

## GRADUATION REQUIREMENTS FOR EACH GSBS/RUTGERS JOINT PROGRAM

### Pharmacology

Pharm program credit requirements: The Ph.D. program in Cellular and Molecular Pharmacology normally requires a minimum of 32 credits of coursework and 40 credits of advanced research.

Pharm program course requirements:

First year Molecular Biosciences Core courses and Ethics

Subsequent years

Principles of Drug Action and Targeting (3 credits)

Four of our seven two credit seminar courses (or equivalent)

new - Two years of our 1 unit independent research presentation course (1 unit/year).

### Biochemistry (Rutgers)

6 credits	Biochem & Molec Biology (16:501 & 502)
2 credits	Topics in Mol & Cell Biology (16:695:611 & 612)
1 credits	Ethical Scientific Conduct (16:115:556)
3 credits	Microbial & Molecular Genetics (16:681:502)
3 credits	Advanced Cell Biology (16:695:601)
6 credits	Lab Rotation (16:695:615 & 616) * At least three rotations are required.
1 credits	Quantitative Problems in Biological Sciences (16:115:615)
	Biochemistry seminar (16:115:613 & 614)
1 credits	*3 seminars are required –
	May substitute seminars from other related programs
3 credits	Biophysical Chem I (16:160:537)
6 credits	Electives of student's choice (approved by advisor)
38 credits	Research in Biochemistry (16:115:701, 702)

Course Total: 34 credits - Research Total: 38 credits

Total Credits Required for a PhD: 72 credits

### Biochemistry (UMDNJ)

Incoming Program students will take the curriculum of the Molecular Biosciences for the first year. Students are required to do three laboratory rotations as part of their graduate education. The laboratory in which the student's research is to be done should generally be chosen at the end of the third rotation. Thesis research will begin at this time. The written qualifying exam will be given to all students entering through the Molecular Biosciences Program after the completion of the first year curriculum sometime in June.

Second- Year	Graduate Program in Biochemistry & Molecular Biology Requirements	Biophysical Chemistry (16:160:537) or equivalent Advanced Electives (Total of 2)	3 credits 6
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			credits
		Translational Regulation-Critical Examination of the Literature (Bioc 5010)	1 credit
		Seminar in Molecular and Cell Biology (Bioc 5013)	2 credits
		Seminar in Molecular and Cell Biology (Bioc 5014)	2 credits
		Bioc-5015 Student Research Seminar 1	1 credit
Third-Year	Graduate Program in Biochemistry & Molecular Biology Requirements	Bioc-5016 Student Research Seminar 2 Research Credits	1 credit
Fourth-Year	Graduate Program in Biochemistry & Molecular Biology Requirements	Bioc-5017 Student Research Seminar 3 Research Credits	1 credit
Fifth-Year	Graduate Program in Biochemistry & Molecular Biology Requirements	Bioc-5018 Student Research Seminar 4 (upon approval of adviser) Research Credits	1 credit
		TOTAL	37 credits
		Research	43 credits
			80 credits

After passing the written Qualifying Examination, each student is required to prepare and defend a Proposition. Normally the written exam is taken in June and the Proposition examination is completed by April of the following year. A Proposition is an assertion concerning some current question in biochemistry and molecular biology. The student proposes an original mechanism or theory which could serve to explain a biological phenomenon in molecular terms. In connection with the Proposition, the student also devises hypothetical experiments designed to test the proposal. The Proposition may be in any area of biochemistry and molecular biology which interests the student, and can be on a topic that is related to the student's Ph.D. thesis.

### **Cell and Developmental Biology**

72 hours total  
32 hours course credits minimum  
24 research credit

First-Year	<i>Molecular Biosciences Requirements</i>	Biochemistry (16:115:501)	3 credits
		Biochemistry (16:115:502)	3 credits
		Seminar in Molecular and Cell	1 credit

	- 23 credits	Biology (16:695:611)	
		Ethical Scientific Conduct (16:115:556)	1 credit
		Lab Rotation I and II (16:695:615)	4 credits
		Microbial and Molecular Genetics (16:680:502)	3 credits
		Advanced Cell Biology (16:695:601)	3 credits
		Seminar in Molecular and Cell Biology. (16:695:612)	1 credit
		Lab Rotation III (16:695:616)	2 credits
		Problems in Quantitative Biochemistry (16:115:615)	2 credits
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Second- Year	<i>CDB Requirements</i>	Adv Developmental Biology (16:148:550)	3 credits
		Advanced Electives (Total of 1 in 2nd or 3rd year)	3 credits
		Seminar in CDB (1 per semester) (16:148:550)	2 credits
			Research Credits (variable)
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Third- Year	<i>CDB Requirements</i>	Seminar (from any program)	1 credit
		Research Credits (variable)	
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Fourth- Year	<i>Graduate Program in Biochemistry &amp; Molecular Biology Requirement</i>	Research Credits (variable)	1 credit
Credits	Course		
3	(3 credits of Cell and Developmental Biology Requirements) Advanced Cell Biology (695:601) (Part of First Year Core Curriculum)		
3	Advanced Developmental Biology (148:550)		
6	(6 credits of Biochemistry and Molecular Genetics Requirements) Biochemistry (115:501, 502) (Part of First Year Core Curriculum)		
3	Molecular Genetics (681:502) (Part of First Year Core Curriculum)		
2	Quantitative Problems in Biological Sciences (115:615) (Part of First Year Core Curriculum)		

- 1 credit each, with a grade of B or better. Five seminar courses are required for the Doctor of Philosophy degree. The seminar course 16:148:598 is intended to expose the student to the current research literature in the discipline, and to serve as a training ground for oral presentations and critical evaluation of papers. It is recommended that students (1) take courses in a variety of different topic areas in order to sample different disciplines; and (2) informally audit seminars to gain experience by observing other student presentations, particularly in the early semesters. The following seminar may also be used to fulfill this requirement. Seminar in Cell and Developmental Biology (16:148:598), Seminar in Biochemistry (16:115:613) and seminars taken in the first year Consolidated BioSciences Core Curriculum.
- 1 x 5 Laboratory Rotation (up to 6 hours can be counted towards fulfilling the 32 course credits requirement for the Ph.D. degree; 2 credits maximum/laboratory)
- 6 A written report is required for credit, which must be approved by the Program Director and retained in the student's program file for review by the preliminary thesis committees. Laboratory rotations are limited to the first 3 semesters in the program.
- 3 or more Electives - all elective courses must be at the 500 level or above. Most courses in the Microbiology, Biochemistry, Physiology, and Neuroscience graduate programs are acceptable.

### **Microbiology and Molecular Genetics (Rutgers)**

Credits: A minimum of 72 credits must be earned for this degree. The Ph.D. credit requirements are based on the equivalent of a minimum of 3 years of full-time study. Since official full-time registration is 9 credits a semester, the Ph.D. degree usually represents 72-90 credits of quality work, with a minimum of 33 course credits at the 500 or greater level. The remaining credits may be taken in research. In special cases some course credits will be accepted at the 300-400 level, and on the advice of the Student Affairs and Standards Committee and the approval of the Program Director, up to 12 graduate course credits may be transferred from other universities. A maximum of 8 credits of Laboratory Rotation in Microbiology and Molecular Genetics may be used to fulfill the coursework requirement for the Ph.D.

All degree candidates are required to complete the following coursework as part of their academic program.

1. 16:681:501 Microbial Life, 3 credits, with a grade of B or better. All students are required to fulfill this requirement or receive an exemption from the director to substitute another course.
2. 16:681:502 Molecular Genetics 3 credits, or 16:681:580 Fundamentals of Molecular Genetics, 3 credits, with a grade of B or better.
3. 16:681:681-688 Seminar in Microbiology and Molecular Genetics, 1 credit each, with a grade of B or better. Five seminar courses are required for the Doctor of Philosophy degree. The seminar sequence, 16:681:681 through 688, is intended to expose the student to the current research literature in the discipline, and to serve as a training ground for oral presentations and critical evaluation of papers. It is recommended that students (1) take courses in a variety of different topic areas in order to sample different

disciplines; and (2) informally audit seminars to gain experience by observing other student presentations, particularly in the early semesters. The following seminar may also be used to fulfill this requirement. Seminar in Cell and Developmental Biology (16:148:598), Seminar in Biochemistry (16:115:613) and seminars taken in the first year Consolidated BioSciences Core Curriculum.

4. 16:115:556 Ethical Scientific Conduct, 1 credit (Graded as Pass/Fail)

5. 16:115:615 Quantitative Problems in Biological Sciences, 2 credits

### **Molecular Genetics Microbiology and Immunology (UMDNJ)**

A minimum of 72 total course credits is required for the PhD. This must include of minimum of 32 credits of formal course work and a minimum of 24 credits of research. The Special Topics Seminars and a maximum of 6 credits of Lab Rotations count towards the course work credits. Additional Lab Rotations count towards the total credit requirements, but not as course credits.

Incoming Program students will take the curriculum of the Molecular Biosciences for the first year.

The curriculum for subsequent years is through the Molecular Genetics, Microbiology and Immunology program.

- \* A minimum of 2 additional semesters of Special Topics Seminars.
- \* Elective courses of student's choice to give the required minimum total of 32 credits.
- \* Research credits to bring each semester's total to 12 credits.

### **Physiology and Integrative Biology**

A minimum of 72 total credits is required for the PhD. This must include a minimum of 32 credits of formal course work and a minimum of 24 credits of research. The Special Topics Seminars and a maximum of 6 credits of Lab Rotations count towards the course work credits. Additional Lab Rotations count towards the total credit requirements, but not as course credits.

(To clarify, our required courses for PhD students are the core courses of MBS. All our PhD students have taken at least one of the following two courses: "Molecular Basis of Physiology" and "Physiological Basis of Diseases", although they are not listed as required courses. All graduate students are required to take "Physiology Journal Club" before they have had enough course credits.)

### **Neuroscience**

A total of 72 combined credits are required for the PhD degree. Of the 72 credits, at least 28 course credits (at a minimum "B" grade average) are required, of which 24 must be at the 500 level or above, including 4 credits of Neurobiology 710:555, 8 seminar credits of Advanced Studies in Neuroscience and 1 credit of Ethical Scientific Conduct. Up to 44

research credits are also required to bring the total to 72.

Written Qualifying Exam: an open-book examination, lasting one week, during which a student is asked to design experiments to test hypotheses posed, and/or to evaluate strengths and weaknesses of an area of the scientific literature with which the student has established familiarity by reading with selected program members. Committee members, after reading the written responses to the Examination, will communicate any comments or concerns directly to the student and the student's major advisor. This part of the Qualifying Examination is to be completed no later than the end of the fourth semester.

For the second part of the Qualifying Examination, the student will submit a written thesis Proposal to the Committee.

### **Toxicology**

Full-time students are required by the Graduate School-New Brunswick to maintain a course load of at least 12 credits per semester. These credits must include the core courses listed below, as well as elective courses chosen in consultation with the student's advisor.

A minimum of 72 course credits are required for the doctorate.

Required Courses	Credits
General Biochemistry I and II (1st year)	6-8
General Toxicology I and II (1st year)	3+3 3
Systems Physiology	1
Advanced Problems in Toxicology: Histology (2nd year)	1
Toxicological Pathology (2nd year)	3
Statistics (1st year)	3
Seminar*	4
Ethical Scientific Conduct (1st year)	1
Track Course(s)** (2nd year)	3-6
Electives (2nd year)	3-6
Dissertation Related Research	24 (minimum)
Total required credits	72

The course requirements for the Ph.D. students are listed above. The Ph.D. student is expected to pass a comprehensive written examination offered at the end of the first year of study. An oral preliminary examination is given at the end of the second year of study. The oral examination committee is composed of the track director (or designee), the student's major professor and at least two members of the research track the student has chosen to pursue, chosen in consultation with the major advisor and the track director. A thesis committee consisting of the faculty advisor and at least three JGPT members is assembled during or shortly after the student's first year. The thesis

committee evaluates the student's research proposal and progress toward a Ph.D. For the Ph.D. defense an outside reader, approved by the Director of the JGPT and by the Dean of the Graduate School-New Brunswick, is added to the thesis committee. It is anticipated that students will complete the Ph.D. degree within 4-5 years after entering the JGPT.

#### \* SEMINAR REQUIREMENT

Students are required to present a seminar every year that they are enrolled in the JGPT. Students are exempt from presenting a seminar in the academic semester in which they graduate since they will then present their work at an open thesis defense. However, the student must be actively writing the thesis or have already established a definitive defense date for the seminar requirement to be waived that semester.

ALL STUDENTS are required to attend the Toxicology Program Seminars and are strongly urged to attend the bi-weekly EOHSI Seminar. A sign-in sheet will be passed around at each seminar. The faculty of the JGPT consider the student seminar program to be extremely important for many reasons, including the experience the student will gain in the analysis and presentation of experimental data. Material from JGPT seminars may be included in the written qualifying examination.

The first and second year students take a one-credit seminar course together each semester. This seminar group meets weekly and the number of presentations will be determined by the seminar director. The aim of this seminar is to familiarize the student with oral presentations and the writing of scientific abstracts. The seminar course is hosted by each of the four tracks in rotation. Consequently, the topics covered in the four semesters of the seminar course will cover a wide range of scientific themes.

Students in the third, fourth, and later years of the program will give a presentation at an annual symposium devoted to their research during the Spring semester of each academic year. These students will also be required to write an abstract on their topic conforming to the style used by the Society of Toxicology. Only students who are defending their thesis before the May 1 deadline for thesis submission will be exempted from presenting in the symposium in the year of their thesis defense. The first and second year students are required to attend the spring student symposium.

### **Exposure Science**

#### **Candidates must take**

32:832:595 Environmental Exposure Measurements & Assessment (3)

16:115:556 (IDST-5000) Ethical Scientific Conduct (1)

Candidates also must take at least 21 credits from the following courses, with at least one course being taken from each area. Substitutions may be allowed if approved in writing by the major advisor and option coordinator.

#### **Epidemiology**

16:832:520 Principles of Epidemiology (3)

16:832:582 Environmental and Occupational Epidemiology (3)

## **Environmental Science**

16:375:523 Fate and Transport (3)

16:375:541 Environmental Models (3)

32:832:589 Advanced Environmental Hygiene Measurements (4)

## **Health**

32:832:541 Toxicology (3)

32:832:586 Environmental Risk Assessment (3)

## **Statistics**

16:960:467 Applied Multivariate Analyses (3)

16:960:590 Design of Experiments (3)

16:970:527 Adv. Multivariate Methods: Environmental & Health Issues (3)

## **BME Ph.D. Program Curriculum rev. Dec 2010**

**\*Students are required to complete a total of 3 core BME courses, in addition to Advanced Math and Cell/Molecular Biology within the first three academic semesters.**

### FALL Year 1

16:125:xxx BME Core Courses (3cr) (*Register for one, possibly two core courses – see note\**)

16:148:514 Molecular Biology of Cells (3cr)

16:155:507 Analytical Methods Bioengineering (3cr), *or*

16:642:527 Methods of Applied Math

16:125:701 Research (3+cr) (*This is a new requirement*)

16:125:601 Journal Club in BME (1cr)

BME Seminars (attendance required)

**Advisor Selection Forms (December through February)**

### SPRING Year 1

16:125:xxx BME Core Course (3cr) (*Register for one or two core courses – see note\**)

16:125:xxx Bioengineering Elective (3cr)

16:125:602 Survival Skills (1cr)

16:125:628 Clinical Practicum (1cr)

16:125:702 Research (3+cr)

BME Seminars (attendance required)

### SUMMER Year 1

**Research Based Qualifying Exam for Doctoral Studies (June)**

### FALL Year 2

16:125:xxx BME Core Course (3cr) (*Register for one remaining core course, if any – see note\**)

16:125:xxx Bioengineering Elective (3cr) (*Register for one or two core courses*)

16:125:607 Preparing Future Faculty I (1cr)

16:125:701 Research (3+cr)

BME Seminars (attendance required)

### SPRING Year 2

16:125:xxx Bioengineering Elective (3cr)

16:125:xxx Life/Medical Sciences Elective (3cr)  
16:125:608 Preparing Future Faculty II (1cr)

16:125:702 Research (3+cr)  
BME Seminars (attendance required)

SUMMER Year 2

**Prepare Thesis/Dissertation Proposal**

FALL Year 3

BME Seminars (Attendance required)  
16:125:701 Research (3+cr)  
Electives (As required)

**Deadline for Defense of Thesis/Dissertation Proposal**

SPRING Year 3

16:125:702 Research (3+cr)  
Electives (As required)

Years 4-6

16:125:701/2 Research (3+cr)  
BME Seminars (Attendance required)  
Electives (Optional)

**Final Thesis/Dissertation and Defense (Year 5)**

**BME Core Courses \* Must take 3 out of 4:**

- 1) 16:125:571 Biosignal Processing and Biomedical Imaging (3cr) Fall
- 2) 16:125:572 Biocontrol, Modeling and Computation (3cr) Spring
- 3) 16:125:573 Kinetics, Thermodynamics and Transport in Biomedicine (3cr) Fall
- 4) 16:125:574 Biomechanics Systems (3cr) Spring

**Physiology**

Students **must** have taken an UG level Physiology course previously or the following courses must be taken.

- 1) 14:125:355/6 BME Systems Physiology (undergraduate course-3cr)  
Fall/Spring
- 2) Other Rutgers or UMDNJ Physiology Courses – Contact the Graduate Program for information

**Advanced Engineering Mathematics**

- 1) 16:155:507 Analytical Methods Chem/Bioengineering (3cr) Fall
- Or 16:642:527 Methods of Applied Math (3cr) Fall

**Life Science and Medical Foundational Course**

- 1) 16:148:514 Molecular Biology of Cells (3cr) Fall  
or  
16:115:511 Molecular Biology and Biochemistry (3cr) Fall  
And
- 2) At least one Life Science electives from the list in the Graduate Handbook

**Developmental Courses**

- 1) 16:125:601 Journal Club (1cr) Fall **(Required during 1<sup>st</sup> year)**
- 2) 16:125:602 Survival Skills (1cr) Spring **(Required)**
- 3) 16:125:607 Preparing Future Faculty I (1cr) Fall **(Required)**

- 4) 16:125:608 Preparing Future Faculty II (1cr) Spring **(Required)**
  - 5) 16:125:628 Clinical Practicum (1cr) Spring **(Required)**
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### **Summary of Minimum Ph.D. Requirements**

<b>3 out of 4 BME Core Courses</b>	<b>9 credits</b>
<b>Advanced Engineering Math Course</b>	<b>3 credits</b>
<b>Molecular Biology Course</b>	<b>3 credits</b>
<b>Life Science/Medical Elective</b>	<b>3 credits</b>
<b>4 Bioengineering Electives</b>	<b>12 credits</b>
<b>5 Developmental Courses</b>	<b>5 credits</b>
<b>Research (minimum)</b>	<b>37 credits</b>
<b>Total</b>	<b>72 credits (35 course credits)</b>

#### **Notes:**

- Prerequisite work may not count as an elective. Please check with the program first.
- The core courses 571 and 573 are offered in the fall, and 572 and 574 in the spring semester. Since only 3 out of 4 core courses are required, this usually leaves room for an elective.