

Graduate Concentration in Cell and Organ Systems: M.S. Policy and Curriculum

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 Cell and Organ Systems. All students are expected to have basic competency in general physiology and cell biology upon admittance to the concentration since these fields underpin the training provided.

The Cell and Organ Systems Graduate Concentration encompasses a wide diversity of research areas, including cell biology, organ systems physiology, extracellular matrix biology, cell signaling, developmental biology and others. ~~It is anticipated that, given the enormous increase in gene sequence data available, there will be an increasing need for individuals broadly trained in disciplines such as these. The goal of this concentration is to provide students a rigorous environment and careful guidance in their efforts towards earning a graduate degree.~~ The curriculum provides for a breadth of background knowledge, skill development in oral and written communication and in critical thinking and opportunities for learning a variety of research techniques. **Required Courses:**

BISC 605 - Advanced Mammalian Physiology 3

BISC 612 - Advanced Cell Biology 3

BISC 827 - Graduate Research Seminar¹ 1 credit every semester

Notes:

1. 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.

~~The M.S. degree program will emphasize the development and critical defense of an independent research project (thesis).~~

~~Students wishing to enter this concentration are expected to have some background (at the undergraduate or graduate level) in general physiology, cell biology, biochemistry and genetics/evolutionary biology.~~

~~Students in the M.S. Degree program will take a 16 credit hour core curriculum, as well as a minimum of 8 credits of Research (BISC 868) and 6 credits of BISC 869—Master's Thesis (total 30 credits). M.S. students are not required to specifically take Laboratory Tutorials (BISC 864), but may opt to as a way of identifying a primary thesis advisor.~~

~~The curriculum outlined below conforms to both Department of Biological Sciences and University of Delaware policy (see Departmental Graduate Program Policy).~~

Graduate Curriculum

Year One:

Fall Semester

Course Name and Number	Credits
BISC 605—Advanced Mammalian Physiology (core)	3
BISC 827—Graduate Seminar (core) ¹	1
Teaching Assistantship ²	0
BISC 868—Research	3

Total: 7 credits

Winter Session³

Spring Semester

Course Name and Number	Credits
BISC 612—Advanced Cell Biology (core)	3
BISC 827—Graduate Seminar (core)	1
Teaching Assistantship	0
BISC 868—Research	3

Total: 7 credits

Summer Session³

Course Name and Number Credits

Graduate Preliminary Exam -	
BISC 868—Research	2

Year Two:

Fall Semester

Course Name and Number	Credits
BISC 6XX—Elective (core)	3
BISC 827—Graduate Seminar (core)	1
Teaching Assistantship	0
BISC 869—Master's Thesis ⁴	3

Total: 7 credits

Winter Session³

Spring Semester

Course Name and Number	Credits
BISC 806—Current Topics in Cell and Organ Systems, or BISC 833—Special Topics in Biology (core)	3
BISC 827—Graduate Seminar (core)	1
Teaching Assistantship	0
BISC 869—Master's Thesis ⁴	3

Total: 7 credits

Notes

1. BISC 827—Graduate Seminar is required every fall and spring semester. Students will present oral summaries of their laboratory tutorials or ongoing research.
2. M.S. students are not explicitly required to serve as departmental teaching assistants but will do so in most cases.
3. Students are expected to spend winter and summer sessions in full time research towards the thesis.
4. BISC 869—Master's Thesis, should be taken by M.S. students who have passed the Graduate Preliminary Exam.

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- 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.

Graduate Electives

The following list of graduate courses are those that have been approved as Electives in the Cell and Organ Systems Concentration. However, other courses, including selected courses from other departments may also be included, with approval of the student's thesis committee or of the Graduate Programs Committee. If a graduate level course similar in content to any of these has been accepted as graduate level transfer credit by the University, the transferred course may be used to satisfy the Concentration requirements with the approval of the Concentration coordinator.

- BISC 602 - Molecular Biology of Animal Cells
- BISC 615 - Vertebrate Developmental Biology
- ~~BISC 618 - Computer Imaging in Biology~~
- BISC 625 - Cancer Biology
- ~~BISC 630 - Ichthyology~~
- ~~BISC 631 - The Practice of Science~~
- BISC 639 - Developmental Neurobiology
- BISC 643 - Biological Data Analysis
- ~~BISC 645 - Bacterial Evolution~~
- BISC 654 - Biochemical Genetics
- ~~BISC 646 - Plant Cell Biology~~
- BISC 656 - Evolutionary Genetics
- ~~BISC 660 - Environmental Physiology~~
- ~~BISC 665 - Advanced Molecular Biology & Genetics~~
- ~~BISC 667 - Biological Statistics~~
- BISC 671 - Cell and Molecular Immunology
- BISC 675 - Cardiovascular Physiology
- BISC 679 - Virology
- BISC 690 - Fundamentals of Pharmacology
- CHEM 641 - Biochemistry
- PLSC 635 - Plant Developmental Biology

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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.

Thesis Committees

~~Students should choose a primary research advisor as soon as possible and prior to the end of their first academic year in the program. This advisor must have a primary or secondary appointment in the Department of Biological Sciences. With the help of the advisor, the student should then select a minimum of two additional advisory committee members, one of whom must have a primary appointment outside the Department of Biological Sciences. It is expected that students will meet at least twice yearly with their committees (see Graduate Program Policy).~~

The Comprehensive Examination

~~Graduate Preliminary Exam in the Cell and Organ Systems Concentration~~

Graduate students in the Cell and Organ System concentration are expected to possess a fundamental body of knowledge (see the core competency list <http://www.bio.udel.edu/graduate-concentration-cell-and-organ-systems-preliminary-exam-guidelines> for more details) as well as the ability to critically analyze scientific literature. To ensure that this is the case, an oral comprehensive examination will be administered to all graduate students in the Concentration.

~~All graduate students in the Cell and Organ Systems Concentration must take an oral "Graduate Preliminary Exam," the purpose of which is to evaluate both breadth of knowledge (see the core competency list for more details) and the ability to assimilate and critically evaluate published scientific work in the field. In order to be eligible to take the **preliminary comprehensive** exam, students must have completed first year core courses (BISC 605 and BISC 612) with a grade of B or better. In all cases, the student is expected to correct all deficiencies in their performance in the first year curriculum by the end of the semester after the deficiency occurred but no later than the end of their third semester in the program. If the applicable course is not offered, a suitable substitute will be determined by the Concentration coordinator. Failure to obtain a B or better in a required course in the second attempt will make the student subject to dismissal from the graduate program. 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. Students are expected to take the preliminary exam within six weeks after the first year curriculum has been successfully completed. If the student fails to complete the **preliminary 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 four 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, then the examination committee will ask questions pertaining to the paper. The committee will also ask questions pertaining to the core competencies as listed at <http://www.bio.udel.edu/graduate-concentration-cell-and-organ-systems-preliminary-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.

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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 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

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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 (BISC869).

Suggested Schedule:

Year One:

Fall Semester

<u>Course Name and Number</u>	<u>Credits</u>
<u>BISC 605 - Advanced Mammalian Physiology</u>	<u>3</u>
<u>BISC 827 - Graduate Research Seminar</u>	<u>1</u>
<u>BISC 868 - Laboratory Research</u>	<u>2</u>
<u>Teaching assistantship, development of oral presentation and teaching skills</u>	<u>0</u>

Total: 6 credits

Spring Semester

<u>Course Name and Number</u>	<u>Credits</u>
<u>BISC 612 - Advanced Cell Biology</u>	<u>3</u>
<u>BISC 827 - Graduate Research Seminar</u>	<u>1</u>
<u>BISC 868 - Research in the laboratory of chosen thesis advisor</u>	<u>4</u>
<u>Teaching assistantship, development of oral presentation and teaching skills</u>	<u>0</u>

Total: 8 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

<u>Course Name and Number</u>	<u>Credits</u>
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<u>Elective</u>	<u>3</u>
<u>BISC 827 - Graduate Research Seminar</u>	<u>1</u>
<u>Research in thesis laboratory</u>	<u>6</u>

Total: 10 credits

Spring Semester

<u>Course Name and Number</u>	<u>Credits</u>
<u>Elective</u>	<u>3</u>
<u>BISC 827 - Graduate Research Seminar</u>	<u>1</u>
<u>BISC 964 - Research in thesis laboratory</u>	<u>6</u>

Total: 10 credits

The examining committee (4 faculty members appointed by the Concentration coordinator each year) will assemble a selection of scientific articles and screen these for consistency in terms of depth and breadth of information covered. Each article will have associated with it, 2-3 secondary or "backup" papers that provide additional background on the topic. The committee will eventually select a candidate pool of 3-4 of these collected papers to present to the students taking the exam. Each student will read through the articles and eventually select one (along with its designated backup papers) to be the basis of their prelim exam. This selection must be communicated to the examining committee.

The student will then be responsible for demonstrating a thorough understanding of all aspects of this work, including tangential areas of methodology, interpretation of results, significance in the context of other work in the field, and any related background (ie. physiology, anatomy, biochemistry, cell biology, etc). Some questions may derive from published articles or textbook materials that are not specifically included in the paper set; it is up to the student to determine what areas they may need to further study by, for example, by carefully reviewing the bibliography of the selected article and the core competency list of topics. The student should have prepared a collection of overheads or slides of all figures and tables from the papers, which may be used during the questioning. Students may consult with members of the examining committee prior to the exam to clarify information or breadth of coverage.

An approximate timetable is as follows:

- May 1: Examining Committee makes available to students the selected paper sets
- June 1: Each student informs the Examining Committee of their selection
- June 15-30: Administration of prelim exam (individually)

There are four possible outcomes: unconditional pass, conditional pass, re-examination, or failure. The student will be informed of the outcome after brief deliberations of the committee and this outcome will also be transmitted to the Graduate Program Director. A conditional pass may be appropriate if the committee felt that the student did not have an adequate background or understanding in one or more specific areas. The conditional pass will be communicated to the student along with specific requirements for

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strengthening these areas and completing the unconditional pass. These requirements may include one or more specific courses, which must be completed with grades of B or better, specific Teaching Assistantship assignments, special problems or others. The student must inform the Graduate Program Director and the Concentration coordinator when these conditions have been completed. In cases where the committee feels there are more significant problems in background or communication skills the committee may decide on a re-examination. This will be done using the same format and prior to the beginning of the next academic semester. If the student still does not perform satisfactorily on this re-examination, he/she will then be terminated from the Concentration and recommended to the Graduate affairs committee for dismissal from the graduate program. Finally, the examining committee may find that a candidate lacks the skills or motivation to successfully complete a graduate program and may then decide on failure without the possibility of re-examination.

M.S. students who successfully complete the Graduate Preliminary Exam are eligible to finish and defend a Master's Thesis.

Thesis Defense

The M.S. Thesis must be defended in a public presentation. The format is a formal seminar summarizing the work done and its significance, followed by general questions from the audience and, finally, a questioning period by the Thesis Committee.