people present (including the student),
3. Purpose of the meeting (e.g., proposal presentation, permission to write),
4. A summary of the discussion of the presented material. May include:
  - a. changes from the original research proposed
  - b. specific concerns raised by committee members
  - c. concerns raised by the students
  - d. exceptional circumstances (good or bad) that may have influenced progress
  - e. recommendations for how the student should or should not proceed with their research or thesis structure,
5. Indication of scholarships and bursaries awarded to student in the time frame between committee meetings taking place,
6. Indication of conferences, meetings, extension events that the student attended and or presented at in the time frame between committee meeting taking place,
7. Indication of any publications submitted or accepted in the time frame between committee meetings taking place,
8. Indication of any teaching done by the student in the time frame between committee meetings taking place,
9. In the case of the first committee meeting, courses that the student will take for their program of studies,
10. In the case of subsequent meetings, any changes to the courses the student will take for their program of studies,
11. Final comment on the outcome of the meeting – e.g., proposal accepted, proposal accepted with the incorporation of suggestions made by committee members, permission to write granted, comment on overall progress made.

### **3. Program Requirements**

The graduate program is considered complete when a student fulfills all the requirements of their specific program. These requirements include course work (including the SLSC 990 seminar), a research project (with a mini-proposal and full proposal), any required oral and written



examinations, a written thesis based on the research work, the oral thesis defense examination, and the submission of the written thesis (see Soil Science Roadmap, Appendix A).

### 3.1 Course work

The course work requirement for all Soil Science graduate student programs is established by the Advisory Committee in consultation with the student. On the recommendation of the Committee, students may be required to take additional courses above the minimum requirement that will provide additional credit units to their academic program. Students entering the program with minimal background training in soil science may be required to take additional course(s) as a condition of admission.

#### 3.1.1 M.Sc.

The M.Sc. program requires a minimum of 9 credit units from 800 level courses, including 3 cu of field training and experimental design (SLSC 825.3 – Field Studies of Saskatchewan Soils), and/or 3 cu of laboratory training (SLSC 826.3 – Physical, Chemical, and Biological Characterization of Soils), and 1 cu of data analysis/statistics. Statistics courses commonly taken by SLSC graduate students include PLSC 835.1 Statistical Foundations, PLSC 836.1 Experimental Analysis, PLSC 837.1 Advanced Linear Modelling, SLSC 852.1 Multivariate Statistics in Soil Science or ANSC 801.3 Animal Experimentation. Students may combine undergraduate classes with additional graduate level learning outcomes and deliverables through SLSC 802.3 Experimental Topics in Soil Science.

A minimum grade of 60% must be obtained in all required graduate level courses, with a cumulative grade-point average of 70%. Any student receiving a grade less than 60% for any given course, under exceptional circumstances, and on recommendation of the Graduate Committee and with approval of the Dean of Graduate and Postdoctoral Studies, may be permitted to write a supplemental examination. The student may also, with permission of the Dean of Graduate Studies, repeat the class to improve their grade, or substitute an additional course that has been recommended by the Advisory Committee.

#### 3.1.2 Ph.D.

The Ph.D. program requires a **minimum of 6 credit units** from 800 level courses, including SLSC 850.1 – Experimental Design in Soil Sciences.

A minimum grade of 70% is required for any course in the student's program of study. When a student receives a grade below the minimum, the situation will be reviewed by members of the Advisory Committee, and they will make a recommendation to the College of Graduate and Postdoctoral Studies concerning any action to be taken. The Advisory Committee members will send a proposal to the College of Graduate and Postdoctoral Studies recommending how the deficiency will be corrected. This could take the form of a supplemental exam (within 4 weeks of the final exam), a repeat of the class, or taking another class to fulfill the deficiency. The latter option will require a change to the program.

### 3.2 Research Proposals: Mini-proposals and Full Proposals

#### 3.2.1 Mini-proposal

The mini-proposal is a two-page synopsis of the research proposal (see Appendix B; template file available from GPA). It briefly states the problem or purpose of the research and why it is



important, hypotheses, project objectives and description, projected timelines for activity completion, and the coursework for the program. This mini-proposal will be presented at the initial advisory committee meeting for discussion and approval, and is an important document providing an overview of the proposed research and program coursework to the Committee. Using the feedback received from the Committee on the mini-proposal, the student will then prepare the full proposal to be presented six to nine months into their program.

### **3.2.2 Full Proposal**

Graduate students are expected to think and act as independently as possible while developing and completing their research projects. Each student is expected to exert initiative and assume responsibility for developing top quality scientific research.

To maintain uniform standards in the program, there is a need to provide members of the Advisory Committee with a detailed outline of the proposed research. This outline will enable the committee to provide more effective guidance and comment on the research plan. A comprehensive proposal also will provide the student with better defined goals or objectives that must be attained in order to complete the research. Students with limited research experience may become "sidetracked" onto peripheral research objectives and consequently use valuable research time inefficiently; this ultimately prolongs the time to complete the degree. The proposal should, therefore, be completed and approved by the end of the first academic year.

Proposals are typically 15 pages at the M.Sc. level and 30 pages at the Ph.D. level. The following is a typical outline of the full proposal for both M.Sc. and Ph.D. candidates:

#### ***Title***

The title should be presented on a single page along with the student's name, proposed degree, program and the date.

#### ***Introduction***

This section should be limited to a few pages and provide the rationale for undertaking the research projects and the overall concepts pertaining to the area of research.

#### ***Literature Review***

This section should be in considerable detail to include all important references and information relevant to the proposal. If this section is prepared in detail at this stage, considerable time may be saved during thesis preparation; it also may be easier for the committee to evaluate the student's background and preparation to conduct research in the proposed area.

#### ***Overall Objectives and Specific Hypotheses***

Based upon items outlined in the previous sections, an overall objective for the study must be identified. To achieve the objective, specific hypotheses are generated. These hypotheses should be brief, to the point, and specific (each should address a particular problem or concern) and be expressed in the form of a simple statement, not a question.

#### ***Experimental Design***

This section is one of the most critical components of the proposal. Sound experimental design, logic, and understanding of scientific principles should be apparent. For each hypothesis,



the details of the proposed experiment should be outlined in depth. Appropriate subsections may include:

- (a) *Specific Hypothesis*
- (b) *Pertinent Facts* - these facts may concern the nature of the model, why you have chosen this system, etc. (e.g. cell types involved).
- (c) *Materials and Methods* - great care and attention should be given to this subsection. All treatment groups including control groups, treatment levels or times, sampling methods, assay procedures, etc., need to be mentioned. Without these details, the committee cannot fully determine whether the study has been designed in a proper scientific fashion. Practical problems associated with feasibility of the project may also be identified.

If appropriate, the types of statistical methods to be utilized should be included. You may have to alter your experimental design based upon the types of statistical methods that are required.

### ***Expected Significance***

In what form will you report your results? How will these results be used to draw conclusions from your research? In what ways do you anticipate that your results will contribute to scientific literature?

### ***Timetable of Proposed Studies***

Since many students do not have previous research experience, it may be useful to plan a tentative timetable of events. Some students have unrealistic expectations and may be disappointed by slow research progress. A well-designed plan may also result in a more optimal and logical approach to the overall research program.

### ***References***

Consult the ASA-CSSA-SSSA Publications Handbook and Style Manual (available at: <https://www.agronomy.org/files/publications/style/style-manual.pdf>) for a complete list of literature referencing.

## **3.3 Progress Reports and Permission to Write Report**

Students are expected to prepare a written progress report for each committee meeting. This report typically includes a brief restatement of the project objectives and/or hypotheses, a summary of methods used to date, tables and figures summarizing data collected, and a brief summary of major findings to date. It should also include a revised timeline and an updated list of conference presentations, publications, awards/scholarships, and teaching experience. Students are to provide one print copy of the report for the committee chair.

In order to receive permission to write, students must normally have completed their fieldwork and laboratory analyses. In addition, they must have completed the majority of their statistical analyses. For the permission to write meeting, the progress report should also include a complete table of contents outlining all of the major headings and subheadings of the thesis/dissertation, sufficient examples of statistical analyses to determine that all data are being properly handled, and a brief summary (e.g., bulleted list) of major findings for each analysis.



### 3.4 Seminars

All graduate students are required to register in SLSC 990 (Soil Science Seminar) for the duration of their program. M.Sc. students are required to give one seminar in their program. This seminar will cover their proposal or research progress. Students in the Ph.D. program are required to give two seminars. Attendance at the seminars is mandatory for all graduate students until such time that the student has attended two full academic years for M.Sc. students and three full academic years for Ph.D. students and have fulfilled their presentation requirements.

Students giving an unsatisfactory seminar or not consistently attending the seminars will result in the Seminar Coordinator notifying the student's Advisory Committee members of the poor presentation or absenteeism. The members of the Advisory Committee will then decide on any action that is to be taken.

### 3.5 Candidacy Examination

The candidacy examination is not required for the M.Sc. program. All Ph.D. students must complete both Part I and Part II of the Candidacy Exam within 24 months of entering the Ph.D. program.

#### 3.5.1 Ph.D. Candidacy Exam Part I:

The Ph.D. candidacy exam part I should be seen as the first step in a candidate's program of study. *The purpose of the candidacy exam part I is to evaluate the student's capability for Ph.D.-level study, and to identify possible deficiencies in the student's academic preparedness for the Ph.D. program in Soil Science.* All incoming Ph.D. students are required to take the Candidacy Exam Part I; however, under exceptional circumstances—upon recommendation by the student's advisory committee and approval by the Graduate Committee—the Candidacy Examination Part I may be waived.

The candidacy exam part I will consist of a written exam of questions based on the performance objectives of the Soil Science Society of America's Soil Scientist Certification Exam. The maximum length of time for sitting this exam is four hours. The five core areas of soil science—Soil Chemistry and Mineralogy; Soil Fertility; Soil Physics; Soil Genesis, Morphology and Classification; and Soil Biology and Biochemistry—will be tested in short answer format. The exam will be offered twice per year; *i.e.*, at the end of the fall term (December) and again at the end of the winter term (April/May). The exact date of the examination will be announced approximately six weeks in advance. Students admitted at the start of the summer (May/June) or fall (September) term will be required to sit the qualifying exam in December of that year. Students admitted at the start of the winter term (January) will be required to sit the candidacy exam part I in May of that year. One practice exam is available to students upon admission to the Ph.D. program (see Appendix D).

The exam will be administered and marked by the Graduate Chair. The results of the examination will be forwarded to the supervisor for information in developing the student's graduate program. Students must achieve a grade of 70% or greater in each section of the exam. Students who fail to achieve the minimum grade in any section of the exam will be required to schedule a committee meeting within two weeks of being notified of their failure. The Graduate Chair will present the student's results to the committee, in the absence of the student, and explain what section(s) the student failed. The committee will be provided with two options: (i) the student



can redo those sections of the exam that they failed at the next sitting of the candidacy exam part I or (ii) the student can take SLSC 802 or another SLSC graduate course that covers the failed section(s) as determined by the committee. The Graduate Chair will answer any questions that the committee has and then absent themselves from the meeting. The student's committee will then discuss the results with the student and decide on which option best fits the student's needs and program. If the second (course) option is chosen, the required course must be taken at its next offering, and the student must attain a minimum grade of 75% in order for the course to be considered a pass. A student who fails the supplemental exam or achieves less than 75% in the required graduate course(s) will automatically be disqualified from further work towards their Ph.D. degree.

### 3.5.2 Ph.D. Candidacy Exam Part II:

All Ph.D. candidates must take and pass the Candidacy Examination Part II within 24 months of entering their program. The examination is normally scheduled after the student has completed all coursework. The candidacy exam part II consists of both a written and oral component.

The candidacy exam part II is graded as pass or fail: a "conditional" pass is not an option in the Department of Soil Science.

The candidacy exam part II may be repeated once, and ONLY with permission of the Dean of the College of Graduate and Postdoctoral Studies and within a time-frame agreeable to the student.

Students are NOT permitted to use Generative Artificial Intelligence (GenAI) to develop their ideas or create their answers. Students are permitted to use the USask secure version of CoPilot to correct grammar.

#### **Written:**

The written portion consists of four questions:

- (a) A question that integrates the student's knowledge based on their course work and area of soil science (5 pages)
- (b) A question where the student is given data and asked to interpret the data (2 pages)
- (c) A question that focuses on developing a research project (*i.e.*, design an experiment based on a particular problem) (5 pages)
- (d) A question where a chapter or article is given to the student and they have to interpret the results for someone else (3-5 pages)

The written exam is developed by the student's Supervisor(s) and the Advisory Committee. It is reviewed and approved by the Graduate Chair and/or other members of the Graduate Committee to ensure some consistency between exams.

The student will be given two days to complete the exam from 9 a.m. on day 1 until 5 pm the next day, and allowed to use any resource. The student will be on the honor system and not allowed to communicate with their peers. The answers must be well-written and typed. The student will be expected to submit both an electronic copy and a hard copy of the exam to their supervisor or to another individual that the supervisor has identified. In the case that the written exam is submitted more than one-hour late, the Advisory Committee will convene at its earliest convenience and the



student will be expected to explain to the committee the reason for the late submission. Any additional action, such as (but not limited to) answering a supplemental question, will be at the discretion of the advisory committee, in consultation with the Graduate Chair.

### **Oral:**

The oral examination occurs within one week of the completion of the written exam. There should be a maximum of seven days, and a minimum of three days between the written and oral exams. The oral portion of the exam focuses on clarification and/or expansion of the answers from the four written questions. To pass the exam the student must not receive a fail grade from more than one committee member.

## **3.6 Thesis/Dissertation**

### **3.6.1 Permission to Write**

Before students begin to write their thesis, approval must be obtained from their Advisory Committee. Permission is granted if the committee members judge that the student has made sufficient progress towards completing their research work. See Section 3.3 for what to include in the written progress report to obtain permission to write.

### **3.6.2 Thesis/Dissertation Preparation**

The thesis, or dissertation is a major component of the Department's graduate program - you cannot graduate without having completed one—and can rightfully be viewed the crowning achievement of your program. Strictly speaking, a thesis is a “statement or hypothesis that can be tested or rationally argued”, while a dissertation is a “document or discourse that offers new insight as the result of structured research”. From an academic standpoint, however, a thesis summarizes and discusses independent, original research carried out by the student on a specific subject, and is the final project for a Master's degree. A dissertation is different in that, although it too summarizes and discusses independent research carried out by the student, it must contribute new knowledge that is original, substantial and verifiable. A dissertation is the final project for a Doctoral degree.

The thesis must: (a) deal in an academically satisfactory way with a definite topic related to the major research field, (b) demonstrate ability on the part of the candidate to conduct independent study and investigation, (c) be written in good scholarly style and conform to the requirements of a style manual approved by the department, (d) comply in presentation features with specifications given in the *Guide to Preparing, Organizing and Formatting a Thesis or Dissertation* (available for download at <https://agbio.usask.ca/students/graduate/graduate-handbooks-reference-documents.php> or from the Graduate Program Assistant). As of September 1, 2026 students must include a declaration of use of GenAI, even if GenAI was not used in producing the thesis. Requirements and templates are available at <https://cgps.usask.ca/onboarding/grad-toolkit/roadmaps/thesis-roadmap/drafting.php>

The thesis format can follow two structures: (1) the traditional style with Introduction, Literature Review, Material and Methods, Results, Discussion, Conclusion, References and Appendices, or (2) a manuscript-based format where it would be similar to format 1 but the Material & Methods, Results and Discussion sections would all be included into specific chapters for individual research projects. Hence, the format for the thesis would be Introduction, Literature Review, Chapter X (Introduction, Material and Methods, Results, Discussion) Chapter Y (Introduction, Material and Methods, Results, Discussion), General Discussion, Conclusion,



single chapter following the Conclusions. The number of chapters would vary with the type of project. The literature review is optional depending on your Advisory Committee and if written could be a traditional literature review or a review article. If a literature review is not included it is expected to be incorporated into the introduction and discussion parts in each chapter. The thesis should follow the ASA-CSSA-SSSA Publications Handbook and Style Manual (<https://www.agronomy.org/files/publications/style/style-manual.pdf>). It is the responsibility of the supervisor to ensure that the thesis is of acceptable standard and quality before it is presented to members of the Advisory Committee, as well as ensuring that the student is ready for the final oral exam. Theses that do not meet acceptable standards by the Advisory Committee will be returned to the student (see p. 45 of *Guide to Preparing, Organizing and Formatting a Thesis or Dissertation* for checklist of standards).

### 3.6.3 Dissertation Summary:

At least seven days prior to their defense, Ph.D. students must provide a *Dissertation Summary* (not bound with the thesis) to the CGPS Programs Officer. This *Summary* will be published in the UMI Dissertations Abstracts.

### 3.6.4 Electronic Theses and Dissertations (ETD)

An ETD is a document that explains the research of a graduate student. It is expressed in a form simultaneously suitable for machine archives and worldwide retrieval. The ETD is similar to its paper predecessor. It has figures, tables, and references. It has a title page with the author's name, the official name of the university, the degree sought, and the names of the committee members. It documents the author's years of academic commitment. It describes why the work was done, how the research relates to previous work as recorded in the literature, the research methods used, the results, and the interpretation and discussion of the results, and a summary with conclusions.

The ETD is different, however, in that it provides a technologically advanced medium for expressing your ideas. You prepare your ETD using nearly any word processor or document preparation system, incorporating relevant multimedia objects. It is mandatory that students submit their thesis electronically. The CGSR provides a website to assist students in this process: <https://cgps.usask.ca/onboarding/roadmaps/submitting.php#Preparingforsubmission>.

## 3.7 Oral Defense

Full details regarding the submission of the thesis for defense, scheduling of the oral examination and appointment of the external examiner are reviewed in the CGPS Policy and Procedures Manual (<https://cgps.usask.ca/policy-and-procedure/index.php>). External examiners for M.Sc. thesis defenses are normally selected by the Advisory Committee from another department at the University of Saskatchewan and approved by the Department. The external examiner must be given a minimum of **two weeks** to read the thesis prior to the defense. For Ph.D. thesis defenses, a "Recommendation for Examination of the Ph.D. Thesis and Award" (GSR 300.1 form) is completed and submitted to the CGSR, along with a CV, for approval of the appointment of the selected External Examiner. The College of Graduate and Postdoctoral Studies requires a minimum of **five weeks** to process the thesis defense recommendation for Ph.D. students. Students should also be aware that thesis defenses are difficult to schedule during July and August due to the number of faculty conducting research and on holidays.



All copies of the thesis must be delivered by the student to the Examining committee at least four weeks prior to the scheduled date of the oral defense.

The character of the oral examination is determined by the Advisory Committee. It will commence with a final seminar presentation that highlights the entire thesis/dissertation project. The M.Sc. thesis seminar is generally 20 to 30 minutes, while the Ph.D. thesis seminar is similar to the M.Sc., but 30 to 40 minutes. After the defense seminar the candidate will meet with the Examining Committee. The candidate will be questioned by the Examining Committee beginning with the External Examiner. The candidate is expected to defend the work and to answer general questions in a clear, direct, and knowledgeable fashion. In general, examination questions are limited to work done by the candidate for the thesis and to knowledge of matters directly related to it. At the conclusion of the examination, the candidate is required to withdraw while the Examining Committee decides by majority vote whether the thesis as submitted and the candidate's oral defense meet the requirements for the degree. Where the Examining Committee's decision is not unanimous, the majority view shall prevail provided that the External Examiner shares the majority view. If those voting in favor of the majority opinion do not include the External Examiner, the person chairing the examination shall so inform the Dean who shall investigate the circumstances and decide upon an appropriate course of action.

### 3.8 Generative Artificial Intelligence Tools Policy

Generative Artificial Intelligence (GenAI) Tools are permitted in graduate thesis work following the specific guidance provided. Improper use of such tools will be considered academic misconduct. The use of GenAI Tools is permitted in graduate thesis work; however, the student is responsible for (i) checking the factual accuracy of any content created by the GenAI including any quotes, citations, or references and (ii) ensuring that any written or visual content produced by GenAI is free from plagiarism.

- Where students use GenAI in the writing process, these technologies can be used only to improve readability and language of the work and students are expected to carefully review and edit the resulting text.
- Figures produced or edited using GenAI must be checked to ensure they accurately reflect the data presented in the thesis.
- Before entering any data from their research into GenAI students must acquire written permission from all involved parties and discuss any potential issues arising from existing confidentiality agreements or data governance/sharing agreements with their supervisor and thesis committee.

GenAI must be acknowledged in the author attribution section for each chapter in a manuscript style thesis and/or in the thesis acknowledgments and methods section as appropriate.

- The use of GenAI must be fully disclosed by including a supplementary document that acknowledges where GenAI was used including the date, name, version, model and source of GenAI technology and by providing a script with all prompts provided to GenAI technology and outputs received from GenAI technology.



The use of GenAI in graduate course work will be at the discretion of the instructor and students are encouraged to review the syllabus for each course and discuss use of GenAI with the instructor.

### 3.9 Time in Program

Time in program is measured from the beginning of the first term of registration for work that is included in the Program of Studies, excluding any periods of approved leave. Program time limits are four years for Master's programs, and six years for Ph.D. Where a student has been suspended from the program for one or more terms because of a penalty imposed through an academic dishonesty ruling, the period of suspension will not count as time in program, subject to University Council regulations on student discipline and appeals. Approved leaves (e.g. parental, health, etc.) do not count toward the time in program.

#### 3.9.1 Time Extensions

Time extension may be granted to students who encounter problems while actively trying to finish their program. Students who have reached the time limit of the program without completing program requirements shall meet with their Advisory Committee. Requests for a time extension shall specifically address the question of why the Schedule for Completion was not followed. While on extension, the policy regarding full-time status and payment of tuition and fees shall apply.

##### 3.9.1.1 Procedures and Guidelines

Students who have reached or will soon reach the time limit of the program without completing their program requirements should meet with their Advisory Committee as a first step. At this committee meeting, the following should be addressed:

- All members should be made aware of the impending request for extension
- Challenges which have impeded progress should be discussed and addressed
- A detailed, reasonable, achievable timeline to completion should be developed and agreed upon by the student and committee.

The items discussed at the committee meeting must be submitted in writing to the supervisor/committee. This document must specifically address the question of why the expected timeframe was not followed and what steps will be taken to ensure adequate progress is made going forward. The detailed timeline for completion must also be included with this document.

If the Advisory Committee supports the extension request, the request is forwarded by the Academic Unit to CGSR. Requests forwarded to CGPS must include the following:

- A completed "Request for Extension to Time in Program" form (<https://jira.usask.ca/servicedesk/customer/portal/7/create/209>) including a written request from the student specifically addressing the question of why the original Schedule for Completion was not followed and what steps will be taken to ensure adequate progress is made going forward
- A detailed timeline for completion
- Written support from the Supervisor and the Advisory Committee



- Meeting minutes from past Advisory Committee meetings, including meeting where extension to time in program was discussed

Please note that any of the following may result in a request being returned:

- Submission of an incomplete extension request form
- Insufficient detail/rationale provided in requesting the extension
- Insufficient/unsatisfactory information on the plan and timeline for completion

Once your extension has been approved and processed by CGSR, the assigned CGSR Advisor will send an e-mail notifying you and the appropriate contacts in your academic unit.

## 4. Funding

### 4.1 Stipends

All students accepted into the M.Sc. and Ph.D. graduate programs receive financial support from their supervisor's research funds and/or scholarships. Funding for M.Sc. and Ph.D. graduate students is not standard; however, the general policy is that student funding be based on the rates recommended by the College of Graduate Studies and Research. For students beginning on or after **January 1, 2027**, minimum stipend amounts increase to \$28,000/year with a maximum of \$30,000/year for M.Sc. students and a minimum of \$31,000/year and maximum of \$33,000 for Ph.D. students. Students will receive a 2% increase per year starting 2028-2030. In the event that a student who has been offered a stipend from a research grant is subsequently awarded a major scholarship (NSERC, Saskatchewan Innovation and Opportunity, etc.), the amount of stipend funding may be adjusted.

### 4.2 Soil Science Graduate Scholarship Fund

The Department of Soil Science administers Student Support Funds allocated by the College of Graduate And Postdoctoral Studies. The primary purpose of our Student Support Fund is to attract and retain high quality graduate students from both within and outside Canada. Given the limited funds available, however, we also ensure that they flow to students who will benefit most from them. We have 3 tiers of scholarships that we provide based upon availability of funds. Students will be assessed for eligibility every term by the graduate committee (in December, April, August). **In the event of insufficient funds to fully allocate, student support funds will be decided based upon GPA.**

#### 4.2.1 Types of Scholarship Support

##### 4.2.1.1 75<sup>th</sup> Anniversary Recruitment Scholarship

The CGPS 75th Recruitment Scholarship is an entrance award valued at \$20 000 for one year for Ph.D. and M.Sc. students which will be awarded in addition to base minimum stipend funding in year 1 of the student's program. Both Ph.D. and M.Sc. applicants are encouraged to apply; however, PhD applicants will be prioritized. To qualify for a 75<sup>th</sup> Anniversary scholarship, the student's total compensation cannot be more than \$57,000 per year for M.Sc. or \$73,000 per year for PhD. The cap will increase by 2% each year beginning 2028-2030.

The Department of Soil Science accepts applications for the CGPS 75th Recruitment Scholarship three times per year, with application deadlines falling on the last business day prior to November 1 for January start date, March 1 for May start date and July 1 for September start



date. In the case that the scholarship is not awarded for a given intake period, an additional award will be made in the next intake period. In the case that less than three awards per year are allocated to the Department of Soil Sciences, application deadlines will be communicated to the faculty and can be obtained by potential applicants by contacting the Graduate Chair. Applicants must have a minimum GPA of 80.0% and are asked to submit transcripts along with a letter of application highlighting their research and career goals and describing their academic and personal achievements, including academic and non-academic volunteer service. The Department of Soil Science faculty member who has agreed to supervise the applicant must provide confirmation of supervision. Applications should be submitted by email directly to the Soil Science Graduate Chair.

#### **4.2.1.2 Tier 1.1: Renewable Ph.D. Scholarships**

All Ph.D. students entering the program with an average entrance mark  $\geq 80.0\%$  (as determined by Student Enrolment Services Division) are eligible. The value of the scholarship is equivalent to the University of Saskatchewan cost of domestic tuition (but not student fees) for doctoral students. These awards are made annually based upon entrance/continuing GPA with a minimum requirement of 80.0%. To qualify for Tier 1 scholarship, the student's total compensation cannot be more than \$73,000 per year.

Qualified new Ph.D. students will receive a scholarship in their entrance year. Canadian citizenship or landed immigrant status is not a requirement. The scholarship is renewable for two additional years (total of three years) assuming the conditions for receiving a scholarship (outlined below) are met. This scholarship is in addition to the base funding received by the student and cannot be used by supervisors to reduce the base funding. M.Sc. students transferring to a Ph.D., and whose cumulative grade point average upon entering the Ph.D. program is  $\geq 80.0\%$ , will qualify for the Ph.D. scholarship. For continuing students to be eligible to apply, they must be in good standing in their Ph.D. program (i.e., they should complete their Ph.D. qualifying exam at the earliest offering (May or December) and full proposal within the first eighteen months of their program).

#### **Tier 1.2: Strategic scholarships**

Our CGPS scholarship funds occasionally need to be used to match other scholarship funds on campus such as CGPS start-up funding for new faculty and doctoral Dean's scholarships. It can also be used to provide targeted scholarships for First Nations students or other important University and Departmental initiatives. These are one-time scholarship awards that are valued up to the minimum stipend for our Department (currently \$28,000 for M.Sc. and \$31,000 for Ph.D.). These scholarships will be managed by the Soil Science graduate committee and may not be applied for directly by graduate students. New faculty must identify a qualified student and use Tier 3 funds as matching funds for the CGPS start-up funding for new faculty within 3 years of appointment.



### ***Tier 1.3: Special requirements for Chinese Scholarship Council (CSC) or Vietnam International Education Development (VIED)***

These programs are administered by CGPS. The student's country of origin will pre-screen high quality students and provide their base scholarship (stipend). The CSC and VIED programs require that a tuition bursary (but not student fees) be provided by their department and/or supervisor. The Tier 2 Student Special Requirements funds may be used to partially meet this requirement for CSC and VIED scholars, provided they meet the conditions of receiving the scholarship as outlined below. The supervisor must provide the balance of the bursary. Note that if a student fails to maintain eligibility for this Tier 2 scholarship, the supervisor must provide the full tuition bursary for the remainder of their program. A student accepted into the Department under one of these programs, but who enters as a M.Sc. student, must transfer to the Ph.D. program within one year of entry.

#### ***4.2.1.3 Tier 2: MSc International Tuition Differential Scholarship***

Depending on the availability of funding (i.e., after all Tier 1 funds have been disbursed), the Department may offer international tuition differential scholarships annually, valued as the difference between international and domestic tuition rates to those student who are required to pay the international rate of tuition (not including student fees). As of September 2022, International Ph.D. students will no longer pay a tuition differential and will not be qualified to receive this scholarship. **This scholarship's funds will be distributed equally up to that differential maximum to all qualified students. Qualifications for this scholarship are an international student enrolled in the Soil Science graduate program or the Toxicology program with a supervisor from Soil Science with a minimum requirement of 80.0% entrance (new students) or continuing GPA (current students). Another requirement is that the student's total compensation not be more than \$57,000 per year (+ 2% from 2027-2023).** To be eligible, students must not hold any other support that is designated for tuition (i.e., domestic or international scholarships or specific support from their supervisor).

International students who obtain permanent resident status are no longer eligible. Note: tuition for permanent residents is assessed at the domestic rate.

For continuing students to be eligible to apply, they must have completed their full proposal within the first twelve months of their program. M.Sc. students can apply for a continuing scholarship in their second year.

*Process:* Failure to disclose *all* funding sources or changes in residency status will render the student ineligible for any further support from the student support fund scholarship fund (Tier 1, 2, or 3).

#### ***Conditions of Receiving Student Support Fund Scholarship Support***

1. Students must be enrolled in the graduate program in the Department of Soil Science and/or Toxicology, with a supervisor in the Department of Soil Science.
2. For Tier 1 scholarships, the award for new students is based solely on incoming grades; the student must have a GPA  $\geq 80.0\%$  (as determined by Student Enrolment Services Division) upon entrance. For Tier 2 scholarships, the award is based on incoming grades or where the



student is initially ineligible, on the student's current GPA including graduate level courses taken as part of the approved program of studies.

3. Scholarship recipients must maintain a cumulative average  $\geq 80.0\%$  in each year of their program for scholarship renewal. Recipients who do not maintain an average  $\geq 80.0\%$  will lose their scholarship. For Tier 3 scholarships, a student who has a GPA  $\geq 80.0\%$  after completing 6 cu, will become eligible for a student support fund scholarship.

#### **4.2.2 Administration of Student Support Fund Scholarships**

1. The Graduate Committee, will be responsible for determining the recipients of Tier 1, 2 and 3 scholarships. All qualified Ph.D. candidates will receive payment of the scholarship shortly after arrival into their programs and, in Years 2 & 3, on or near the anniversary of their start date.
2. Decisions regarding the disbursement of the Tier 2 scholarships will occur at regular meetings of the graduate committee after the disbursement (from the CGPS) of the scholarship fund for the upcoming year.
3. In the event that the total monies available in the student support scholarship fund increase, a recommendation will be made by the graduate committee to all faculty to either increase the value of Tier 1 awards, or to offer a Tier 3 scholarship. Any change to disbursement of the devolved require the approval of the entire Soil Science faculty.
4. Administration of the student support scholarship fund will be reported upon annually at a Soil Science departmental meeting by the graduate committee.

### **4.3 Other Scholarships**

#### **4.3.1 Rhizosphere 5 Student Travel Award**

In July 2019, the fifth in a series of international conferences devoted to the study of the rhizosphere was held in Saskatoon and hosted by the University of Saskatchewan. The general theme for the conference was "Shining light on the plant-root-soil interface". Rhizosphere 5 built on past successes of Rhizosphere conferences held in Europe and Australia and provided a multidisciplinary forum for exchanging innovations in rhizosphere research. The conference hosted over 400 delegates from across the globe and generated profits of ca. \$50,000. These profits will be used to support soil science graduate student attendance at scientific conferences to promote their research and enhance their training experience by networking with senior researchers in their field. The maximum award amount is \$1,000 CAD for conferences held in Canada or \$1,500 CAD for international conferences held outside of Canada. Awards will be made until residual profits from the Rhizosphere 5 conference are depleted.

#### **Conditions of Receiving Rhizosphere 5 Student Travel Award**

1. Applicants must be actively registered in graduate studies at the University of Saskatchewan and must be supervised/co-supervised by a faculty member from the Department of Soil Science.



2. Eligible students must be making satisfactory progress in their program, as deemed by their committee and includes at minimum that 1) they have met with their advisory committee within the previous 12 months and 2) they are in good academic standing on their CGPS graduate profile.

3. An individual student may receive the award only once.

4. Awardees must be presenting their research at the conference as either a poster or oral presentation.

5. Funds will be awarded to cover costs for registration, travel, accommodation, and meals (at the per diem rate of the applicant's institution).

#### **Application to Rhizosphere 5 Student Travel Award**

1. Applicants must submit a one-page letter describing the conference/workshop or meeting to be attended, the importance of this meeting to their research and training, the dates of the meeting, and deadlines for registration. Applicants must also submit a budget estimate, including as much documentation as possible to show the basis for this estimate (e.g. registration fees, accommodation, airfare, etc.).

2. Applications are to be submitted to the Soil Science Graduate Committee, c/o the Chair of Department of Soil Science.

3. Applications will be reviewed on an on-going basis and decisions will be made within 4 weeks of the receipt of the application.

#### **4.3.2 College of Agriculture and Bioresources**

The College of Agriculture and Bioresources administers some graduate level award funding. Graduate students can apply for college-administered awards by filling out the Post-Graduate Awards Application Form online at: <https://agbio.usask.ca/students/graduate/graduate-scholarships.php#Minimumfundinglevels>. Please read all questions carefully and answer as accurately as possible. Students are no longer required to submit unofficial transcripts or letters of support from their supervisors. The application deadline varies from year to year. All current graduate students will be contacted by the Department Graduate Administrator and notified of the application deadline each year.

#### **4.3.3 College of Graduate Studies and Research**

Several scholarships are available from CGSR throughout the year. Other major awards, such as NSERC and Saskatchewan Innovation and Opportunity Scholarships, are also administered through CGPS. Announcements are circulated as these awards become available. For a complete list of CGSR scholarship awards: <https://students.usask.ca/money/awards/graduate-awards.php>.

#### **4.3.4 Department Teaching Assistantships**

The Department of Soil Science also offers Teaching Assistantships to qualified graduate students. These opportunities are circulated to graduate students. A full-time graduate student, whether or not a recipient of a graduate scholarship, may take up a teaching assistantship appointment, Graduate Teaching Fellowships, perform course marking, sessional teaching or any other work unrelated to the students research or academic program requirements. In the



Department of Soil Science, this normally consists of demonstrating and evaluating practicum sessions, but may also include giving lectures.

#### 4.4 Research Project Funding

The Department of Soil Science has no specific policy regarding funding for research projects. Furthermore, acceptance to conduct graduate studies in the Department does not constitute a commitment, on the part of the Department, to financially support research although the supervisor must make a commitment to provide the resources for the projects. Funding for graduate student research usually comes from the particular supervisor's research grants. In certain circumstances, graduate students may have also obtained funding specifically for their own research.

Students receiving stipends from research grants must be registered as 'fully-qualified', and are expected to spend 40 hours per week on their graduate program. Consistent with Revenue Canada guidelines, the whole amount of such funds is paid as 'employment income' since (a) the terms of the agreement require the student to render service in return for the payment and (b) separate payment of fellowship and employment components has not been provided for. As such, this funding is subject to both Canada Pension Plan and Employment Insurance deductions.

#### 4.5 Volunteer Research Assistants

The Department of Soil Science has approved a policy regarding volunteers effective October 13, 2000. Students planning to have someone assist them with research in any way must consult with their supervisor and attain their approval ahead of time. It is important that all volunteers realize that because they are not employees, they do not qualify for Worker's Compensation or any other University disability benefit in the event of injury sustained in the course of, or as a result of, their volunteer activity. It is for this reason that a formal "Memorandum of Agreement" must be signed by the volunteer and the supervisor prior to commencement of activities. To initiate preparation of this "Memorandum of Agreement", students must discuss the arrangement with their supervisor to ensure approval, then complete a "Request Form – Volunteer Memorandum of Understanding" (*available in the Main Office or from the Administrative Assistant*) and turn it in to the Administrative Assistant for processing.

#### 4.6 Travel Funds

Travel funds to attend conferences, meetings, field days, etc. may be available from research grants of the student's supervisor. Travel awards may also be available through the *CGPS Awards Search Database* (search for "travel" at <https://students.usask.ca/money/awards/graduate-awards.php>). A 'Student Travel Award' is available to provide financial assistance to graduate students to enable them to participate in academic-related conferences, academic competitions, U of S Study Abroad and other university activities. The funding may partially support students' involvement in one of these activities.



## 5. Vacation, Leaves of Absence, Transfers, Withdrawals

### 5.1 Vacation and Leaves

#### 5.1.1 Vacation

Students are eligible to receive three weeks of vacation per year. Due to the flexible nature of a student's work schedule, however, pay in lieu of vacation is unusual. Students must arrange vacation schedules with their supervisors.

#### 5.1.2 Leaves of Absence

Details regarding leaves, for Compassionate, Maternity, Adoption and Parenting, as well as for Co-Op Program Leaves and Graduate Studies in Industry, are outlined in the *“College of Graduate and Postdoctoral Studies Policy and Procedures Manual, Section 13.1”*, <https://cgps.usask.ca/policy-and-procedure//leaves-accommodations/Accommodations-and-Supports.php#131LEAVESOFABSENCE>. A link to online forms for leave requests is found on the CGPS homepage (<https://cgps.usask.ca/>) in the upper right hand corner under “CGPS Service Desk”.

### 5.2 Program Transfers

All program transfer requests must be made in writing to the CGPS. These requests must include both the written transfer request from the student, as well as the written approval of the academic unit receiving the transfer student. The Graduate Chair of the new program shall submit a new Program of Studies, and a new Advisory Committee must be established. Time in program starts from the first class credited towards the postgraduate diploma or degree sought.

#### 5.2.1 Transfer from One Academic Unit to Another

Students admitted to a graduate program in one academic unit may transfer to another program at the same level in another academic unit. It is the student's responsibility to consult with both units before any change is made. The student may not begin work in the new program until the transfer has been approved by the CGPS, and until the academic unit to which the student wishes to transfer has indicated formal approval and accepted the student.

#### 5.2.2 Transfer from Ph.D. Program to M.Sc. Program

With the approval of their supervisor, Advisory Committee, and Graduate Chair, students may transfer from a Ph.D. program to a M.Sc. program with thesis or project.

Students who have entered a Ph.D. program who are unsuccessful in their qualifying or comprehensive exam, or who do not meet the academic standing required for continuation in the program, will be given the opportunity to revert to the M.Sc. degree program in their field, and successful work done towards the Ph.D. degree will be credited towards the M.Sc. degree.

#### 5.2.3 Transfer from M.Sc. Program to Ph.D. program

Transfer from a M.Sc. program to a Ph.D. program shall take place after the end of the first year and no later than the end of the second year in the program. Recommendation for the transfer must be initiated through a formal meeting of the student's Advisory Committee, which shall forward its recommendation through the academic unit to the CGPS. The following conditions must be met:



1. The student shows great promise both in terms of academic accomplishments and in potential for research.
2. The student has completed at least 9 credit units, and has achieved a high-academic standing in these 9 credit units.
3. There is evidence of good writing and oral communication ability.
4. There is evidence the student has the requisite research skills and knowledge to be able to successfully complete a Ph.D. dissertation.
5. The student has successfully completed the Ph.D. Qualifying Examination prior to being recommended for transfer. This examination for the purposes of transfer can only be taken once. A student failing the Qualifying Examination or any part thereof cannot be recommended for transfer.

### **5.3 Withdrawals and Requirement to Discontinue (RTD)**

#### **5.3.1 Voluntary Withdrawal**

Students who are considering voluntarily withdrawing from their program should discuss the withdrawal with their supervisor(s) and the Graduate Chair. A withdrawal form, available at <https://jira.usask.ca/servicedesk/customer/portal/7/create/228> should be submitted by the student to the academic unit. The academic unit then submits this form to the CGSR.

#### **5.3.2 RTD for Lack of Registration**

Failure to register for three (3) consecutive terms is just cause for the CGPS to impose a RTD to a student from their program. A student who has been RTD from their program and then later wishes to resume their graduate program must make a formal application through the academic unit.

#### **5.3.3 RTD for Unsatisfactory Progress in Program**

Upon recommendation of the Advisory Committee or staff within the CGPS, a student may be RTD at any time for failure to achieve satisfactory progress in any aspect of the degree program. Such students will be invited to meet with their Advisory Committee as soon as evidence of unsatisfactory performance is available to either the Supervisor or the Graduate Chair.

When academic units or a CGPS staff member recommends to the Associate Dean, CGPS that a student is RTD, they must also inform the student in writing by providing a copy of the recommendation. If the Associate Dean, CGPS upholds the recommendation, official notification of the RTD will be sent by the Associate Dean, CGPS to the student. The Associate Dean's decision may be appealed to the Graduate Academic Affairs Committee, within 30 days. The basis for the appeal must be outlined in writing. (See *Graduate Studies and Research Policies*, <https://cgps.usask.ca/policy-and-procedure/index.php>).

#### **5.3.4 Readmission After Withdrawal or RTD from Program**

Students who have voluntarily withdrawn or have been RTD from their graduate program and then later wish to resume their program must make a formal application through the academic unit. The academic unit shall make a recommendation for readmission to the CGPS. If approved, the



program start date is considered to coincide with the first course used on the student's Program of Study and the original time limits for the program shall apply.

## 6. Grievances and Appeals

Grievances concerning relational problems between a student and supervisor should be dealt with in the following manner. The student should first approach the supervisor and try to resolve the grievance. If the conflict cannot be resolved then the student should meet with the members of their Advisory Committee. If the committee cannot resolve the problem, then the student should meet with the Graduate Chair who may contact the Department Head. Should the grievance still not be resolved, the student can then go to the Dean of Graduate and Postdoctoral Studies. Guidelines for academic dishonesty and other academic offenses are outlined at the University Secretary's website.

Grievances and appeals will be handled according to Student Appeals in Academic Matters. Unless the CGPS Dean agrees otherwise, the first formal step in a grievance procedure is to be taken within 30 days of the alleged grievance. Other time limits for appeals will be those applying in the College to which the student's academic unit belongs.

### 6.1 Appeals With Respect to Academic Standing

The Student Appeals in Academic Matters outlines regulations and procedures to be followed by students seeking a review of grades assigned for examinations and other work (see <https://cgps.usask.ca/policy-and-procedure/conduct-discipline/appeals.php>).

There are two steps to the appeal process:

1. The graduate student should consult with the Chair of their Advisory Committee (or the Chair of the academic unit Graduate Committee where no committee exists), the academic unit Head, and the Dean of the CGPS before invoking formal procedures. These individuals are charged with the responsibility of encouraging an informal review and resolution of the dispute.
2. If, after these consultations, the student is dissatisfied, they may petition the Master's or Ph.D. Committee of the CGPS, as appropriate, for a formal ruling on the matter. If the concern relates to a written examination, essay or research paper, the student may request, or the Committee may institute a formal re-assessment. If the concern involves any other form of assessment, the Committee shall consider and rule on it. The ruling by the Master's or Ph.D. Committee of the CGPS on a matter of substantive academic judgment will be final. This includes decisions on the acceptability of the thesis and the results of oral examinations.

The Master's or Ph.D. Committee hearing the appeal shall meet with the student making the appeal and permit a verbal presentation. The student shall have the right to be accompanied by a representative who must be a member of Graduate Faculty and who may speak on behalf of the student. Depending on the nature of the appeal, the Committee shall invite other interested parties to appear at the appeal as witnesses.

University policy and procedure on academic appeals also apply:

<https://students.usask.ca/academics/grading/appeals.php#Graduate>



## **6.2 Appeals With Respect to Academic Unit RTD**

A student may appeal a recommendation that they be RTD. The Associate Dean of CGPS will inform the student of the right to appeal, and provide advice, if requested, as to the type of information that must form part of the appeal. The student will also be informed of the date by which an appeal must be submitted.

Upon receipt of an appeal, the Associate Dean shall inform the academic unit Head and/or Graduate Chair that an appeal has been submitted and provide information regarding the nature of the appeal in writing. The academic unit may, if it so wishes, withdraw its RTD at this time. Should the academic unit stand by its original recommendation; the case will be referred to the Graduate Academic Affairs Committee of the CGPS. The Committee shall conduct an investigation into the matter and make a binding recommendation.

## **7. Student Representation**

### **7.1 Soil Science Graduate Students' Association**

#### **7.1.1 Purpose of the Association**

The purpose of the association is to support the graduate students in the Soil Science graduate program at the University of Saskatchewan both academically and socially and to foster a cohesive working environment between graduate students, faculty, and support staff. A list of current Soil Science Graduate Students' Association (SSGSA) executive and their contact information can be found on the SSGSA message board located in the lunchroom (Room 5D43). For announcements and upcoming events please check the SSGSA message board and the SSGSA Facebook page ('Soil Science Graduate Students Association').

#### **7.1.2 Membership**

Membership is open to any student within the Department of Soil Science at the University of Saskatchewan. Only members of the GSA (current graduate students) are eligible to hold voting privileges and executive positions in the organization.

### **7.2 Representation at Departmental Meetings**

Graduate students have direct representation in certain department affairs. One student is selected by the students on an annual basis to represent them at regular departmental committee meetings.



## 8. Appendix A –Soil Science Roadmap





The chart below provides the timeline for progress in program. Please note times without (MSc or PhD) designation apply to both programs.

| Time                                                             | Requirement                                                                                                                   |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Month 1                                                          | Signed Student-Supervisor Agreement filed                                                                                     |
| Month 2-3                                                        | Mini-proposal submitted/approved<br>Committee meeting notes approved and submitted<br>Program of study approved and submitted |
| Month 4 (PhD)                                                    | Qualifying exam completed and filed                                                                                           |
| Month 12                                                         | Proposal submitted/approved<br>Committee meeting notes approved and submitted                                                 |
| Every 12 Months (minimum)                                        | Progress Report and Progress meeting<br>Committee meeting notes approved and submitted                                        |
| ~Month 12-24<br>Month 24 (PhD)                                   | Course work completed<br>Comprehensive exam completed and filed                                                               |
| ~ Month 18-20 (MSc)<br>~Month 30-32 (PhD)                        | Permission to Write<br>Committee meeting notes approved and submitted                                                         |
| ~Month 23 (MSc)<br>~Month 35-45 (PhD)                            | Thesis draft completed<br>Permission to Defend<br>Approval by the committee to defend submitted                               |
| 3 weeks prior to defense (MSc)<br>4 weeks prior to defense (PhD) | Thesis sent to external examiner for review by graduate program administrator                                                 |



## **9. Appendix B Mini-proposal outline**



|                                                                                              |                                                                                                              |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Student Name:</b>                                                                         | <b>Student Number:</b>                                                                                       |
| <b>Name of Supervisor(s):</b>                                                                | <b>Program:</b> <input type="checkbox"/> Ph.D. <input type="checkbox"/> M.Sc.<br><b>Date approved:</b> _____ |
| <b>Project Title:</b>                                                                        |                                                                                                              |
| <b>Context:</b> (briefly state the problem or purpose of the research; why is it important?) |                                                                                                              |



**Hypotheses:** (a useful hypothesis is a **testable** statement which may include a prediction.)

**Project Objectives:** (define the specific aims of the study; clearly state what will you do to prove/disprove your hypotheses.)

**Project Description:** (Provide a brief overview of the project, including the experimental approach you will take to achieve your objectives; **2 page maximum**. Note: box will expand automatically as you type.)



**Timelines** (add rows as needed):

| Activity | Start Date | End date |
|----------|------------|----------|
|          |            |          |
|          |            |          |
|          |            |          |
|          |            |          |
|          |            |          |
|          |            |          |
|          |            |          |
|          |            |          |

**Proposed Coursework** (add rows as needed):

| Course No.      | Title                                | Term                  |
|-----------------|--------------------------------------|-----------------------|
| SLSC 990        | Seminar                              | F/W                   |
| SLSC 994 or 996 | Research                             | F/W/S                 |
| GSR 960         | Introduction to Ethics and Integrity | First term in program |
|                 |                                      |                       |
|                 |                                      |                       |
|                 |                                      |                       |
|                 |                                      |                       |
|                 |                                      |                       |

**Student Signature:** \_\_\_\_\_

**Supervisor Signature(s):** \_\_\_\_\_

\_\_\_\_\_

**Date submitted:** \_\_\_\_\_



## 10. Appendix C Soil Science Education Equity Plan

(Accepted April 28, 2000)

*Education Equity* - intended to address the disadvantages experienced by certain groups in accessing education opportunities

### **Education Equity Plan:**

1. All Canadian Aboriginal students will be eligible for a scholarship if accepted into the Graduate program as a conditional or fully qualified student. Aboriginal students will be given first preference for a Research Stipend.
2. The Department is committed to training Canadian women for careers at Universities, in industry and research in Canada and will encourage women to pursue a Ph.D. in Soil Science by relaxing the Departmental Scholarship eligibility requirements to 75%, if necessary.
3. The Department will encourage disabled persons to pursue academic and research training and will relax Departmental scholarship eligibility requirements to 75%, if necessary. Individuals would be eligible to apply for additional support to conduct laboratory or field work.
4. The Department will encourage minorities from Canada to pursue academic and research training and will relax Departmental scholarship eligibility requirements to 75%, if necessary.



## 11. Appendix D: Example Ph.D. Candidacy Exam Part I

This examination consists of 5 sections, each representing one of the major sub-disciplines of soil science. The exam is worth 100 marks in total (marks as indicated after each question) and you will have four hours to complete all questions. This is a closed-book exam and students are expected to work independently.

### Soil Chemistry (/20)

1. Define pH-dependent charge and pH-independent (permanent) charge, including how the soil solid fraction influences both types of charge (/4).
2. Define “redox”. Under what soil redox conditions would you expect to find the formation of Fe(III) compounds? Would methane production also be likely under these same conditions? Explain (/4).
3. For each of the following minerals, identify its mineral structure (1:1, 2:1, 2:2, etc.), and rank according to which would be considered the most reactive (1 is most reactive, 5 is least reactive) (/4).

| <i>Clay mineral</i>        | <i>Mineral structure</i> | <i>Rank</i> |
|----------------------------|--------------------------|-------------|
| Chlorite                   |                          |             |
| Vermiculite                |                          |             |
| Kaolinite                  |                          |             |
| Mica (illite)              |                          |             |
| Smectite (montmorillonite) |                          |             |

4. A 1 kg soil sample was extracted with ammonium acetate. The following six cations were measured in the extract. All concentrations are provided in moles per litre. Complete the following table, including correct units (/8).

| Soil ID | Ca <sup>2+</sup> | Mg <sup>2+</sup> | K <sup>+</sup> | Na <sup>+</sup> | Al <sup>3+</sup> | H <sup>+</sup> | Cation exchange capacity | % Base saturation | Exchangeable acidity |
|---------|------------------|------------------|----------------|-----------------|------------------|----------------|--------------------------|-------------------|----------------------|
| A       | xx               | xx               | xx             | xx              | xx               | xx             | xx                       |                   |                      |
| B       | xx               | xx               | xx             | xx              | xx               | xx             |                          |                   | xx                   |
| C       | xx               | xx               | xx             | xx              | xx               | xx             |                          | Xx                |                      |

### Soil Fertility (/20)

5. Which of the following nitrogen fertilizer applications is likely to result in maximum nitrogen use efficiency in the sub-humid Prairies: fall broadcast ammonium nitrate or spring side-banded urea? Explain (/4).
6. Differentiate between saline and sodic soils. What are key limitations to crop production associated with each soil type (/4)?
7. List the major forms of nitrogen available in the soil, specifying which is dominant, which is most plant available, and which is most mobile (/4).
8. If you apply 11-52-0 fertilizer at a rate of 100 pounds of product per acre, how many kilograms of each of the following elements have you applied per hectare: K, N, P, S? (1 ac = 0.405 ha, 1 lb = 0.45 kg) (/8)

### Soil Physics (/20)



9. Label the soil landscape below with each of the following terms, adding lines or other features as required: runoff, recharge, discharge, percolation, throughflow, groundwater table, capillary fringe, vadose zone (/4).
10. Define matric and osmotic potentials (/4).
11. Which of the following soils would have the most plant available water: a clay soil with a matric potential of -1500 kPa or a sandy soil with a matric potential of -10 kPa? Explain (/4).
12. The following measurements were taken on three soil cores, each with a volume of 300 cm<sup>3</sup>. Complete the following table, including correct units (/8).

| Soil wet mass | Soil dry mass | Bulk density | Porosity (%) | Volumetric water content |
|---------------|---------------|--------------|--------------|--------------------------|
|               | xx            |              |              | Xx                       |
| xx            |               |              | xx           |                          |
|               | xx            | xx           |              | Xx                       |

### Soil Genesis and Classification (/20)

13. Describe the process of podzolization, including the soil-forming environment where this process is most likely to occur (/4).
14. Name and define the three major taxonomic levels in Canadian System of Soil Classification includes, providing an example of each level (/4).
15. Ellis identified groundwater as one of seven soil-forming factors of significance to soil formation in western Canada. Describe the characteristics of Solonetzic soils, with reference to how groundwater may influence their formation in Prairie environments (/4).
16. In the Boreal Shield, it is not unusual to find Organic and Brunisolic soils occurring in close proximity. Describe how Jenny's six soil-forming factors influence the type and intensity of soil formation that would give rise to this complex (/8).

### Soil Biology (/20)

17. Define mycorrhizae and briefly describe their role in soil (/4).
18. Describe the significance of the C:N ratio in determining the rate of decomposition (/4).
19. Describe at least four major ecological functions of soil organic matter (/4).
20. Sketch a simple nitrogen cycle, identifying major pools and processes and briefly discussing the role of microorganisms in at least four of the processes (/8).