Genetics, Genomics, and Bioinformatics

Assessment Plan for the PhD Program

Program Learning Outcomes

The Ph.D. program in Genetics, Genomics, and Bioinformatics (GGB) is guided by seven Learning Outcomes that define the set of skills and knowledge that Ph.D. students should possess at the time of degree conferral. A variety of direct and indirect assessment tools are used to provide evidence of student learning. This document describes the learning outcomes of the three main areas of specialization within the GGB program including Genetics, Genomics, and Bioinformatics. Requirements applying only to specific areas are stated in the text accordingly.

Learning Outcome 1: Knowledge Acquisition

Each PhD student in the GGB will attain a comprehensive knowledge and master theoretical principles and methodological approaches in Genetics, Genomics and Bioinformatics. A student should be able to apply knowledge and skills to address complex research problems in these areas.

Approach: The student’s focus within one or more areas will be established within the first year of study after discussions with the student, research advisor and Guidance Committee. Students will acquire the factual knowledge, theoretical principles, and methodological approaches in one or more areas of specialization through their course program, independent studies and laboratory rotation projects.

Assessment Methods: Assignments and examinations in courses that incorporate historical and contemporary literature. Core courses in each area cover the fundamental concepts (e.g. GEN 203, GEN 241 and GEN 242). Attendance at GEN 261 and one or more related seminar series. Annual progress report. Written and oral qualifying examinations. Quality assessment of Ph.D. Dissertation Defense seminar.

Learning Outcome 2: Critical Thinking Skills

Students will be able to (1) critically read, understand, and evaluate scholarly literature; (2) integrate, synthesize and conceptualize ideas and theories; (3) identify and evaluate novel and relevant research questions; (4) develop appropriate and effective research strategies; and (5) communicate clearly and effectively both orally and in writing.

Approaches: Students will learn to critically evaluate science through a variety of course activities including writing proposals, reviews, and discussions. Students will learn to critically evaluate data, integrate and synthesize ideas, develop research questions, conduct research, and
communicate results under the supervision of a faculty dissertation advisor. Students will be encouraged and supervised to apply for competitive scholarships. Cornerstone courses, such as GEN 241-242 will provide guidance for best practices in oral and written communication and opportunities to develop these skills. Students will present their research at the annual GGB Graduate Student Research Symposium, critically evaluate student seminar presentations, and present a public dissertation defense.

**Assessment Methods:** Assignments and examinations in courses that incorporate contemporary literature and course projects. Assessment of student course presentations and Dissertation Defense Seminar quality, performance in all required courses. Success rates on the written and oral Qualifying exams. Outcomes and reviews of research projects and fellowship submissions. Dissertation defense.

**Learning Outcome 3: Research Skills**

Students will be able to (1) conduct research in a responsible and ethical manner; (2) evaluate, analyze, and interpret results; (3) develop and test hypotheses; (4) develop and sustain evidence-based arguments; (5) convey findings clearly and effectively; (6) identify broader implications of findings; and (7) disseminate research results through peer-reviewed publications and documents.

**Approach:** Students will be trained to be competitive and responsible scientists enabling a transition from mentor-led to independent research through the iterative process of hypothesis testing, data collection, and evaluation. Skills in data evaluation and interpretation of evidence will be developed through courses, student seminar presentations, and faculty feedback on research data. Students will publish research results in peer-reviewed journals. Training in research ethics will be addressed in the core courses, such as GEN 241-242, as well as in the new GDIV 403 class on “Research and Scholarship Ethics”, online courses with practical examples of issues in research ethics, formal training in responsible conduct of research by the Office of Research, and informal training in individual laboratories.


**Learning Outcome 4: Research Milestones**

Students will conduct independent research and be able to produce sound research results within reasonable time frames.
**Approach:** Presentations in laboratory meetings and discussions with research advisers to focus students on productive and creative research paths with measurable research outcomes. The student research presentation at the annual GGB Graduate Student Research Symposium will provide an opportunity for students to relay research progress. Progress will be formally monitored by annual meetings of the Guidance and Dissertation Committees.

**Assessment Methods:** Annual progress reports. Dissertation defense. Published manuscripts. Advancement to candidacy within 1 year of normative time; degree conferral within 1 year of normative time.

**Learning Outcome 5: Effective Teaching**

Students will become effective teachers and communicators.

**Approach:** All students must complete the training provided by the Teaching Assistant Development Program (TADP). All students will serve as a Teaching Assistant for at least one quarter prior to graduation; during this time students are enrolled in a teaching practicum. When possible, students will assist teaching courses close to their discipline or broad-based classes that are foundational to the field of Genetics, Genomics and Bioinformatics. Students will have opportunities to mentor other students in directed research activities. Presentations in laboratory meeting, courses and seminar programs will develop oral communication skills. GEN 241-242 will provide guidance for best practices in oral and written communication and opportunities to develop these skills, which are critical for teaching excellence.

**Assessment Methods:** Completion of TADP training, the teaching practicum, and GEN 241-242. Quality of student teaching evaluations. Success in a course with individual presentations (e.g. GEN 203, GEN 241-242). Attendance at GEN 261 seminars. Participation in undergraduate mentoring. Dissertation defense.

**Learning Outcome 6: Professional Skills**

Students will learn leadership skills and become capable professionals.

**Approach:** Students will be trained to become professionals in their area of focus through faculty mentorship, coursework, and in professional development skills. We will emphasize ethical behavior in all aspects of the graduate experience. Students will be encouraged to apply for external funding. Students will attend regional, national or international meetings in their discipline. Leadership and productive interactions amongst students across all of the disciplines of the GGB will be promoted in all core courses. Students and faculty will be encouraged to submit applications or nominations, respectively, for student awards. Students will be given opportunities for formal and informal interactions with visiting scientists.
**Assessment Methods:** Assignments in professional development course. All students will participate in the GGB annual retreat and will present a talk on their research at the beginning of their third year of graduate study. Conference participation and presentations. Fellowship and grant proposal applications and awards. Publications. Job placement. Community service. Documentation of service on department committees and graduate student organizations. Professional service and awards. Documentation of responsible conduct of research training. Documentation of interactions with visiting scientists.

**Learning Outcome 7: Professional and Academic Satisfaction**

The GGB program will produce graduates who are satisfied with research and learning during their PhD program.

**Approach:** The GGB Student Handbook will be updated annually after consultation with graduate students. Classes will be adapted to accommodate student’s changing academic and professional needs; students’ recommendations will be assessed and implemented where appropriate. Opportunities for students to interact with visiting scientists and promote networking will be provided. New graduate-level courses and seminars will be offered according to students’ interests and disseminated in a timely manner. An annual student satisfaction survey and an independently administered focus group will be used to provide students the opportunity to identify the strengths and weaknesses in the program.

**Assessment Method:** Annual survey on the content and delivery of the materials in the GGB Student Handbook. Assessment of academic classes and implementation of changes where appropriate. Assess opportunities for student interactions with visiting scientists. Recommendations from the student satisfaction survey and focus group will be reported, responses delivered to students promptly, and changes implemented where appropriate.
Assessment Plan for the MS Program (Thesis)

Program Learning Outcomes

The Master of Science (M.S.) Program in Genetics, Genomics and Bioinformatics is guided by seven Learning Outcomes that define the set of skills and knowledge that M.S. students should possess at the time of degree conferral. A variety of direct and indirect assessment tools will be used to provide evidence of student learning. A variety of direct and indirect assessment tools will be used to provide evidence of student learning. This document describes the learning outcomes of the three areas of specialization (tracks) within the GGB program including Molecular Genetics (MG), Genomics and Bioinformatics (GB), and Evolution & Population Genetics (EPG). Requirements applying only to specific tracks are labeled in the text accordingly.

Learning Outcome 1: Knowledge Acquisition

Each M.S. student in Genetics, Genomics and Bioinformatics will attain extensive knowledge of the facts, theoretical principles and methodological approaches in MG, GB or EPG. A student should be able to apply knowledge and skills in these areas to address complex research problems in these areas.

**Approach:** The area of specialization in Genetics, Genomics and Bioinformatics will be determined within the first year of study after discussions with the student, research advisor and Guidance Committee. Students will acquire the factual knowledge, theoretical principles, and methodological approaches in the area of specialization through their course program, independent studies and research experiences.

**Assessment Methods:** Performance in courses. Attendance at GEN 261 and one or more related seminar series (e.g. BIO 252, BIO 265, BMSC 252, BCH 252, BPSC 260, CMDB 257, CS 287, ENTM 250, ENTX 270, PLPA 260, STAT 251). Annual progress report. Thesis evaluation and optional Thesis defense seminar.

Learning Outcome 2: Critical Thinking Skills

Students will be able to (1) critically read, understand, and evaluate scholarly literature; (2) integrate, synthesize and conceptualize ideas and theories; (3) identify and evaluate novel and relevant research questions; (4) develop appropriate and effective research strategies; and (5) communicate clearly and effectively both orally and in writing.

**Approaches:** Students will learn to critically evaluate science through a variety of course activities including writing proposals and reviews, and participating in discussions. Students will learn to critically evaluate data, integrate and synthesize ideas, develop research questions, conduct research, and communicate results under the supervision of a faculty
advisor. A GEN 261 seminar will be delivered and a M.S. thesis seminar will be encouraged. Students will critically evaluate the presentations in the GEN 261 seminar series.

**Assessment Methods:** Assignments and examinations in courses that incorporate historical and contemporary literature. Assessment of GEN 261 seminar quality and performance. Annual assessment of research progress. Outcomes and reviews of thesis. Publication of research results. Completion of critical evaluation forms at GGB260 seminars.

**Learning Outcome 3: Research Skills**

Students will be able to (1) conduct research in a responsible and ethical manner; (2) evaluate, analyze, and interpret results; (3) develop and test hypotheses; (4) develop and sustain evidence-based arguments; (5) convey findings clearly and effectively; (6) identify broader implications of findings; and (7) disseminate research results through peer-reviewed publications and documents.

**Approach:** Students will be trained to be competitive and responsible scientists with the ability to test hypotheses and collect and evaluate data. Skills in data evaluation and interpretation of evidence will be developed through courses, student seminar presentations and faculty feedback on research data. Students will publish research results in peer-reviewed publications. Training in research ethics will be addressed in online courses with practical examples of issues in research ethics, formal training in responsible conduct of research by the Office of Research, and informal training in individual laboratories.

**Assessment Methods:** Annual progress reports and presentations to Guidance Committee. Seminar presentations. M.S. thesis. Publication of research results. Participation in responsible conduct of research training.

**Learning Outcome 4: Research Milestones**

Students will conduct independent research and be able to produce sound research results within reasonable time frames.

**Approach:** Presentations in laboratory meetings and discussions with research advisors will focus students on productive and creative research paths with measurable research outcomes. The GEN 261 seminar presentation will provide an opportunity for students to relay research progress. Progress will be monitored by annual meetings of Guidance and M.S. Thesis Committees.

**Assessment Methods:** Annual progress reports; Date of GEN 261 seminar presentation. Published manuscripts. Degree conferral within 1 year of normative time.
Learning Outcome 5: Effective Teaching

Students will be given the opportunity to acquire skills to become effective teachers and communicators.

**Approach:** Presentations in laboratory meetings, the GEN 261 seminar and courses will develop oral communication skills. Students may have opportunities to mentor other students in directed research activities. In addition, although not required, M.S. students may serve as a Teaching Assistant for one quarter before graduation. If serving as a TA, the student must complete the training provided by the Teaching Assistant Development Program (TADP) and enroll in a teaching practicum during the quarter of their TAship. When possible, students will assist teaching courses close to their discipline or broad-based classes that are foundational to the field of Genetics, Genomics and Bioinformatics.

**Assessment Methods:** Completion of TADP training and the teaching practicum course. Quality of student teaching evaluations. Performance in GEN 261 seminars. M.S. thesis defense. Assessment of undergraduate mentoring opportunities.

Learning Outcome 6: Professional Skills

Students will learn leadership skills and become capable professionals.

**Approach:** Students will be trained to become professionals in their area of specialization through faculty mentorship and coursework. Students will be encouraged to apply for external funding. Students will attend regional, national or international meetings in their discipline. Leadership and productive interactions amongst students across all of the disciplines of the GGB will be promoted. Students and faculty will be encouraged to submit applications or nominations, respectively, for student awards. Students will be given opportunities for formal and informal interactions with visiting scientists.

**Assessment Methods:** Conference presentations. Fellowship and grant proposal applications and awards. Publications. Job placement. Community service. Documentation of service on departmental committees and in graduate student organizations. Academic, professional or service and awards. Participation in responsible conduct of research training.

Learning Outcome 7: Professional and Academic Satisfaction

The Genetics, Genomics and Bioinformatics program will produce graduates who are satisfied with research and learning during their M.S. program.

**Approach:** The Genetics, Genomics and Bioinformatics Handbook will be updated annually after consultation with graduate students. Classes will be adapted to accommodate student’s changing academic and professional needs; students’ recommendations will be assessed and implemented.
where appropriate. Opportunities for students to interact with visiting scientists and promote networking will be provided. Timely dissemination of new graduate-level course offerings and seminar schedules will occur. An annual student satisfaction survey and an independently administered focus group will be used to provide students the opportunity to identify the strengths and weaknesses in the program.

**Assessment Method:** Annual survey on the content and delivery of the materials in the Genetics, Genomics and Bioinformatics Student Handbook. Assessment of academic classes and implementation of changes where appropriate. Assess opportunities for interactions with visiting scientists in annual progress reports. Recommendations from the student satisfaction survey and focus group will be reported, responses delivered promptly and changes implemented where appropriate.