

# Biological Sciences – Molecular Biology and Genetics Concentration (MS)

## Program Educational Goals:

The central mission of the Master's degree program in Biological Sciences is to train students in an inclusive environment to think creatively to drive scientific inquiry and to work collaboratively to address significant challenges in the life sciences.

Our program will achieve this mission through the following educational goals:

1. **Core Concepts:** Acquire a breadth of knowledge in Molecular Biology and Genetics, as well as in-depth expertise in the student's specific area of study and how their research fits into the broader framework of biology. For details: [click here](#).
2. **Critical Thinking Skills:** Develop the ability to critically evaluate primary literature and identify key scientific questions as well as approaches to address them.
3. **Research Skills:** Develop skills that demonstrate critical and analytical scientific thinking, interpretation, and application. These include the ability to formulate testable hypotheses based on theory and empirical research, design a scientific research plan that tests these hypotheses, and acquire the technical skills necessary to implement the research plan. Build analytical skills that enable rigorous qualitative and quantitative scientific data evaluation.
4. **Scientific Communication Skills:** Develop scientific writing skills necessary for publication of primary research, literature review, and preparation of fundable research proposals. Develop a strong foundation in oral presentation that enables students to share scientific information and ideas to both specialized and general audiences.
5. **Professional Development Skills:** Develop skills in advancing their career by participating in opportunities for networking, collaborations, mentoring, working in culturally diverse groups, and taking on leadership roles.

## Requirements for the Degree:

The prospective student must meet all general requirements for the M.S. degree in the Department of Biological Sciences. The curriculum described below was developed to ensure that students achieve the breadth of knowledge, written and oral communication skills, and proficiency in the practice of research expected of individuals holding an advanced degree with a specialization in Molecular Biology and Genetics. All students are expected to have basic competency in biochemistry, molecular biology and genetics upon admittance to the program since these fields underpin the training provided in this concentration. Competency in Molecular Biology and Genetics is primarily assessed by the student's performance on the oral comprehensive exam. However, all students are required to take a written diagnostic exam or equivalent after one semester of enrollment to help them assess their level of preparation for the comprehensive exam. The results of this exam will be discussed with the student by the concentration coordinator to help the student plan a strategy to prepare for the comprehensive exam.

## Required Courses:

- BISC 602 - Molecular Biology of Animal Cells - Credit(s): 3
- BISC 612 - Advanced Cell Biology - Credit(s): 3
- BISC 654 - Biochemical Genetics – Credit(s): 3
- BISC 827 - Graduate Research Seminar\* - Credit(s): 1 credit every semester
- BISC 850 - Advanced Topics in Biology - Credit(s): 1

### Notes:

\*-BISC 827 - Graduate Seminar is required every fall and spring semester while enrolled as a student. Students will present oral summaries of their laboratory tutorials or ongoing research.

## Electives:

Students must take either two courses from the following list of three- and four-credit courses, or one course from this list plus three one-credit sections of BISC850.

- BISC 605 - Advanced Mammalian Physiology Credit(s): 4
- BISC 606 - Advanced Mammalian Physiology II Credit(s): 4
- BISC 615 - Developmental Biology Credit(s): 3
- BISC 639 - Developmental Neurobiology Credit(s): 4
- BISC 643 - Biological data analysis Credit(s): 3
- BISC 656 - Evolutionary Genetics Credit(s): 3
- BISC 671 - Cellular and Molecular Immunology Credit(s): 4
- BISC 675 - Cardiovascular Physiology Credit(s): 3
- BISC 682 - Bacterial Pathogens: Molecular Mechanisms Credit(s): 3
- BISC 690 - Fundamentals of Pharmacology Credit(s): 3
- BISC 693 - Human Genetics Credit(s): 3
- BINF 644 - Bioinformatics Credit(s): 3
- BINF 694 - Systems Biology I Credit(s): 3
- MAST 625 - Microbial Physiology and Diversity Credit(s): 3

### -Note:

If any graduate courses equivalent to those listed above have been taken in previous graduate degree programs and have been accepted as graduate level transfer credit by the University, the transferred courses may be used to satisfy the Concentration requirements with the approval of the Concentration coordinator.

Other three- or four-credit courses at the University may be used to fulfill the elective requirement if approval from the Concentration coordinator is received prior to taking the course.

# The Comprehensive Examination

Graduate students in the Molecular Biology and Genetics Concentration are expected to possess a fundamental body of knowledge in biochemistry, molecular/cellular biology, and genetics, as well as the ability to critically analyze scientific literature. See the core competency list for more details (<https://www.bio.udel.edu/graduate/prospective-students/m-s-and-ph-d/degree-requirements/graduate-concentration-in-molecular-biology-and-genetics-comprehensive-exam-guidelines>). To ensure that this is the case, an oral comprehensive examination will be administered to all graduate students in the Concentration.

In order to be eligible to take the comprehensive exam, students must have completed first year core courses (BISC 602, BISC 612 and BISC 654) with a grade of B or better. Students are required to take the comprehensive exam at a time set by the Concentration Coordinator for as soon as feasible after the first year curriculum has been successfully completed. If the student fails to complete the comprehensive exam by this time, the student will be subject to dismissal.

## Procedure

Students will be provided with at least four sets of papers from the primary literature selected by faculty, from which they must choose one set as the basis for their oral examination. These papers will be available at least three weeks before the exam, so that the exam can be administered the first or second week of June for students admitted the previous summer or fall. Students admitted in the spring will usually have paper sets available by December 10 so that the exam can be administered in early January. Two weeks prior to the exam, the student should inform the Concentration coordinator of the chosen paper set. Prior to the exam, the student should prepare slides of all of the figures and tables presented in the papers so that they will be available for discussion during the exam.

During the exam, the student will be tested by a committee of three to six faculty on the student's comprehension of all aspects of the paper and the core competencies. Students will present a synopsis of the primary paper and the examination committee will ask questions pertaining to the paper. The committee will also ask questions pertaining to the core competencies as listed at <https://www.bio.udel.edu/graduate/prospective-students/m-s-and-ph-d/degree-requirements/graduate-concentration-in-molecular-biology-and-genetics-comprehensive-exam-guidelines>. Prior to the exam, students are encouraged to contact faculty to discuss the topics they are responsible for and to clarify difficult concepts.

## Grading

The comprehensive exam committee will grade the student based on:

- the quality of the student's oral presentation of the primary paper and background information;
- the student's understanding of the background, methods, results, interpretation, and overall significance to the field of the primary paper;
- the student's understanding of the topics in the list of core competencies.

After the oral examination, the examination committee will determine an appropriate grade. Four grades are possible at the initial exam:

1. Unconditional pass. The student may proceed to the next stage of the degree training.

2. Conditional pass. The student performed marginally in one or more areas and may be asked to complete (with a grade of B or better) one or more courses as a condition for changing the grade to pass. The examination committee may prescribe conditions in addition to, or in lieu of, course enrollment. Once the condition is fulfilled, the student is responsible for informing the Biology Graduate Program Director so that the grade can be changed officially.
3. Re-examination. This result is appropriate for a student whose performance was unsatisfactory, but displayed evidence of the potential to complete graduate degree training. Re-examination must be completed within eight weeks of the initial exam, at a time to be set by the examining committee. The possible outcomes of the re-examination are unconditional pass, conditional pass or failure. The student may not take the exam a third time.
4. Failure. This outcome would indicate that the examination committee considers the student incapable of completing degree training. The student's academic progress will be reviewed by the Graduate Affairs Committee, who will make recommendations to the Department Chair regarding the student's enrollment status. The Chair may recommend to the Office of Graduate & Professional Education that the student be dismissed from the Program immediately.

Once the student passes the comprehensive examination, the student becomes eligible to register for Master's thesis credit (BISC 869).

## **Suggested Schedule:**

### **Year One:**

#### **Fall Semester**

##### **Course Name and Number Credits**

BISC 602 - Molecular Biology of Animal Cells - Credit(s): 3

BISC 612 - Advanced Cell Biology - Credit(s): 3

BISC 827 - Graduate Research Seminar - Credit(s):1

BISC 868 - Laboratory Research - Credit(s): 2

Teaching assistantship, development of oral presentation and teaching skills

Total: 9 credits

#### **Winter Session**

- Molecular Biology and Genetics Diagnostic Exam

#### **Spring Semester**

##### **Course Name and Number Credits**

BISC 654 – Biochemical Genetics – Credit(s): 3

BISC 827 - Graduate Research Seminar - Credit(s): 1

BISC 850 - Advanced Topics in Biology - Credit(s): 1

BISC 868 - Research in the laboratory of chosen thesis advisor - Credit(s): 4

Teaching assistantship, development of oral presentation and teaching skills

Total: 9 credits

### **Summer Session**

early June

- Comprehensive examination

late June, July and August

- BISC 868 - Research in the thesis laboratory (3 credits)

## **Year Two:**

### **Fall Semester**

#### **Course Name and Number Credits**

Elective - Credit(s) 3

BISC 827 - Graduate Research Seminar - Credit(s) 1

BISC 868 – Research in thesis laboratory – Credit(s): 6

Total: 10 credits

### **Spring Semester**

#### **Course Name and Number Credits**

Elective - Credit(s) 3

BISC 827 - Graduate Research Seminar - Credit(s) 1

BISC 868 – Research in thesis laboratory – Credit(s): 6

Total: 10 credits