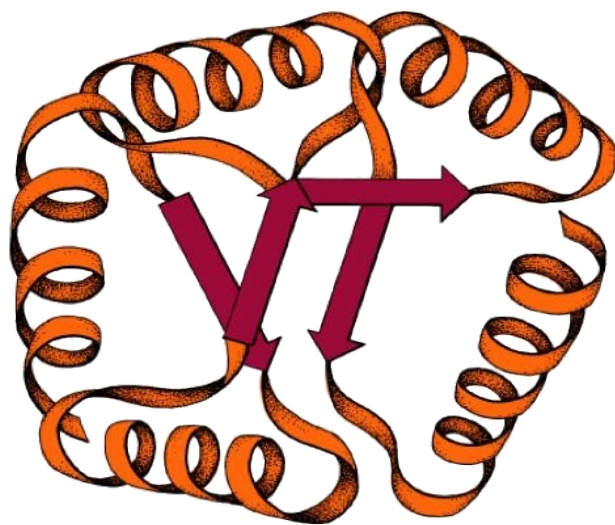


GRADUATE STUDENT HANDBOOK

Department of Biochemistry



Fall 2019

TABLE OF CONTENTS

Meet the Biochemistry Graduate Program Committee	3
I. Guidelines for Graduate Education	4
II. Overview of Graduate Degree Programs	4
III. The Doctor of Philosophy (Ph.D.) Program	10
IV. The Master of Science in Life Sciences (MSLS) Program	15
V. Comparison of Doctoral and MSLS Degree Requirements	17
VI. Career Development	17
VII. Facilities	18
VIII. Resources and Contact Information	19
IX. Institutional Policies	20
X. Suggested Elective Courses	21
XI. Faculty Research Areas	24

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I. GUIDELINES FOR GRADUATE EDUCATION

Two sets of guidelines are provided for graduate study in the Department of Biochemistry:

1. The Graduate School has general guidelines, which are found in the document [Expectations for Graduate Education](#).
2. The Department of Biochemistry guidelines, which are outlined in this Handbook.

II. OVERVIEW OF GRADUATE DEGREE PROGRAMS

Department of Biochemistry Mission Statement

The mission of the Department of Biochemistry is to help build a better future by:

1. Providing aspiring molecular life scientists with the opportunity to obtain a world-class education by engaging in a program of instruction that emphasizes:
 - Critical thinking.
 - Rigorous and effective application of the scientific method.
 - Quantitative analysis.
 - Fundamental chemical, biological, and physical principles.
 - Clear and accurate written and verbal communication.
 - Intensive experiential learning activities.
2. Generating new tools and knowledge that will advance our understanding of the living world and enhance the quality of life through better medical care, disease prevention measures, nutrition, and environmentally sound and sustainable agricultural and manufacturing processes.
3. Leveraging these research activities to provide students with opportunities to participate in genuine, challenging experiential learning activities involving state-of-the-art approaches and technologies.
4. Enhancing public understanding of biochemistry, molecular biology, and science in general through public engagement via presentations, publications, and outreach to K-12 students.
5. Providing education, training, and work environments that are characterized by mutual respect, personal responsibility, fairness, equality, and a commitment to providing opportunities and support for all — especially those individuals belonging to populations traditionally underrepresented in the fields of science, technology, engineering, and mathematics [STEM].

The mission of the BS degree program in the Department of Biochemistry is to provide undergraduate students with a foundational understanding of the chemical basis of biological processes as well as the skill sets to critically evaluate, interpret and create biochemical information. This mission aligns with the institutional and college missions of educating undergraduate students in the life sciences through diverse, hands-on, experiential opportunities.

The mission of the PhD and MSLS degree programs in the Department of Biochemistry is to provide graduate students with the ability to master discovery and translation of new knowledge concerning the molecular basis of life through interdisciplinary research and training, while enhancing quality teaching and professional skills. This mission aligns with the institutional and college missions of advancing knowledge and improving the quality of life.

Overview of Graduate Degree Programs

The Department of Biochemistry offers two graduate degrees, the Doctor of Philosophy (Ph.D.) and Master of Science in Life Sciences (MSLS). The core requirements for both programs in terms of courses and research expectations are similar, but each degree comes with its own requirements. At their core, each degree prepares students for careers as scientists across different specialties.

II.1. COURSEWORK

Core Courses for All Graduate Students

There are two core courses that are taken by all Biochemistry graduate students in the first year, BCHM 5224 “Protein Structure and Function,” taken in the Fall semester, and BCHM 5784 “Advanced Applications in Molecular Life Sciences,” taken in the Spring semester. All students will enroll in ALS 5324 “Research Ethics in Agriculture and Life Sciences” in the Fall semester to satisfy the Graduate School’s requirement for training in ethics and research integrity (see Section II.3).

Specialized Courses

Doctoral students will complete five additional courses during the first two years and MSLS students complete courses throughout their enrollment. Students should confer with their Major Professor and Advisory Committee to select the most appropriate courses. Students are strongly encouraged to complete all course requirements by the end of year 2. See Section X for some graduate-level courses that may be of interest. See also [a complete list of graduate courses by department](#).

Statistics Requirement

All MSLS students are required to take one 3-credit statistics course (STAT 5605 or STAT 5615 or ALS 5984). There is no statistics requirement for doctoral students, but they may choose to take a statistics course as an elective.

Seminar Courses

BCHM 5004 Seminar in Biochemistry

Students will enroll in the 1-credit departmental seminar class every semester while they are registered in the graduate program.

Research and Dissertation (Doctoral students)

BCHM 7994 Research and Dissertation

The number of credits of BCHM 7994 varies per semester to give a total of 12 credits as required for full-time status. These credits contribute to the 90-credit graduate study requirement.

Research and Thesis (MSLS students)

BCHM 5994 Research and Thesis

MSLS students will enroll in BCHM 5994 for a total of 6-10 credits to meet the 30-credit graduate study requirement.

Notes on Course Requirements

- Graded course work on the Plan of Study must be taken for an A-F grade unless the course is only offered P/F. Courses offered P/F can be used to meet the graded credit minimum if **only** offered P/F.
- At least 27 graded credits (doctoral) or 12 graded credits (MSLS) must be at the 5000 level or higher.
- The 5000-level coursework may include a maximum 18 credits total in 5974, 5984, and 6984 courses and 4 credits of seminar.
- The Plan of Study may include a maximum of six credits of graded 4000-level undergraduate coursework. These six credits of 4000-level coursework may include Special Study (4984) but **may not** include Undergraduate Independent Study (4974) or Undergraduate Research (4994) courses.
- MSLS students may count three of the six credits for BCHM 4124 towards Experiential Learning, but the full six credits count towards the maximum of 4000-level coursework.

- Students who are not serving as teaching assistants during the first three semesters, but during which they are supported by the department, are required to take an additional 3-credit graduate-level course. This course will count towards the five required specialized courses.

Financial Support

All graduate students receive a tuition waiver. The stipend for Ph.D. students for 2019-2020 is \$25,000 and the stipend for MSLS students is \$4,000. Stipend support and tuition waivers are contingent upon remaining in good academic standing and making satisfactory progress towards completion of the student's dissertation or thesis, as judged by the student's Major Professor and Advisory Committee.

Academic Probation

Any student who fails to maintain satisfactory academic progress (does not achieve a B or better in any required course and/or fails to maintain an overall 3.0 GPA) will be placed on academic probation for one semester. Terms for completing academic probation and returning to good standing will be decided by the Graduate Program Director in consultation with the Department Head and provided to the student in writing. Probation may include reduction in, or loss of, stipend, scholarships, and/or tuition remission. A student who fails to satisfy the requirements for restoration from academic probation within the timeframe specified in that letter will be subject to dismissal from the graduate program.

II.2. RESEARCH ROTATIONS

Rotations are an opportunity for students to learn about the diversity of research in the department and help inform the selection of a mentor. Enrollment in BCHM 5014 and rotation talks are both **mandatory for all first-year students**.

Direct Recruiting vs. Normal Rotations

Students entering either the Ph.D. or MSLS programs may have already arranged with a faculty member to serve as the student's Major Professor **during the admissions process**. In this case ("direct recruiting"), a student may elect to forgo formally rotating through different labs and directly join the Major Professor's lab. All other students are required to perform three laboratory rotations with different Biochemistry faculty. Directly recruited students are still required give two seminar presentations according to the following guidelines, in the form of progress updates.

General Information

- First-year students conduct three laboratory rotations, each approximately 4 weeks in duration.
- See the Table below for due dates for rotation selection and for begin and end dates for each rotation. Students will communicate their rotation and Major Professor choices with the faculty Rotation Coordinator.
- Students who join the graduate program early (during the summer) and work in any laboratory cannot have this time counted towards satisfying the rotation requirement.
- Students will give brief presentations at the end of two of their rotations as part of the weekly seminar series. Students will be notified at least three weeks in advance of their scheduled date to present and will be told how long they will have to speak.
- For the rotation for which they do not give a presentation, students will write a short journal "note" or research report. Students should discuss an appropriate format with their advisors. Example formats include [FEBS Letters](#), Rapid Reports format of [Biochemistry](#), and [BMC Research Notes](#). Reports should be submitted to rotation advisors by the last day of the rotation.
- Register for BCHM 5014 in the Fall semester as Pass/Fail. The decision to give a "passing" grade will be made jointly by the rotation mentor and the Graduate Committee and is based primarily on

day-to-day performance in the laboratory. Rotation mentors provide detailed feedback in a formal evaluation letter that is included in the student’s file.

Selection of Major Professor

After discussions with faculty of interest, students will submit a ranked list of preferences for their major professor to the Graduate Rotation Coordinator by the date indicated in the Table below. Students may choose to work with faculty other than those with whom rotations were performed. Every effort will be made to place students according to their preferences given the resources available.

Directly recruited students who forgo rotations will immediately join the Major Professor’s lab by selecting that faculty member as their first choice for their “first rotation” and by notifying the Rotation Coordinator that they intend to join that lab. The Rotation Coordinator will confirm with that faculty member. All other students will select their Major Professor after the conclusion of three distinct rotations. **No exceptions will be made to allow selection of the Major Professor at any other time.**

Fall 2019 Rotations: Important Dates

Rotation	List of labs due (by 8:30 AM)	Lab assignment (by noon)	Begins	Ends	Presentation
1	08/26/2019	08/26/2019	08/27/2019	09/20/2019	09/23/2019
2	09/16/2019	09/17/2019	09/24/2019	10/18/2019	10/21/2019
3	10/14/2019	10/15/2019	10/22/2019	11/22/2019	12/2/2019
	Ranked list of three labs/Major Professors 12/2/2019 (by 8:30 AM)	Major Professor lab assignment 12/2/2019 (by noon)		MS/PhD research project begins 12/3/2019	

II.3. ETHICS AND RESEARCH INTEGRITY (E&RI) TRAINING

Commission on Graduate Studies and Policies Resolution 2012-13B mandates that “the Program of Study for all graduate students show a record of the student’s participation in the particular ethics and integrity activities delineated by the student’s program, department, or college, as part of the student’s graduation requirements.” This requirement came into effect for students matriculating in Fall 2014.

Required components

- ALS 5324 Research Ethics in Agriculture and Life Sciences
- BCHM 5784 Advanced Applications in Molecular Life Sciences
- GRAD 5004 GTA Training Workshop

Additional research-specific ethics training (e.g. in treatment of animals or human subjects research) may be required by the student’s Advisory Committee.

Implementation

The Department of Biochemistry will ensure the implementation of the ethics and integrity training component in the education of our graduate students in the following ways.

- The E&RI Training Plan will be provided to incoming graduate students during Orientation Week, which takes place the week prior to the start of classes. The Graduate Program Director will discuss the requirements with the students.
- At the first meeting with their Advisory Committee, graduate students will describe their progress in satisfying the E&RI training requirements and will outline a plan for completing any outstanding

requirements. The Committee will also determine whether any additional training is required on the basis of the student's research plans.

- The Advisory Committee will confirm that students have completed all required elements of the E&RI Training Plan prior to defense of the thesis.
- Completion of the E&RI training requirement will be documented on the student's Plan of Study.

II.4. THESIS AND DISSERTATION RESEARCH

Advisory Committee

In consultation with their Major Professor, students should select members of their Advisory Committee by considering whose expertise would be most relevant to the student's research. The Advisory Committee for doctoral students requires a minimum four faculty, of whom three must be affiliated with the [Biochemistry Department](#) (either departmental or adjunct faculty). MSLS committees shall comprise three faculty (at least two affiliated Biochemistry faculty). The Major Professor serves as the Chair of the Advisory Committee. **All students must arrange a meeting of the Advisory Committee before the end of the Fall (MSLS) or Spring (Ph.D.) semester of the first year.** The Graduate Committee will serve in an advisory capacity for all students prior to their selection of a Major Professor.

An annual meeting with the Advisory Committee is mandatory. More frequent meetings may be scheduled as desired by the student and/or Advisory Committee. **Before each meeting, a written summary of the student's research progress must be submitted to the Advisory Committee no later than one week ahead of the meeting time.** An exception to this requirement is made for the first meeting with the Advisory Committee.

Plan of Study

The Graduate School requires all graduate students to submit a valid [Plan of Study](#). Each student should begin to prepare his/her Plan of Study during the **Spring semester of the first academic year**. Students should use the worksheet available from the Department office and seek the assistance of their Major Professor. The Plan of Study must then be presented to, and approved by, the student's Advisory Committee, including a projected date for taking the Preliminary Examination (doctoral students only). This approval must be obtained at the student's first committee meeting during Spring of the first year. The Plan of Study and the projected date for the Preliminary Examination are then submitted to the Department Head and the Graduate School for review and approval. Department staff submit the Plan of Study to the Graduate School electronically.

Thesis Defense/Final Exam

Degree candidates are required to present a departmental research seminar prior to the Final Exam (i.e. thesis defense). Candidates for the Ph.D. degree must take an oral Final Exam, which is primarily a defense of their dissertation. The Final Exam is scheduled by submitting electronically a completed form "[Request to Admit Candidate to Final Exam](#)" to the Graduate School two weeks in advance of the exam date. The Final Exam is an opportunity for candidates to discuss their research project. The student passes the Final Exam if all or all but one member of the Advisory Committee votes for approval. However, the degree is conferred only after the [Electronic Thesis and Dissertation](#) (ETD) Approval Form has been signed by Advisory Committee members and submitted within two weeks to the Graduate School, and the Graduate School has approved the ETD. See also Graduate School [guidelines for final semester enrollment, degree completion and commencement](#). Students are encouraged to submit the "Application for Degree" on [HokieSPA](#) the semester before they plan to graduate, at which time a "to do" list will be generated to assist in timely completion of all requirements.

Annual Evaluation

As required by the Graduate School, the Major Professor will submit a written annual evaluation of the student's progress. The evaluation will be distributed to the Graduate Program Director, the Graduate School, members of the Advisory Committee, and the student.

Publications

Students are expected to publish their research in peer-reviewed, professional journals. Therefore, students should have published their research, or should provide the Major Professor with manuscript(s) in the appropriate format for publication prior to the time of graduation.

II.5. TEACHING

All doctoral students serve as teaching assistants for two semesters, usually within the first three semesters of enrollment. MSLS students serve as teaching assistants for one semester. Students will be notified of their assignment no later than one week prior to the start of the upcoming semester. For each course, TAs will be responsible for at least **one meaningful teaching experience** beyond preparing materials and grading student work. Examples include leading a discussion, giving a guest lecture, or leading a help session for working on problem sets and/or preparing for exams.

The goals for the TA assignment are primarily for students to:

- Develop teaching and communication skills, and
- Support the implementation of undergraduate courses, especially courses that enroll many students (large lecture courses) or that require significant time or effort to prepare materials (lab courses).

III. THE DOCTOR OF PHILOSOPHY (Ph.D.) DEGREE PROGRAM

The doctoral program in the Department of Biochemistry at Virginia Tech prepares students for careers as independent researchers in biochemistry, molecular and cellular biology, molecular microbiology, biotechnology, and related areas. Training involves a combination of advanced coursework, participation in seminars, and laboratory research conducted under the guidance of a faculty committee selected by agreement of the student, the faculty advisor, and the departmental Graduate Committee.

Graduate School

- Complete 90 credits of graduate study
- The 90 total credits must include 30 graded credits (i.e. from coursework)
- Pass the Preliminary Examination and dissertation defense
- Complete the ethics and research integrity training

Biochemistry Department

- Successfully complete **two core courses** (B grade or better) and **five specialized courses** during their first two years
- Maintain a **cumulative GPA of 3.0** or above in all coursework
- Enroll in three laboratory rotations during the first semester
- Deliver two departmental seminars for A-F grade while registered in the doctoral program
- Serve as Teaching Assistants for Biochemistry courses for two semesters (generally during the first two years, but departmental needs will vary)
- Pass the Qualifying Examination at the end of the Spring semester of the first year

Typical Schedule for a Biochemistry Doctoral Student

	Fall	Credits	Spring	Credits
Year 1	BCHM 5004 Biochemistry Seminar	1	BCHM 5004 Biochemistry Seminar	1
	BCHM 5224 Protein Structure & Function	3	BCHM 5784 Adv Applic in Mol Life Sci	3
	XXXX XXXX Specialty course	3	XXXX XXXX Specialty course	1-3
	BCHM 5014 Rotations	4	XXXX XXXX Specialty course	1-3
	ALS 5324 Research Ethics in Ag & Life Sci	1	BCHM 5014 Rotations	4
	Total	12	Total	12
Year 2	BCHM 5004 Biochemistry Seminar	1	BCHM 5004 Biochemistry Seminar	1
	XXXX XXXX Specialty course	3	XXXX XXXX Specialty course	3
	BCHM 7994 Research & Dissertation	8	BCHM 7994 Research & Dissertation	8
	Total	12	Total	12
Years 3-5	BCHM 5004 Biochemistry Seminar	1	BCHM 5004 Biochemistry Seminar	1
	BCHM 7994 Research & Dissertation	11	BCHM 7994 Research & Dissertation	11
	Total	12	Total	12

III.1. QUALIFYING EXAMINATION

To complete the Qualifying Examination, students will write and orally defend an original research proposal that is **unrelated to the student's doctoral research**. This proposal will follow the same guidelines outlined below for the Preliminary Exam (see Section IX), except that the proposal will be limited to 5 pages. **Students must successfully complete this requirement by the end of Spring**

semester of the first year. The written portion of the proposal will be completed by **all graduate students** as part of the course requirements for BCHM 5784. The instructor for this course will specify the format of the proposal and arrange for the oral defense of the proposal for doctoral students. The instructor will also serve as the Examination Committee Chair for each student's Qualifying Examination. The remainder of the Examination Committee membership will be determined by the Graduate Committee in consultation with the instructor of BCHM 5784.

Evaluation of the Qualifying Examination

Students' proposals and oral defenses are evaluated in three categories, in which they are assigned a numerical score by the Examination Committee, from 1 to 3. The categories and interpretation of the scores in each category are listed here.

(i) Reviewing and summarizing relevant scientific literature

1. The student includes all relevant literature and provides a meaningful, concise summary. Student understands all underlying conceptual bases of work cited.
2. The student includes most of the relevant literature, provides a meaningful summary, and illustrates understanding of most key concepts.
3. The student misses relevant literature, or does not adequately summarize, or does not illustrate adequate conceptual understanding.

(ii) Writing a research proposal, including (1) explanation of specific aims, (2) methods to be used, (3) expected results, and (4) alternate plans

1. The four key areas described above are included, adequate consideration is given to each, descriptive passages are well-written, and logical assessment of controls and alternate plans is described.
2. The four key areas described above are included, adequate consideration is given to most, and logical assessment of most controls and alternate plans is described.
3. The student does not include these four sections, or does not consider a key, fundamental point that renders the proposed work impossible, incomplete, or without novelty.

(iii) Oral scientific communication skills

1. The student can frame proposed work in the appropriate context, has prepared excellent graphics, can communicate a clear and concise summary of proposed work, and can answer most questions posed by committee.
2. One of the above areas is lacking.
3. Two or more of the above areas are lacking.

Possible Outcomes of the Qualifying Examination

Pass: The Examination Committee has rated the student as having satisfactorily completed the elements described in the previous section. A student will receive a passing evaluation if their overall average score from the above three categories is 2 or better, and no category is rated as a 3. The student advances in good standing to their second year in the doctoral program.

Conditional Pass: The Examination Committee has reservations about the student's advancement, and at least one category listed above is scored as unsatisfactory (score of 3) by the Examination Committee. In the event of a conditional pass, the student will be given additional work to complete and a deadline specified. Failure to satisfactorily complete these additional tasks set forth by the Examination Committee will result in a failing evaluation.

Failure: The student's proposal and/or oral defense is unsatisfactory in more than one category. A student will receive a failing evaluation if they do not attain an average of 2 or better across the three categories listed above and/or more than one category is rated a 3. Failure of the Qualifying Exam is not by itself a cause for expulsion from the program. Rather, the Graduate Committee will consider the totality of the student's academic record and will reach a decision regarding continuation of the student in the program.

The decision of the Examination Committee is final. There is no opportunity to retake the Qualifying Examination or have the outcome reevaluated.

III.2. PRELIMINARY EXAMINATION

To advance to Ph.D. candidacy, students must pass a Preliminary Examination consisting of an oral defense of an original, written research proposal. The purpose of this Exam is to determine whether a student has sufficient depth and breadth of understanding to propose, execute, and defend their dissertation research project.

Scheduling

The Preliminary Exam must be scheduled with the Graduate School using the [online form](#). **The Exam must take place by the end of the second academic year** (i.e. by the first week of May).

Examination Committee

In the Biochemistry Department, the Major Professor is not part of the Preliminary Exam Committee. Because the Graduate School requires that the doctoral Preliminary Exam Committee have four members, the Chair of the Preliminary Exam Committee is selected from Biochemistry faculty outside of the Advisory Committee. Before the Preliminary Exam, the student should make a request to a Biochemistry faculty member to serve as the Chair of the Exam Committee. The request should then be sent to the Graduate Program Director via email for approval.

Written Research Proposal

- Students prepare a **10-page original research proposal** based on their dissertation project.
- The proposal must be formatted according to National Institutes of Health or National Science Foundation guidelines (except for length) and must include descriptions of the significance, background, impact, and research plan of the project. Research plans should include the underlying rationale, significance, experimental design, anticipated results, alternative hypotheses or explanations, and potential problems as well as how problems will be addressed (i.e. backup plans). While proposals may include preliminary results, this section should be kept to a minimum (around one page) with the bulk of the proposal focused on describing plans for completing the dissertation research.
- The writing of the proposal must be original. Students should avail themselves of all available resources but **cannot copy verbiage from any grant proposals or manuscripts written by others**. If there is a connection between the student's research proposal and work that the advisor has proposed, the student's research aims and proposed activities should **build upon, and move beyond, those of the advisor**. The role of the Major Professor is to discuss with the student his/her research goals and objectives, principles of experimental design and techniques, and elements of good scientific writing. The advisor should not author verbiage for the student.
- **Three weeks prior** to oral examination, proposals must be submitted to the Exam Committee for determination of whether the proposal is satisfactory for oral defense. The Exam Committee Chair will consult with the Major Professor and decide whether the student can proceed with the oral

exam. Minor issues can be corrected, and the proposal redistributed prior to oral exam. Substantial issues that require considerable rewriting may require rescheduling of the oral exam.

- The final document must be distributed to the Exam Committee **one week prior to the oral exam**.
- Except in extraordinary circumstances, a student who misses a distribution deadline will need to reschedule the oral exam.
- Except in extraordinary circumstances, a student who fails to make timely progress in completing both aspects of the Preliminary Exam will have this issue noted in an annual or semi-annual evaluation and will be at risk of dismissal from the program.

Oral Examination

- Students should prepare a brief (~20 minute) overview of their proposal.
- Committee members will question the student with the research proposal as a starting point. Questions will focus on assessing the student’s ability to design experiments, interpret experimental results, and recognize alternate approaches should the main strategy fail.
- Discussion will not be limited to the research proposal. Members of the Exam Committee may pursue whatever other areas they feel are necessary to evaluate the abilities and knowledge of the student, including topics addressed in the coursework the student has completed.
- Based on a student’s performance during the exam, the committee will recommend: (a) advancement to candidacy, (b) conditional advancement contingent upon completion of recommended coursework or individual study, or (c) failure. In the event of failure, a second Preliminary Exam must be scheduled during the semester immediately following the first attempt.
- Students are allowed a **maximum of two opportunities** to pass the Preliminary Exam.
- The Exam Committee Chair will provide a letter to the student describing the outcome of the exam, summarizing the strengths and weaknesses of the student’s performance, and articulating the committee’s recommendations regarding the student’s future work. The letter is sent to the student with copies sent to the Major Professor and the Biochemistry Department for inclusion in the student’s file.

Evaluation

The Preliminary Examination is evaluated in a manner similar to the Qualifying Examination (see Section III.1).

Timeline for Completion of Qualifying and Preliminary Exams

Year	Fall	Spring
1		Qualifying Exam
2		Preliminary Exam
3	Retake Prelim Exam if necessary	

III.3. RESEARCH PRESENTATIONS

After passing the Preliminary Exam and before the Thesis Defense, **students are required to give two oral presentations on their research**. This requirement may be fulfilled by giving two presentations in BCHM 5004 “Seminar in Biochemistry” (only one presentation per semester). Oral presentations at scientific meetings (not posters) also count towards this requirement.

III.4. DOCTORAL STUDENT TIMELINE

This table depicts the typical timeline for doctoral students who enter with a Bachelor’s degree to complete the activities described above for completion of a doctoral degree.

	Committee Established	Plan of Study Filed	Prelim Exam Taken	Dissertation Defended	ETD Submitted	Graduated
Timeline	End of spring semester of 1 st year	End of spring semester of 1 st year	End of spring semester of 2 nd year	Within five years	Within five years	Within five years

Doctoral students typically convene their Advisory Committees after the Qualifying Examination (typically late April). Students should be actively discussing with faculty their willingness to serve on Advisory Committees during the Spring semester, before the Qualifying Examination.

IV. THE MASTER OF SCIENCE IN LIFE SCIENCES (MSLS) DEGREE PROGRAM

The Master of Science in Life Sciences (MSLS) merges the efforts of the departments of Biochemistry, Entomology, Food Science and Technology, and Plant Pathology, Plant Physiology, and Weed Science. Students in basic and applied disciplines in the College of Agriculture and Life Sciences share common experiences that prepare them for careers in which interdisciplinary interactions become increasingly valued. At the same time, discipline-specific education and research experience, which characterizes the MSLS program in each department, prepares students for unique positions and career development. For graduation, students must complete a minimum of 20 graded credit hours among 30 total credit hours. Completion of an MSLS degree through the Department of Biochemistry requires collection, documentation, and graphical representation of publication-quality data

Graduate School

- Complete 30 credits of graduate study
- The 30 total credits must include 20 graded credits
- Complete the ethics and research integrity training

Biochemistry Department

- Successfully complete **two core courses** (B grade or better) and **additional specialized courses**
- Maintain a **cumulative GPA of 3.0** or above in all coursework
- Successfully complete 6-10 credits of Research and Thesis
- Present a departmental seminar and defend a thesis
- Serve as Teaching Assistants for Biochemistry courses for one semester

Typical Schedule for a MSLS Student

	Fall	Credits	Spring	Credits
Year 1	BCHM 5004 Biochemistry Seminar	1	BCHM 5004 Biochemistry Seminar	1
	BCHM 5224 Protein Structure & Function	3	BCHM 5784 Adv Applic in Mol Life Sci	3
	STAT 5605 Statistics	3	XXXX XXXX Specialty course	1-3
	BCHM 5014 Rotations	4	XXXX XXXX Specialty course	1-3
	ALS 5324 Research Ethics in Ag & Life Sci	1	BCHM 5014 Rotations	4
	Total	12	Total	12
Year 2	BCHM 5004 Biochemistry Seminar	1	BCHM 5004 Biochemistry Seminar	1
	XXXX XXXX Specialty course	3	XXXX XXXX Specialty course	3
	XXXX XXXX Specialty course	3	XXXX XXXX Specialty course	3
	BCHM 5994 Research & Thesis	5	BCHM 5994 Research & Thesis	5
	Total	12	Total	12

IV.2. OPTIONAL QUALIFYING EXAMINATION

MSLS students may elect to take the Qualifying Examination (Section III.2) by notifying the instructor of BCHM 5784 of their intention. Doing so allows MSLS students to enter the doctoral program upon completion of their M.S. degree if they choose and are admitted to the Ph.D. program.

III.3. ACCELERATED BS/MS PROGRAM

Students may enter the MSLS program during their senior year of undergraduate study and pursue B.S. and MSLS degrees simultaneously. Students in the accelerated BS/MS program will complete undergraduate coursework alongside required graduate courses. Modifications to the timing of required courses (see Table above) may be made with the written permission of the Graduate Program Director.

Students wishing to enter the accelerated BS/MS program must apply for graduate admission no later than **March 31 of their junior year**. Students in the BS/MS program are considered undergraduate students during their first year in the program and thus receive no stipend or tuition support. Upon completion of their degree, students become MSLS students for their second year and receive a stipend and tuition support for one year only.

There is no option for dual-enrollment in B.S. and Ph.D. tracks. Students must complete a B.S. degree before they can be admitted to the Ph.D. program.

IV.4. MSLS STUDENT TIMELINE

This table depicts the prescribed timeline for MSLS students who enter with a Bachelor’s degree to complete the activities noted above.

	Committee Established	Plan of Study Filed	Thesis Defended	ETD Submitted	Graduated
Timeline	During fall semester of 1 st year	End of spring semester of 1 st year	Within two years	Within two years	Within two years

Note that while Ph.D. students typically form their Advisory Committees and convene meetings after the Qualifying Examination (typically late April), MSLS students should form their Advisory Committees **as soon as possible upon choosing a Major Professor**. Since MSLS students are expected to complete their degrees within two years, the earlier the student receives feedback on the direction of his/her research project, the better it is for the student. While the Plan of Study **must** be submitted by the end of Spring semester of the first year, it is strongly recommended that students complete their Plan of Study to be approved by the Advisory Committee during the first meeting during Fall semester.

IV.5. THESIS REQUIREMENT

Every MSLS student enters the program with the expectation that he/she will complete a thesis, however if circumstances dictate that completing a thesis is not feasible, the student may be allowed to graduate without submission of a formal thesis. This option is only available with the agreement of the Major Professor and Advisory Committee. The student must have met the minimum requirement of 6 credit hours of research or independent study. In this case, the student is required to submit all data (raw data, figures, presentation slides, etc.) to the Major Professor in a format suitable for publication prior to graduation.

V. COMPARISON OF DOCTORAL AND MSLS PROGRAM REQUIREMENTS

Requirement	Doctoral	MSLS
Total Credits	90	30
Graded Credits	30	20
Required Courses	BCHM 5224 (3 cr) BCHM 5784 (3 cr) ALS 5324 (1 cr)	BCHM 5224 (3 cr) BCHM 5784 (3 cr) ALS 5324 (1 cr) STAT 5605 or STAT 5615 or ALS 5984 (3 cr)
Elective Credits	13+	16+
Laboratory Rotations	Yes BCHM 5014 (4 cr)	Optional but all students enroll in BCHM 5014 (4 cr)
Required Research Credits (BCHM 5994 or BCHM 7994)	(varies)*	6-10
Seminar Requirement	BCHM 5004 every semester, 2 graded presentations	BCHM 5004 every semester
Advisory Committee	Spring of Year 1 4 members	Spring of Year 1 3 members
Qualifying Examination	Yes	Optional
Preliminary Examination	Yes	No
Defend Dissertation or Thesis	Yes	Yes**

* BCHM 7994 comprises the balance of credits necessary to maintain full-time status each semester. See typical schedule (Section III) for guidance.

** See section IV.5 for exceptions to this requirement.

VI. CAREER DEVELOPMENT

Most graduate and post-doctoral trainees do not end up in academic tenure-track positions. It is important that graduate students think about and plan for their post-graduation careers. Fortunately, there is a growing number of resources and opportunities for help with this.

Broadening Experiences in Scientific Training (BEST) Project

Virginia Tech has recently been awarded a BEST grant from the National Institutes of Health to support professional development activities for doctoral students and postdoctoral trainees in the biomedical sciences. Students may enroll in one or more of the [BEST program activities](#) that are designed to

Broaden the Experiences of Scientific Trainees in order to:

- provide exposure to multiple diverse career paths in the biomedical sciences
- provide early career guidance and skill development
- better prepare trainees to pursue a variety of career paths

Transformative Graduate Education (Graduate School)

[Transformative Graduate Education](#) is a university-wide initiative developed by Vice President and Dean

for Graduate Education Karen DePauw and facilitated by the Graduate School. The implementation of unique programs and opportunities pushes the boundaries of traditional disciplinary academic education and provides the philosophical underpinnings for a truly innovative graduate education experience. The initiative aims to significantly change how graduate students are prepared to become the next generation of scientists, educators, scholars, engineers, artists, and career professionals in an ever-evolving global context.

Professional Development Courses

There are a number of professional development courses that may be of interest. Students should confer with their Major Professor and Advisory Committee to decide whether one of these might be beneficial. The indicated GRAD 5XXX courses are recommended for more advanced students and are generally not taken in the first year.

BIOL 5154	Exercises in Grantsmanship
GRAD 5104	Preparing the Future Professoriate
GRAD 5114	Contemporary Pedagogy

See all professional development courses offered by the Graduate School: [Transformative Graduate Education](#)

Graduate School Courses

Toward the goal of transforming graduate education at Virginia Tech, the Graduate School has created a series of [graduate courses](#) and experiences designed to better prepare and equip our graduate students with knowledge and skills for meaningful and relevant contributions as citizens in the 21st century.

Individual Development Plan (IDP)

The National Institutes of Health recommends that all NIH-funded trainees prepare an Individual Development Plan to explore and set career goals. There is a free [IDP web interface](#) run by the journal *Science*. **All students must complete an IDP to be submitted to their Advisory Committee prior to the first committee meeting in the Spring of the first year.**

Career Services, Division of Student Affairs

Career Services can assist with all aspects of career planning. See [services directed to graduate students](#).

VII. FACILITIES

Keys

Keys are available for the main door, reading room, and for specific laboratories. Keys for Engel Hall are distributed by Zerita Montgomery (Engel main office, room 111) upon payment of a deposit. Keys for Fralin are distributed by Paul Bibb (Fralin main office). Students needing access to other buildings should consult their Major Professor.

Reading Room

A Reading Room (Engel 217B) is available for use by graduate students and is accessible with an Engel main door key. The Reading Room contains a refrigerator and microwave, a seating area, and a white board, all for general use.

Equipment

Students may use any departmental instruments after checking with the appropriate faculty to ensure that the student is knowledgeable in the proper operating techniques and will not interfere with other work in progress. Students should be sure that borrowed items are always signed out, log books are properly maintained, and the instrument and/or lab area are cleaned after use. Students should notify the faculty in charge immediately if equipment malfunctions or breaks during use. Ultimately, Major Professors are responsible for the care of equipment used by their students.

VIII. RESOURCES

Topic	Organization
Writing Resources	Virginia Tech Writing Center
Teaching Resources	Center for Excellence in Teaching and Learning Graduate Education Development Institute
Graduate School	Support Resources Transformative Graduate Education Formatting Guidelines for Theses and Dissertations “Graduation 101 Series”- a set of YouTube videos: <ul style="list-style-type: none"> • Graduation Guidelines • Preparing for Graduation • Start of Semester Defense Exception • ETD Review
Other Professional Resources	Career Services
Quality of Life Resources	Cook Counseling Center Graduate Life Center Schiffert Health Center

IX. INSTITUTIONAL POLICIES

[Equal Opportunity/Affirmative Action Statement](#)

Virginia Tech does not discriminate against employees, students, or applicants on the basis of age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, genetic information, veteran status, or any other basis protected by law. Discrimination or harassment on any of these bases is prohibited by [Policy 1025](#), "Anti-Discrimination and Harassment Prevention Policy."

Disability Accommodations

Accommodations are available for students with disabilities. Please notify the Major Professor and/or course Instructor of any accommodations needed. Accommodations are approved through the [Services for Students with Disabilities Office](#).

[Graduate Honor System](#)

Compliance with the standards of academic conduct expressed in the Graduate Honor Code is expected of all students.

Principles of Community

Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the global community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

- **We affirm** the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
- **We affirm** the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
- **We affirm** the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.
- **We reject** all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
- **We pledge** our collective commitment to these principles in the spirit of the Virginia Tech motto of *Ut Prosim* (That I May Serve).

X. SUGGESTED ELECTIVE COURSES

Listed below are recommended graduate-level (5000 and above) courses and allowable 4000-level courses. Note that availability of these courses varies from year to year and students must formulate their Plan of Study accordingly.

General

BIOL 6704	Eukaryotic Pathogen Host Interaction
BCHM 5024	Computational Biochemistry for Bioinformatics
BCHM 5984	Integrated Prokaryotic/Eukaryotic Gene Regulation
BIOL 5184	Prokaryotic Recombinant Proteins
BIOL 5214	Biomacromolecular Structure
BIOL 5424	Computational Cell Biology
BIOL 5624	Advanced Microbial Genetics
BIOL 5674	Advanced Pathogenic Bacteriology
BIOL 5834	Advanced Practical Analysis of Protein Structure and Function
BIOL 5844	Advanced Proteomics and Biological Mass Spectrometry
BMVS 6724	Molecular Mechanisms of Pathogenic Bacteria
PPWS 5524	Advanced Plant Physiology and Metabolism I

Computational Biology/Bioinformatics

GBCB 5045	Computation for the Life Sciences I and II (basic computer science
5046	courses)
BCHM 5024	Computational Biochemistry for Bioinformatics
BIOL 4075	Bioinformatics Methods
CS 6824	Advanced Topics in Computational Biology and Bioinformatics (requires CS Background or prerequisites)

Omics and Systems Biology

GBCB 5415	Continuous Models in Biological Applications (requires basic foundation in
5416	multivariable calculus and ordinary differential equations)
CS 5424	Computational Cell Biology
CS 5854	Computational Systems Biology (requires computer science background)
GBCB 5874	Problem Solving in Genetics, Bioinformatics and Computational Biology
BMES 5054	Quantitative Cell Physiology (requires computer science background)
BIOL 4844	Proteomics and Biological Mass Spectrometry
ENT 5324	Genomics of Disease Vectors
GBCB 5844	Plant Genomics

Bioengineering

BSE 4544	Protein Separation Engineering
BSE 5544	Advanced Protein Separation Engineering
BSE 4604	Food Process Engineering
BSE 5604	Advanced Food Process Engineering
BSE 5644	Bio-Based Industrial Polymers
BSE 5114	Physical Properties of Biomaterials
BSE 5504G	Bioprocess Engineering
BSE 5624	Enzyme Engineering
BSE 5614	Advances in Recombinant Protein Production
BMVS 5224	Biomedical Engineering and Human Disease (also listed as BMES 5024)

Infectious and Vector-Borne Disease

BIOL	4674	Pathogenic Bacteriology
BIOL	4664	Virology
ENT	5324	Genomics of Disease Vectors
ENT	5624	Molecular Virology
BMVS	5624	Molecular Virology
BMVS	5224	Biomedical Engineering and Human Disease (also BMES 5024)
BMVS	5005	Emerging Infectious Diseases I and II - fully online (also VM 9085/9086)
	5006	
PHS	5984	SS: Principles of Infectious Diseases
PHS	5304	Zoonoses and Infectious Diseases Common to Humans and Animals
PHS	5314	Infectious Disease Epidemiology
PHS	5334	SS: Modeling Infectious Diseases
BIOL	4704	Immunology
FST	5614	Food Safety and Security
FST	5624	Applied Food Microbiology and Sanitation
FST	5634	Epidemiology of Foodborne and Waterborne Disease
FST	4634	Epidemiology of Foodborne Disease
PPWS	5214	Diseases of Crop Plants
PPWS	5454	Plant Disease Physiology and Development
PPWS	6004	Plant Disease Epidemiology

Drug Development

NANO	4314	Nanomedicine
BMVS	5324	General Neurochemistry
CHEM	4554	Drug Chemistry
BIOL	4554	Neurochemical Regulation (also ALS 4554)

Applied Plant Biology

PPWS	4504	Fundamentals of Plant Physiology
PPWS	5204	Principles of Plant Disease Management
PPWS	6004	Molecular Weed Science
PPWS	5524	Advanced Plant Physiology and Metabolism I and II
	5534	
PPWS	5304	Plant Stress Physiology

Applied Microbiology

FST	5604	Advances in Food Microbiology
BIOL	5634	Microbial Physiology
BIOL	4164	Environmental Microbiology (also CEE 4164, CSES 4164, ENSC 4164)
BIOL	4604	Food Microbiology (also FST 4604)
BIOL	4644	Microbial Molecular Genetics
FST	4644	Fermentation Microbiology
CEE	5194	Environmental Engineering Microbiology
CEE	5124	Fundamental of Environmental Toxicology
FST	4414	Fermentation Process Technology and Instrumentation
FST	5624	Applied Food Microbiology and Sanitation

Food Science and Technology

- FST 4405 Food Processing I and II
4406
- FST 4504 Food Chemistry
- FST 4524 Food Quality Assurance
- FST 5664 Flavor Chemistry

XI. FACULTY RESEARCH AREAS

Faculty	Research Areas
<u>Dennis Dean</u>	Enzymology and molecular genetics of metallocluster biosynthesis; biological nitrogen fixation
<u>Glenda Gillaspay</u>	Growth control and signal transduction in plants
<u>Richard Helm</u>	Cell-cell communication in model systems; application of mass spectrometry to life sciences research
<u>Peter Kennelly</u>	Control of cellular processes by protein phosphorylation-dephosphorylation; identification of new kinases and phosphatases; evolution of cellular control mechanisms
<u>Michael Klemba</u>	Hemoglobin catabolism by the human malaria parasite, <i>Plasmodium falciparum</i> ; protein trafficking to the food vacuole
<u>Brandon Jutras</u>	Cell biology of the Lyme disease bacterium <i>Borrelia burgdorferi</i> and the pathogenic properties of spirochetal peptidoglycan
<u>Chloe Lahondère</u>	Impact of temperature on disease vector insect-host-pathogen interactions
<u>Timothy Larson</u>	Regulation of prokaryotic gene expression
<u>Justin Lemkul</u>	Protein and nucleic acid simulations; conformational ensembles of disordered states; empirical force field development; computer-aided drug design

<u>Jianyong Li</u>	Structure-function relationships of proteins involved in tryptophan oxidation pathway in mosquitoes; biochemical mechanism of mosquito chorion formation and hardening
<u>Zachary Mackey</u>	Biological and Biochemical characterization of druggable targets in <i>Trypanosoma brucei</i>
<u>Biswarup Mukhopadhyay</u>	Methanogenic archaea
<u>Daniel Slade</u>	Characterizing the role of outer membrane bound and secreted proteins in bacterial invasion and modulation of host cell signaling
<u>Pablo Sobrado</u>	Mechanistic enzymology of redox enzymes and drugs discovery
<u>Zhijian Tu</u>	Insect molecular biology, genomics, evolution, and applications of transposable elements
<u>Clément Vinauger</u>	Neural and molecular mechanisms that modulate the way disease vector insects interact with their vertebrate host
<u>Robert White</u>	Application of stable isotopes and mass spectrometry to biochemistry; biosynthesis and function of coenzymes; archaeobacterial biochemistry; prebiotic chemistry
<u>Jinsong Zhu</u>	Signal transduction and gene regulation in insects; genetic control of the mosquito defense reactions against malaria parasites

ACKNOWLEDGMENT PAGE

I, _____ (print name), have received a copy of the 2019 Biochemistry Graduate Student Handbook and have read and understand its contents, the requirements of my degree program, and the expectations the Department has for me as a graduate student. If I have any questions about the content of the Handbook or any policy or procedure therein, I understand that it is my responsibility to seek clarification directly from the Graduate Program Director.

Signature

Date