University of Delaware

MICROBIOLOGY GRADUATE PROGRAM

PROGRAM POLICY DOCUMENT

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Table of Contents

I. Program History

A. Statement of purpose

Earth is microbial: Bacteria, archaea, viruses, protists, and fungi are the largest store of biomass on the planet and represent nearly all of its biodiversity. They store massive genetic resources that can be used to solve challenges faced by our rapidly growing human population. Microbes are key to developing more sustainable energy generation and material synthesis, improving human health and wellness, and satisfying increased food demands of larger human populations in the face of limited environmental resources. The faculty and students of the University of Delaware (UD) Microbiology Graduate Program address these challenges in five colleges and thirteen departments. This program brings these faculty and resources together to train the next generation of microbiologists.

The goals of this graduate program are to:

- Recruit and support a diverse pool of high-quality graduate students in Microbiology.
- Support diverse Microbiology faculty invested in cutting-edge student training.
- Rigorously deliver foundational concepts in genome-enabled Microbiology via a core curriculum.
- Provide rigorous electives to support broad exploration beyond the core curriculum.
- Foster professional skills in trainees, enabling them to succeed in multiple career paths.
- Facilitate cross-departmental and cross-college research collaborations.

B. Current program status

The program is currently probationary. The first cohort of students matriculated in Fall 2019.

C. Degrees offered

The program offers Master of Science and Doctor of Philosophy degrees in Microbiology. There are two M.S. degrees (M.S. thesis and M.S. non-thesis). Our students take courses and perform research in the following topics, including but not limited to:

- ***Environmental Microbiology****:* This track includes geobiology, microbial ecology of non-host environments, biogeochemistry, and viral ecology.
- ***Host-Microbe Interactions****:* This track includes host-associated microbiomes, microbial ecology of host-associated environments, pathogenesis, immunology, and virology.
- ***Applied Microbiology****:* This track includes bioremediation, biopharmaceuticals, microbial fermentation, food microbiology, and industrial microbiology.

- ***Microbial Physiology and Genetics****:* This track includes systems and synthetic biology, microbial biochemistry, metabolism, and gene regulation.

D. College and departments that offer the Microbiology degree

The Microbiology Graduate Program (MGP) is an interdisciplinary graduate program that resides in the Graduate College. Students are admitted by MGP and the Graduate College. Once the student is admitted to a laboratory, the student's home department and college become the same as that of the primary faculty advisor. As an interdisciplinary graduate program, MGP administers the student curriculum and promotes academic progress. The following colleges and departments currently offer the Microbiology M.S. and Ph.D. degrees:

- College of Agriculture and Natural Resources: Departments of Animal and Food Sciences, Plant and Soil Sciences
- College of Arts and Sciences: Departments of Biological Sciences, Chemistry and Biochemistry
- College of Health Sciences: Department of Medical and Molecular Sciences
- College of Earth, Ocean and Environment: Department of Earth Sciences, School of Marine Science and Policy
- College of Engineering: Departments of Biomedical Engineering, Civil and Environmental Engineering, Chemical and Biomolecular Engineering, Computer and Information Sciences

II. Admission

A. Admission requirements

Applicants should fulfill the following requirements:

- A completed University of Delaware Graduate College application (online).
- A personal statement that responds to questions specified on the Graduate College application.
- Official, up-to-date transcripts of all undergraduate and graduate programs. A minimum of 3.0/4.0 is required in the major.
- Three letters of recommendation from individuals with knowledge of the applicant's research experience, academic preparation and potential ability as a graduate student.
- International students (except those that qualify for a waiver) must take the Test of English as a Foreign Language (TOEFL) (Minimum Score: 550 paper test, 79 on Internet-based tests) or International English Language Testing System (IELTS) (minimum score 6.5 overall, individual speaking subscore minimum 6.0). TOEFL and IELTS scores more than two years old cannot be considered official. Higher scores are required to be considered as a Teaching Assistant (e.g. 100 TOEFL, 7.0 IELTS).
- Interview with one or more faculty members of the Microbiology program including but not limited to the potential major advisor. Interviews may be conducted in person for domestic applicants and via video or phone call for international applicants.

Graduate Record Examination Scores are not required and are not used in evaluating applicants.

Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

B. Prior degree requirements

Applicants should have a B.A. or B.S. in Microbiology or a related field, and as part of their undergraduate training, should have completed the following (or the equivalent): two years of biological sciences; one year of mathematics, preferably including calculus and/or statistics; one semester of college physics; one year of general chemistry; and at least one semester of organic chemistry. Other applicants will be considered if they have strong academic backgrounds in other scientific areas. Provisional admission may be offered with the stipulation that any deficiency in undergraduate training be made up (without graduate credit) during the first year of graduate study.

1. Admission to the Ph.D. with a M.S. Degree from another university

Individuals may be considered for admission to the Ph.D. program if holding a previous Master's degree in microbiology or a related field from another institution. In recognition of graduate degree experience, up to a maximum of 12 credits out of the 42 required credits may be waived for a student who is entering the Ph.D. Program with a previously awarded Master's degree from an international or accredited US institution. The relevance of the student's prior Master's degree coursework and the total number of credits to be waived (up to the maximum) is determined by the Program Director in consultation with the faculty advisor after the student enrolls in the Ph.D. program. To consider Master's degree coursework relevant, evidence must be provided to show that the prior graduate coursework and/or research experience is sufficiently similar to the Master's degree requirements at UD that will be waived. Detailed degree requirements are outlined in the Ph.D. Degree Requirements section of this policy. If credits are waived, the student should make a plan of study in consultation with their advisor and committee, with specific courses and milestones.

2. Change of classification and transfer students

Students that are currently matriculated in other degree programs at the University should complete a "Change of Classification" Form to seek approval to be admitted into the Microbiology Program. The Program Executive Committee will evaluate the change in classification and transfer requests on a case-by case basis to determine if the applicant will need to complete a full application form submitted to the Graduate College. All transfer students will still have to meet the requirements listed above.

Students already enrolled in the M.S. program who wish to transfer into the Ph.D. program should meet with the Program Director to discuss the possibility. M.S. students may be considered for a bypass to the Ph.D. if recommended by their advisor and committee. Students enrolled in the Ph.D. program who wish to transfer to the M.S. program should similarly meet with Program Director. If a transfer is approved, the student submits a Change of Classification form to be signed by their advisor and the Program Director.

C. Application deadlines

Applications normally are considered only for fall entrance but will also be accepted for spring admission in certain cases. International applicants are considered only for fall admission. To ensure optimum consideration for fall admission, complete applications should be received at this university by January 5 for priority consideration including for funding, with a final deadline of May 1. Evaluation of applications will begin on January 5, and applications received between January 5 and May 1 will be considered only if unfilled slots remain. Applications for spring admission will be considered on a case-by-case basis, depending on available funding. Spring applicants should contact the program director ahead of applying to confirm availability. Deadlines for spring admission are October 1 for priority consideration with a final deadline of December 1.

D. Special competencies needed

Applicants should provide evidence of research experience (academic or otherwise), communication, and leadership skills in their personal statement and on their curriculum vita. Applicants with demonstrated experience will receive priority consideration.

III. Academic

A. Degree Requirements

1. Overview of requirements

a. Master's degree requirements

M.S. students are required to take 8 credits from the core curriculum (see descriptions below), 12 credits chosen from the electives (see list below), 4 research credits and 6 thesis credits, for a total of 30 credits. Completion of thesis credits requires a successful M.S. thesis defense.

M.S. in Microbiology with thesis	**No. of credits**
Core courses	8
Elective courses	12
Research credits	4
Thesis credits	6
Total credits	**30**

Students who are admitted as M.S. students are expected to complete a thesis. However, if a student encounters circumstances that mean they are unable to complete a thesis, they may petition to complete a non-thesis M.S. in Microbiology. If approved by the Graduate Director in consultation with the Program Executive Committee, the thesis credit requirement is replaced with 6 elective and/or research course credits (*) such that the total credits amounts to at least 30. The student and advisor may choose to design a capstone project to fulfill some or all of these 6 course credits.

Non-thesis M.S. in Microbiology	No. of credits
Core courses	8
Elective courses	12-18*
Research credits	4-10*
Total credits	**30**

b. Ph.D. degree requirements

Ph.D. students that do not have a M.S. in Microbiology or a related subject are required to take 12 credits of the core curriculum, 15 credits chosen from the electives, and 9 dissertation credits, for a total of 42 credits. Ph.D. students have the option of laboratory rotations in their first semester (no credit). A qualifying exam (described below) is also required. Completion of dissertation credits requires a successful Ph.D. dissertation defense.

Ph.D. in Microbiology	No. of credits
Core courses	12
Elective courses	15
Research credits	6
Dissertation credits	9
Total credits	**42**

Credit waiver for a relevant Master's degree (up to 12 credits): If the Graduate Admission Committee and the student's advisor have determined that a previously awarded Master's degree includes coursework sufficiently similar to some of the Master's degree requirements at UD, up to a maximum of 12 credits out of the 42 required credits can be waived. The required credits for research (6 credits) and dissertation (9 credits) may not be waived. All students are responsible for organizing their course plan in consultation with their advisor and committee such that they are well prepared for the Ph.D. qualifying examination, and that they fully undertake the coursework needed for their research.

2. Course curriculum

This section describes the core courses and electives.

a. Core courses

Microbial Physiology and Diversity (MAST625; 3 credits): Microbial growth and composition, cell architecture and structures, energy metabolism, diversity in energy and assimilatory metabolism.

Microbial Genetics and Genomics (MAST626; 3 credits): Central dogma, genetic techniques, gene regulation, genome structure and function, -omics, focus on archaea, bacteria and viruses.

Current Topics in Microbiology: Seminar (*MCRO811*): Exposure to the breadth of research including microbiology from external and internal speakers; required presentation on the student's research project will foster oral communication and professional development. 1X for M.S. [1 credit], 3X for Ph.D. with no M.S. [3 credits], 2X for Ph.D. with M.S. [2 credits]. Students are strongly encouraged to participate in seminar throughout their graduate career.

Microbiology Journal Club (*BISC850 or equivalent course*, 1X for M.S. [1 credit] 3X for Ph.D. [3 credits]): Develop critical literature analysis skills and discussion practices; requirement to present a paper will foster oral communication skills. Note that BISC850 has multiple sections; students should select the microbiology-focused seminar, although Ph.D. students may choose to take the grant-writing seminar once.

Laboratory Rotation (Ph.D. only): Acquisition of laboratory skills and selection of advisor through three laboratory rotations (4 weeks each). Rotations are organized by the Program Director in consultation with the student and faculty hosting rotations. The rotations are typically completed within the first semester.

b. Elective Courses

A range of electives is available based on the teaching activities of Microbiology program faculty. To be included as an elective in the Microbiology graduate program, a course must be 600-level or higher and be approved after a review of the syllabus by the Program Director and Executive Committee.

Course Number	**Course Title**	**Semester**
ANFS635	Animal Virology	Fall
ANFS636	Immunology of Domestic Animals	Spring/Fall
ANFS639	Food Microbiology	Fall
ANFS649	Food Biotechnology	Spring
ANFS655	Gut Microbiome	Spring
ANFS671	Paradigms in Cell Signaling	Spring*
BINF640	Database for Bioinformatics	Spring
BINF644	Bioinformatics	Fall/Spring
BINF690	Programming for Bioinformatics	Fall/Spring
BINF694	Systems Biology I	Spring
BISC679	Virology	Spring
BISC682	Bacterial Pathogens: Molecular Mechanisms	Spring
CHEG620	Advanced Biochemical Engineering	

CHEG621	Metabolic Engineering	Fall
CHEG660	Systems Biology	
CHEG840	Rate Processes and Dynamics for Microbial Systems	Spring
CHEM641	Biochemistry	Fall
CIEG644	Microbiology of Engineered Systems	*
GEOL604	Writing in Geosciences	
GEOL645/MAST645	Geomicrobiology	Fall*
MAST616	Methods in Molecular Biology	Spring*
MAST618	Microbial Ecology	Spring
MAST634	Marine Molecular Science	Fall
MMSC638	Diagnostic Medical Mycology and Bacteriology	Fall
MMSC650	Medical Biochemistry	Spring
MMSC690	Clinical & Molecular Cell Biology	Fall
PLSC611	Molecular Plant Pathology	Fall*
PLSC619	Soil Microbiology	Spring
PLSC645	Biogeochemical Cycling of Nutrients	
STAT608	Statistical Research Methods	

An asterisk (*) indicates a course is not taught every year. The timing of courses is subject to change. A current listing of electives is maintained on the MGP website.

3. Transferability

Graduate level courses (up to 9 credits) taken prior to matriculation into the Microbiology Graduate Program at UD may be applied toward completion of a M.S. or Ph.D if not already applied toward a different degree. (See Graduate Catalog for detailed requirements and policies.) The student should complete the Request for Transfer of Graduate Credit form and submit to their advisor and Graduate Director for consideration**.**

4. Course substitution

If a student wishes to make a course substitution, they should make the request to the Program Director, who may require a syllabus. Substitutions will be made using the Course Substitution form.

B. Advisor and Committees

1. Faculty Advisor

a. M.S. students

Masters' students must have identified a faculty advisor **prior** to acceptance into the program and the faculty advisor must have (1) agreed to mentor this student and (2) funding for the duration of the student's time at UD.

b. Ph.D. students

Ph.D. students may be admitted directly to a laboratory; in this case, that faculty member is the research advisor. Otherwise, students will be advised by one of the Director(s) until a primary research advisor has been identified, generally via the rotation program. Faculty willing to advise new students will submit their names to the Program Director by January 5; incoming Ph.D. students will identify three faculty from this list with whom to do rotations. Each rotation will last 4 weeks during the first semester after matriculation. Before the end of the first semester, the Program Director will match students with a faculty advisor. The match will take into account student and faculty preferences, as well as funding availability.

2. Procedure for committee member selection and committee responsibilities

The major advisor and student should discuss potential committee members who might provide support for the student's research. It is the responsibility of the graduate student to ask each committee member if they are willing to serve.

<u>Responsibilities of committee members include the following:</u>

- Work with student to develop a program of study and research
- Review research proposal and provide recommendations
- Ensure acquisition of technical skills and professional development
- Serve as advisory body during period of candidacy
- Administer written and oral qualifying examinations to Ph.D. candidates
- Establish the contribution of the thesis or dissertation to chosen area of expertise and determine the degree of scholarship attained by the student

Basic requirements for the composition of advisory committees are as follows. Students are advised to consult the Graduate Catalog (Degree Requirements) for additional rules and guidance on committee membership. Committees are established by submitting the MGP Committee Formation form to the Graduate Director and Graduate Coordinator for review and approval.

a. M.S. Students

The committee will consist of a minimum of three members; the advisor and at least one other current and active Microbiology program faculty member (full-time or affiliate within UD). The third member may be Microbiology faculty, other UD faculty, or a scientist external to UD.

b. Ph.D. Students

The committee will consist of a minimum of four members; the advisor and at least two other current and active Microbiology program faculty members. The fourth member of the committee may either be a UD faculty member or a scientist external to the University, which is strongly encouraged but not required.

3. Procedures for changes of committee members for both M.S. and Ph.D. students

Changing committee members should follow these steps: (1) the student and advisor discuss the change to be made and the rationale for it; (2) the student and advisor discusses the change with both the outgoing and incoming committee member either together or separately, as needed; (3) an email is sent to the entire committee, including the incoming and outgoing members, to inform about the changes. For all changes, a committee form must be changed accordingly and emailed to the Director.

Should the student need to change advisors, the following steps should be taken: (1) the student should discuss the change and reasons for it with the Graduate Program Director; (2) the student and the Director should determine a suitable advisor; (3) the student and Director should discuss, as/if needed, the ensuing change as per the steps above.

C. Progress towards degree

1. Academic load and timeline

Full-time students should complete the M.S. in two years, with 30 credits total, while the Ph.D. students without a prior M.S. should complete their program in five to six years, with 42 credits total. Ph.D. student with a prior M.S. should complete their program in four to five years, with 42 credits or fewer if credits were waived. Timeline and milestones are detailed below and summarized in a table at the end of this section.

In any given semester, students enrolled in at least 9 credit hours or in sustaining credit are considered full-time students. Students on contract (holding assistantships) are considered full-time with six credits. Otherwise, those enrolled for fewer than 9 credit hours are considered part-time students. Generally, a maximum load is 12 graduate credit hours; however, additional credit hours may be taken with the approval of the student's adviser and the Graduate College. Permission must be obtained from the Office of Graduate and Professional Education to carry an overload in any session.

Students on contract in the summer are required to be registered for 3 credits (MCRO887 for P/F, MCRO868 for grade, or another course) or as sustaining.

2. Grade requirements

Students are advised that university policy (Graduate Catalog, Degree Requirements) establishes minimum grades and grade point averages.

Only graduate courses completed with a grade of B- or higher will count towards the requirements of the M.S. and Ph.D. program in Microbiology. In special cases, 300 level, upper-undergraduate level courses may be required to supplement the student's knowledge base but will not be counted towards overall credits. Students must obtain at least a 3.0 cumulative grade point average in the courses in the curriculum to receive the degree.

3. Master's degree requirements

Students in the M.S. program will develop their program of study in conjunction with their faculty advisor and committee members. The thesis committee must be established by the beginning of the student's second semester of their program and committee meetings should be held every six months and documented using the MGP Committee Report form. Students should develop a thesis proposal or plan for their committee's approval by the end of their first year in the program. Students must submit a final thesis to their committee two weeks before their thesis defense date, along with an announcement of their thesis defense seminar, advertised to the Microbiology Graduate Program faculty and students. The defense seminar will be open to the public, including all members of the Microbiology program. Students are expected to complete the program within two years. The program may be completed over a longer time frame for part-time students. The maximum time for completion of a M.S. degree is 5 years from the time of entry.

4. Ph.D. degree requirements

Students in the Ph.D. program will develop their program of study in conjunction with their faculty advisor and their committee. The dissertation committee must be established by the beginning of the student's second semester of their program and committee meetings should be held every six months and documented using the MGP Committee Report form. Students should develop a proposed plan of study for their committee's approval by the end of their first year in the program. Students are expected to complete the program within 4-5 years (if a M.S. was completed prior) or 5-6 years without a prior M.S.. The maximum time for the completion of the Ph.D. program is 7 years from the time of entry, without a prior M.S., and 5 years with a prior M.S..

a. Qualifying exam

The faculty advisor will determine the specific nature of the exam, with guidance, as needed from the Graduate Director and the student's Dissertation Committee. Both written and oral parts must be passed in order to advance to candidacy, and one or both should draw upon key concepts from the core curriculum. The following outlines the requirements, procedure, and assessment of the qualifying exam components.

Timing: The student should schedule their qualifying exams (written and oral) according to the timing in the Milestones table below.

Proposal: Students will write a dissertation proposal and submit it to the committee at least 6 weeks before the oral defense date.

Written exam: Committee members will each provide one written question to the student, based on coursework and applied to the thesis topic, within 2 weeks of receiving the proposal. Students then provide written responses to the questions from the committee in a time frame defined by the committee, but before the oral defense date.

Oral exam: Students will then present and defend their thesis proposal to the committee. The committee may ask students any questions related to the proposed work, completed coursework, and follow up to written exam questions during this defense.

Assessment: The Dissertation Committee will be responsible for grading both portions and will decide on a single outcome. Outcomes may be:

- Unconditional Pass
- Conditional Pass - Student will pass, provided they meet criteria such as additional coursework, revised written exam answers, and/or revisions to the written proposal. The conditions must be clearly stated, i.e. the exact nature of the deficiency must be described along with a mechanism to repair this deficiency. The timeline of completion and evaluation procedure should be documented clearly. When finished, the Chair of the Examining Committee must resubmit the Results of the Qualifying Examination form to the Program Director clearly stating that the student has resolved the conditional pass.
- Re-Examination - Student did not meet the criteria for passing, but could do so with additional preparation.
- Fail - A grade of FAIL will result in the recommendation for dismissal of the student from the program.

While it is customary to report the exam results immediately after the final portion (usually the oral exam), the formal results of the qualifying exam, including rationale for outcome, must be documented using the Results of the Qualifying Examination form submitted to the student, the Graduate Director and Graduate Coordinator within one week of the examination. The approved proposal should be submitted to the Graduate Coordinator to be filed in the program records.

Upon the recommendation of the Dissertation Committee, the student may be admitted to candidacy for the Ph.D. degree. The University stipulations for admission to doctoral candidacy are that the student has (1) had a program of study approved, (2) completed one academic year of full-time graduate study in residence at the University, (3) passed the program's qualifying examination, (4) demonstrated the ability to do research, and (5) had a research project accepted by the Dissertation Committee. For item 5, an approved research proposal constitutes an accepted research project.

b. Dissertation and defense

The final examination of the Ph.D. degree will involve approval of the written dissertation and an oral defense of the candidate’s dissertation. The written dissertation will be submitted to the Dissertation Committee and the Microbiology Graduate Program office at least three weeks in

advance of the oral defense date. The oral defense date will be publicly announced at least two weeks prior to the scheduled date and will be open to the public including all members of the Microbiology Graduate Program. The Dissertation Committee is responsible for evaluating and approving the candidate's dissertation. The student and graduate advisor will be responsible for making all corrections to the dissertation document and for meeting all Graduate College deadlines for submission. **Ph.D. candidates must have at least one year between their qualifying exam and their dissertation defense.**

Students are encouraged to follow the university's Steps to Graduation, which can be found at this link: https://www.udel.edu/academics/colleges/grad/current-students/academic-support/steps-to-graduation/

5. Program milestones

See next page for Academic Milestones table and notes.

Academic Milestones for Microbiology Graduate Students
University of Delaware - Graduate College

Milestones for M.S.	**Deadline**
Approved Thesis Committee	End of first semester
Approved Thesis Proposal	End of second semester/first year
Complete required 30 credits	Before graduation
Submit final Thesis and Defense	End of fourth semester
Graduate	Within two years
Milestones for Ph.D.	**Deadline**
Complete Lab Rotations (if rotating) and select Primary advisor	End of first semester
Approved Dissertation Committee	End of second semester
Pass Qualifying Exam	Beginning of third year
Complete required 42 credits	Before graduation*
Defend Dissertation	During fifth year
Graduate	Within five years
Milestones for Ph.D. (prior M.S.)	**Deadline**
Complete Lab Rotations (if rotating) and select Primary advisor	End of first semester
Approved Dissertation Committee	Beginning of second semester
Pass Qualifying Exam	Fourth semester
Complete required credits	Before graduation*
Defend Dissertation	During fourth year
Graduate	Within four years

Recurring milestones for all students:

- All MGP students must submit an Annual Progress Report by the first week of January of every year.
- Committee meetings should be held every six months and the Committee Report Form should be submitted by the advisor immediately following the meeting.

*Once credits are completed (including thesis and/or dissertation credits), students move to sustaining status. Please work with the Graduate Coordinator for advice on registration once all credit requirements have been met.

6. Guidelines for research proposals involving human or animal subjects

Success depends upon following all UD rules and regulations. Students working with human or animal subjects in the Microbiology Graduate Program must attend human or animal subjects training and request approval from the human or animal subject committee at the University. Proposals that include interviews, case studies, or other interrogative methodologies must have all questions approved by the University Human Subjects Review Board.

7. Consequences of unsatisfactory academic progress

If a student is failing to make satisfactory progress towards a degree (including holding and documenting committee meetings every 6 months), the program directors will meet with the advisor and student to discuss and decide on suitable action. Possible actions include (but are not limited to): (i) requirement for additional courses, (ii) suspension of financial support, and (iii) recommendation for dismissal.

8. Standards of student conduct

All graduate students are subject to University of Delaware regulations regarding academic honesty. Violations of the UD regulations regarding academic honesty or other forms of gross misconduct may result in immediate dismissal from the Program.

9. Dismissal

The procedures for dismissal as detailed in the University Catalog will be followed. Briefly, the Graduate Committee will report its recommendation and reason for dismissal to the Microbiology Graduate Program Director(s). The Director(s) will make a recommendation to the Graduate College, who will decide whether to dismiss the student. The student may appeal this decision to the Graduate College, following the procedure given in the University Catalog.

10. Graduate student grievance procedures

Students who feel that they have been graded inappropriately or receive what they perceive as an unfair evaluation by a faculty member may file grievances in accordance with University of Delaware policies. Students are encouraged to contact the Microbiology Graduate Program Director(s) prior to filing a formal grievance in an effort to resolve the situation informally.

IV. Program Educational Goals

Thesis-based M.S.

The **Microbiology Graduate Program thesis-based M.S. degree** seeks to produce individuals that have obtained fundamental knowledge of modern microbiology research who have demonstrated the ability to conduct experiments and communicate research findings. Graduates will be ready to enter into the workforce or pursue the Ph.D.

Goal 1: Graduates will critically analyze microbiology primary research literature to identify research outcomes and experimental protocols. This goal is accomplished through literature-based courses and literature review for the thesis.

Goal 2: Graduates will be able to accurately perform complex experimental designs based on analysis of the primary literature and collaborative experiment design with their mentor and peers. This goal is accomplished through performance of the thesis research project.

Goal 3: Graduates will be able to independently analyze microbiological data and present the results of these analyses in both oral and written form. This goal is accomplished through both written and oral assignments in core and elective courses, writing the thesis, a thesis seminar, presentation at meetings/conferences, and/or primary literature publication.

Non-thesis M.S.

The **Microbiology Graduate Program non-thesis M.S. degree** seeks to produce individuals that have obtained fundamental knowledge of modern microbiology research who have demonstrated the ability to conduct experiments and communicate research findings. It is currently reserved for Ph.D. students who in consultation with their advisor and committee decide that the Ph.D. program is not aligned with their career goals or desires. The degree will be awarded when a student has completed all required coursework for the Ph.D. except for passing the qualifying examination and dissertation credits. It requires that their advisor affirm to program leadership that a written summary of work completed during their program to date has been provided.

Goal 1: Graduates will critically analyze microbiology primary research literature to identify research outcomes and experimental protocols. This goal is accomplished through literature-based courses and literature review captured in the written summary of work.

Goal 2: Graduates will be able to accurately perform complex experimental designs based on analysis of the primary literature and collaborative experiment design with their mentor and peers. This goal is accomplished through performance of research and documentation of that research in the written summary of work.

Goal 3: Graduates will be able to independently analyze microbiological data and present the results of these analyses in both oral and written form. This goal is accomplished through both written and oral assignments in core and elective courses, meetings/conferences, the written summary of work, and/or primary literature publication.

Ph.D.

The **Microbiology Graduate Program Ph.D.** degree seeks to produce individuals that have obtained fundamental knowledge of modern microbiology research who have demonstrated the ability to identify research areas/gaps and independently design research to address these problems. Graduates will be ready to enter into the workforce and lead research projects in industry, government, or academic settings.

Goal 1: Graduates will critically analyze microbiology primary research literature to identify research outcomes and experimental protocols. This goal is accomplished through literature-based courses and literature review for the dissertation proposal and dissertation document.

Goal 2: Graduates will be able to accurately perform complex experimental designs based on analysis of the primary literature and collaborative experiment design with their mentor and peers. This goal is accomplished through performance of the dissertation research project.

Goal 3: Graduates will be able to independently analyze microbiological data and present the results of these analyses in both oral and written form that meets professional standards. This goal is accomplished through both written and oral assignments in core and elective courses, writing the dissertation, a dissertation seminar, presentation at meetings, and/or primary literature publication.

Goal 4: Graduates will be able to identify significant knowledge gaps in Microbiology and independently design research to creatively address the knowledge gap. This goal is accomplished through developing and successfully defending the dissertation research proposal through the qualifying exam process.

Goal 5: Graduates will develop and demonstrate skills for effectively transferring knowledge to others. This goal may be achieved through completion of varied activities including teaching assistantship, designing and developing educational aids for classroom use, designing and developing experiments for teaching laboratory use, and/or guest lecturing.

V. Assessment Plan

The program educational goals are assessed by direct and indirect measures:

Direct measures:

1. Qualifying exam (Ph.D.)
2. Masters thesis or capstone
3. Ph.D. dissertation
4. Committee meeting report
5. Research products, including publications, data reports, conference presentations

Indirect measures:

1. Annual report with updated CV (due first week of January)
2. Course products and cumulative GPA
3. Exit and alumni surveys

Assessment data are collected in association with assessment events (committee meeting , qualifying exam, thesis/dissertation defense). Student accomplishments are collected every January in an annual report and CV. Exit surveys will be conducted at graduation. Data will be summarized in an annual report, shared with program faculty and the Graduate College each fall.

VI. Financial Aid

A. Financial Awards

Financial aid is awarded on a competitive basis. Admission to the Microbiology Graduate Program does not automatically entitle an applicant to financial aid. The University of Delaware's policies apply to all forms of financial aid (see University Policies for Graduate Student Assistantships and Fellowships in the Graduate Catalog). Students may seek financial aid opportunities, such as fellowships or scholarships from sources within the University and from private and federal agencies. Interested students should check the Graduate College website for the most current opportunities (https://www.udel.edu/academics/colleges/grad/).

Students in the Microbiology program may be funded by Graduate Assistantships:

Research Assistantships (RAs) are generally funded by research grants and contracts provided by external funding agencies. Students may be supported as an RA through their Faculty Advisor's research funds. A research assistantship provides a stipend and typically provides tuition per grant and department guidelines. The RA's advisor is responsible for defining the student's responsibilities and for evaluating the student's performance. The amount of service or research may vary from week to week but the average is expected to be 20 hours per week.

Teaching Assistantships (TAs) are offered for graduate students to perform teaching and other instructional activities. The amount of service may vary from week to week but the average is usually expected to be 20 hours per week. A teaching assistantship provides a stipend and may also provide tuition, depending on the position and department policies. If a student requires a TA, the advisor should notify the Program Director and Graduate Coordinator at the beginning of the prior semester. Award of a TA will be decided by the Program Executive Committee, the primary advisor, and the departments offering the course for which the TA will teach.

The University offers competitive scholarships and fellowships; these are usually via nomination by the graduate program. In these cases, students that meet the stated qualifications may discuss the potential for nomination with their advisor, who can propose and help coordinate the nomination with the Program Director.

VII. Program Operations

Once a student joins a laboratory (i.e. identifies a faculty advisor), the student is departmentally situated with that of the faculty advisor. Students are expected to adhere to all operational policies of that department.

In cases where a Ph.D. student is rotating between labs prior to joining a lab, the Graduate Director or Associate Director will serve as advisor, until one is established

A. General student responsibilities

Up-to-date addresses—Graduate students are required to provide the Microbiology Graduate program with an up-to-date address and other contact information and to update this address whenever it changes.

Laboratories and research equipment—Graduate students must comply with all UD safety regulations when working in any UD laboratory. Individual labs may have additional rules and regulations; students are expected to comply with these as well. All members of the program are responsible for creating a safe working environment for each other. If anyone notices unsafe working conditions, they should bring it to the attention of the individual responsible for the lab (e.g. Principle Investigator, facility director, or lab manager). If students have ongoing safety concerns, these should be brought to the attention of the UD Environmental Health and Safety group (http://www1.udel.edu/ehs/) and the MGP Program Director and/or the Associate Program Director.

Hazardous Chemical Information Act—All students, staff, and faculty are expected to comply with the Delaware Hazardous Chemical Information Act (delcode.delaware.gov/title16/c024/index.shtml). Any questions regarding compliance should be directed to the individual responsible for the lab and/or to the UD Environmental Health and Safety group (http://www1.udel.edu/ehs/).

Vehicles—UD vehicles can be rented by students if needed to perform duties associated with the program (https://sites.udel.edu/transportation/motor-pool/). Students should consult with their advisor or the MGP Program Director before renting a vehicle.

Keys, offices, mail, telephone, copy machine, computer terminals, etc.—Students will follow the policies of their home department (that of their faculty advisor) as it relates to these items. If there are items needed that are not provided by the advisor's department, students can reach out to the MGP Graduate Coordinator for assistance.

D. Travel for professional meetings or presentations

Students are generally expected to travel for professional meetings and to present results at these conferences. Funding for student travel can come from a variety of sources: advisor research grants, UD Graduate College Travel Awards (grad.udel.edu\travel-award-application), professional society grants, conference travel grants, etc. Students should consult with their advisors on appropriate conferences to attend and how to fund their travel. While at conferences, students are representing UD and are expected to abide by the UD Student Code of Conduct and any professional codes of conduct implemented by the conference.

E. Professional development

The MGP sponsors a student-led EmPOWER program, which provides peer mentoring and a variety of workshops. As a student in the Microbiology program, one is automatically a member of this group and can choose to participate as they wish.

For additional professional development opportunities, students are encouraged to sign up for the Graduate College Newsletter as well as visit their website at: https://www.udel.edu/academics/colleges/grad/current-students/professional-development/