

# Ph.D. Program in Biochemistry and Molecular Biology

## Program Requirements

### Required Courses

		Credits
BI 501, 511, 521, 531	Research Rotations (3 research rotations are usually required)	3 each
BI 525	Biochemistry and Molecular Biology – Genetic Information Transfer	3
BI 535	Biochemistry and Molecular Biology – Metabolism	3
BI 612	Dynamics of Macromolecules	3
BI 614	Macromolecular Function	3
BI 710, 720, 730	Seminar – must enroll for 9 semesters	1 each
BI 910, 920, 930	Dissertation Research	Variable
GC 550	Foundations in Biomedical Sciences	10
GC 640	Research Ethics: The Responsible Conduct of Research	1
GC 660	Statistical Methods	3
PR 613	Macromolecular Structure	3

### Recommended Elective Courses

BI 624	Extracellular Matrix Proteins and Complex Carbohydrates	2
CB 615	Developmental Biology I – Embryology	3
CB 625	Mechanisms of Development	3
GE 636	Regulation of Cell Cycle and Apoptosis	3
GE 637	Advanced Human Genetics	3
GE 652	Molecular Basis of Cancer	2
IMP 505 A and B	Fundamentals of Immunology, Parts 1 and 2	2 each
NS 700	Introduction to Neuroscience	4
NS 715	Cell and Molecular Neuroscience	3
PR 680	Molecular Pharmacology	3

### Course Descriptions / Required Courses

**BI 501, 511, 521, 531**                      **Research Rotation Pre-entry, 1, 2, 3(Merry)**

Credits 3

Each semester/session; must complete 3 rotations

Students rotate through faculty laboratories to gain experience with a wide variety of basic laboratory techniques.

**BI 525                    Biochemistry and Molecular Biology – Genetic Information Transfer (Hou)**

Credits 3

Prerequisite: GC 550 or equivalent

Spring I

This course focuses on current advances of molecular biology research for the understanding of genetic information transfer from DNA to RNA to protein. Topics include DNA replication, repair, and recombination, RNA transcription, processing, and regulation, protein synthesis, ribosome, and quality control. The course will contain formal lectures, as well as student presentations, and two examinations.

**BI 535                    Biochemistry and Molecular Biology - Metabolism (Faculty)**

Credits 3

Prerequisite: Organic Chemistry

Spring II

The topics covered include the catabolic and anabolic pathways of carbohydrate, lipid, and amino acid metabolism and their biochemical interrelationships and regulation. Also addressed will be research directed at understanding the biochemical basis of a few selected diseases, as well as current research efforts in the field of metabolic regulation. Assigned reading.

**BI 612                    Dynamics of Macromolecules (Faculty)**

Credits 3

Prerequisite: GC 550

Spring I

The course is intended to familiarize students with the native structures and dynamics of proteins and nucleic acids. Students will present literature articles followed by class discussions. Presenters are to organize the material according to the course goals, condense the material in order to allow discussion and critique it in terms of feasibility of approach, data and further research application. Topics include the thermodynamic stability of proteins and nucleic acids, the roles of kinetics and thermodynamics in protein and nucleic acid folding, predictive schemes for protein folding and an analysis of the loss of stability in mismatched DNA and its biological and biochemical implications.

**BI 614                    Macromolecular Function (Scott, Root)**

Credits 3

Prerequisite: PR 613

Spring II

The course will introduce students to the biological role of ligand binding and catalysis with an emphasis on experimental techniques to study the function of macromolecules. Topics include bimolecular, multivalent, cooperative and competitive binding kinetics and thermodynamics and methods for their study (dialysis, fluorescence, biosensor, calorimetry), an overview of enzyme chemical mechanisms, and detailed discussion of enzyme kinetics including single and multisubstrate reactions, steady state and pre-steady state methods, inhibition kinetics and allostery.

**BI 624 Extracellular Matrix Proteins and Complex Carbohydrates (Schick)**

Credits 2

Prerequisites: Biochemistry and some background in physical chemistry

Spring II

In depth review and discussion of the structure, function, biosynthesis and cellular interactions of the collagens, glycoproteins and proteoglycans of skin, tendon, cartilage, bone, and other connective tissues. Basic knowledge of the biochemistry of amino acids and carbohydrates will be built upon to describe the structural, molecular, and cell biology of these complex macromolecules and understand their role in development, normal function, and disease. Assigned reading of the literature and student reports. Designed for second-year (and higher) graduate students and postdoctoral fellows who wish to broaden their view.

**BI 710, 720, 730 Seminar (Course Coordinator changes from semester to semester)**

Credits 1

Fall, Spring I, Spring II

The purpose of this course is to provide a forum for the presentation and critical evaluation of recent publications in biology, including the experimental approaches taken and the conclusions drawn. The course consists of a series of oral student presentations to be discussed and evaluated by two attending faculty members following the seminar. As a part of the course, the students are expected to attend the department's guest speaker seminars and meet with the speakers to further discuss their work. Assigned reading.

**BI 910, 920, 930 Research (Merry)**

Credits variable

Fall, Spring, Summer

Under the supervision of a member of the graduate faculty and guidance of a thesis research committee, the student will learn research design, methodology, and experimental techniques relevant to the graduate program. Research leading to the doctoral thesis is a major requirement for the Ph.D. degree and will occupy a dominant part of the student's time and attention.

**GC 550 Foundations of Biomedical Sciences (Ellingson)**

Credits 10

Fall

This course is designed to provide a basic knowledge of biochemistry, genetics, molecular biology and cellular biology to the beginning student. The primary goal is to convey knowledge of the molecular and cellular mechanisms controlling cell, tissue and organ system function using material drawn from biochemistry, cell biology, genetics, pharmacology and physiology. The course will familiarize the student with the powerful technologies used in scientific research and will train the student in the communication of science through informal sessions on evaluation of published literature, scientific writing, oral presentations, and information retrieval.

**GC 640                    Research Ethics: The Responsible Conduct of Research (Flynn)**

Credits 1

Fall, Spring I, Spring II

This graduate seminar course is designed to familiarize students with the ethical dilemmas inherent to the conduct of research. Topics to be discussed include codes of ethical behavior, research design, conflicts of interest, informed con-sent and the appropriate use of animals. The student will be required to prepare a paper on the analysis of one or more case studies.

**GC 660                    Statistical Methods of Data Analysis (Diamond, Winter, Crawford)**

Credits 3

Fall, Spring I, Spring II

Students learn to apply the principles and techniques of basic statistical analysis, including descriptive and inferential statistics. Applications using the normal, t and chi-square distributions are emphasized. The SAS software package for analysis is included.

**PR 613                    Macromolecular Structure (Wickstrom, J. Williams)**

Credits 3

Prerequisite: GC 550 or equivalent

Spring I

We will study protein and nucleic acid structure and function, focusing on energetic forces that guide folding, and computer modeling to predict structures. To reveal protein and nucleic acid structures we will study optical spectroscopy (absorbance, fluorescence, circular dichroism), electrophoresis, mass spectroscopy, magnetic resonance spectroscopy, and X-ray crystallography. We aim to develop your critical, analytical and problem-solving abilities in structural biology. Lectures on Monday and Friday will be supplemented by problem sessions or hands-on experience on Wednesdays, in the classroom, laboratories, or offices.

## Course Check List

### First Year

Course Name	Fall (credits)	Spring (credits)		Summer (credits)
		Spring 1 (credits)	Spring II (credits)	
Research Rotation	BI 511 (3)	BI 521 (3)	BI 531 (3)	
Foundations in Biomedical Science	GC 550 (10)			
Biochemistry		BI 525 (3)	BI 535 (3)	
Protein Structure and Function		PR 613 (3)	BI 614 (3)	
Statistics		GC 660 (2)		
Seminar		BI 720 (1)	BI 730 (1)	
Elective			3 credits	
Research Ethics	GC 640 (1)			
Research	BI 910 (6)	BI 920 (variable)		BI 930 (10)
<b>Credits Required for Full-time Enrollment</b>	<b>20</b>	<b>30</b>		<b>10</b>

### Second Year

Course Name	Fall (credits)	Spring (credits)		Summer (credits)
		Spring 1 (credits)	Spring II (credits)	
Biochemistry		BI 612 (3)		
Ethics		GC 640 (1) If not completed 1st year		
Seminar	BI 710 (1)	BI 720 (1)	BI 730 (1)	
Elective	3 credits	3 credits	3 credits	
Research	BI 910 (variable)	BI 920 (variable)		BI 930 (10)
<b>Credits Required for Full-time Enrollment</b>	<b>20</b>	<b>30</b>		<b>10</b>

**Seminar Requirement: 9 credits**