

## CURRICULUM FOR BIOCHEMISTRY AND MOLECULAR BIOLOGY Ph.D. PROGRAM

### Year 1

#### Fall

- G715 Biomedical Science I—Biochemical Basis of Biological Processes (3 cr.)
- G716 Biomedical Science II—Molecular Biology and Genetics (3 cr.)
- G717 Biomedical Science III—Cellular Basis of Systems Biology (3 cr.)
- G718 Research in Biomedical Science (1st lab rotation) (2 cr.)

#### Spring

- G655 Research Communication Seminar (1 cr.)
- G718 Research in Biomedical Science Rotations 2 and 3 (4 cr.)

Students will take 6 credits from the IBMG open enrollment electives in Spring.

Students must take at least two of the ~~six~~ two Biochemistry “core” courses (G805, 807, 811, 817, 848, 852, 825) shown below (offered among the Spring IBMG electives or offered in the Fall ~~2~~). These may also be taken in later years.

- G817 Molecular Basis of Cell Structure and Function (2 cr.)
- G852 Concepts of Cancer Biology: Signaling Gone Awry (2 cr.)
- G807 Structural and Chemical Biology (2 cr.)
- G848 Bioinformatics, Genomics, Proteomics and Systems Biology (2 cr.)

### Year 2

#### Fall

- G805 Diabetes and Obesity (2 cr.)
- G825 Advanced Topics in Molecular Biology (2 cr.)
- G505 Responsible Conduct of Research (1 cr.)
- G855 Experimental Design and Research Biostatistics (1 cr.)

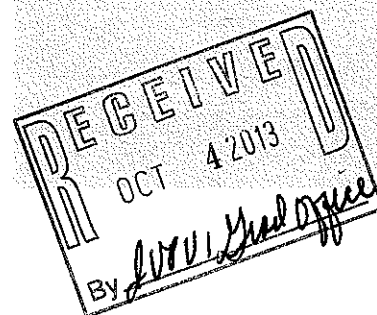
#### Spring

- B803 Advanced Biochemistry (1 cr.)

This course in grant writing will culminate in the submission and oral defense of an “NIH or NSF style” grant proposal on the students intended research topic. The assigned grade for this course is dependent on the successful defense of the proposal that will serve as a qualifying exam and be required for Advancement to Candidacy.

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### Spring and Fall

- B811 Advanced Intermediary Metabolism (1-3 cr.)

### Years 2-5

- During years 2 through 5, the student will take didactic courses as needed to fulfill either requirements for the biochemistry major or their chosen minor. The student will register for a total of 10cr hours each fall and spring, including 1cr hr of B890 each semester until advancing to candidacy. The student will advance to candidacy upon completion of 30 or more didactic hours of coursework and successful defense of their thesis proposal. Seminar B890 (2 cr./year)
- Total credits 33
- B855 Research Project: a minimum of 45 credit hours

Work will begin in the field of the candidate's thesis with e-Emphasis on the ability to pursue research with relative independence and responsibility.

### Notes:

- Students will be questioned on topics outside of their thesis work during their thesis proposal oral defense in B803. Passing of this defense (with B/3.0 grade or better) will be required for advancement to candidacy.
- Students will be enrolled for credit in B890 in years 2-5 in which they will present a seminar each year as well as attend all student and faculty seminars. Students will present one of the following: a research seminar (4<sup>th</sup> year students are strongly encouraged to consider this type of presentation), a proposal seminar (3<sup>rd</sup> year students preparing for their qualifying exams are encouraged to consider this type of presentation), or a "literature club" type of seminar (open to students at any level), where the student presents a paper from the literature. Students enrolled in G901 are encouraged to consider giving a research presentation in B890, even though they are not enrolled in the course. Students will be enrolled for credit in B890 in years 2-5 in which they will present a seminar each year as well as attend all student and faculty seminars. Student seminars will generally be of a "journal club" format, where current, published work in the field of biochemistry is presented. Students who have advanced to candidacy may present their own lab work upon approval of course director and thesis advisor.
- After choosing a laboratory for thesis research, an advisory committee consisting of at least 3 Biochemistry and Molecular Biology and 1 external faculty member will be formed with the approval of the thesis advisor and departmental chairperson. Upon advancement to candidacy a thesis research committee will be similarly formed that may consist of different faculty.
- Students must score at least B<sup>-</sup> on each course and maintain at least a B average (3.0 minimal GPA).

- M.D./Ph.D. students will not be required to take G715-717 but will be expected to perform lab rotations (G718) during summer breaks from medical school classes. They will take B848 and at least one more of the 2-credit Biochemistry "core" courses (G805, 807, 817, 848, 852, 825) along with other courses required of Biochemistry and Molecular Biology Ph.D. students (G505, G655, G855, B803 and B890) plus 2 credits from other department offerings. In the case of combined M.D./Ph.D. students, the committee may approve substitution of appropriate medical school courses for the electives. The minor representative will be selected from outside the student's major department and must be approved by the diabetes and obesity training program.

### Grades

A minimum grade point average of 3.0 (B) must be maintained in all nonresearch course work.

- BIOC-B 500 Introductory Biochemistry (3 cr.) P: C341 or equivalent. Structures of carbohydrates, proteins, lipids, and nucleic acids. Basic principles of enzyme catalysis, protein synthesis, intermediary metabolism, and nutrition.
- BIOC-B 800 Medical Biochemistry (3 cr.) P: One semester of organic chemistry. Structure and function of biological molecules, regulation of cellular processes by nutrients and hormones, biochemical and molecular basis of disease.
- ~~BIOC-B 803 Advanced Biochemistry (1-3 cr.) Tutorial instruction in biochemistry. does not match description above as the grant writing course. MD/PhD take the granting course too?~~
- BIOC-B 805 Diabetes and Obesity (3 cr.) P: One semester of biochemistry. Biochemistry, cell biology, molecular biology, genetics, immunology, and pathophysiology of diabetes and obesity. Topics include metabolic regulation, signal transduction, insulin resistance, insulin production, beta-cell function, animal models, complications, nutrition, prevention, and therapy.
- BIOC-B 807 Protein Structure and Function (3 cr.) P: Two semesters of organic chemistry; one semester of biochemistry. Physical forces stabilizing protein structure; protein folding. Essential features of macromolecular interactions. Introduction to enzyme kinetics and chemical mechanism in enzyme reactions.
- BIOC-B 808 Physical Biochemistry (3 cr.) P: Two semesters of physical chemistry; two semesters of calculus; one semester of biochemistry. Thermodynamics and biophysical chemistry of protein, enzymes, nucleic acids, and membranes.
- BIOC-B 809 Advanced Organic Chemistry (1-3 cr.) P: Two semesters of organic chemistry; two semesters of physical chemistry; B807 or consent of instructor. Tutorial instruction in organic chemistry, as applied to biochemistry.

- BIOC-B 810 Cellular Biochemistry and Regulation (3 cr.) P: Two semesters of organic chemistry, one semester of biochemistry. Mechanisms of signal transduction and the control of cellular function by hormones, growth factors, and other extracellular regulators.
- BIOC-B 811 Advanced Intermediary Metabolism (1-3 cr.) P: ~~B810~~. Tutorial instruction in specialized areas of metabolism.
- BIOC-B 814 Advanced Enzymology (1-3 cr.) P: B807 or B810. Tutorial instruction in enzyme isolation and kinetics.
- BIOC-B 821 Scientific Writing and Communication in Biotechnology (1 cr.) P: B807 or B810. Discussion and individual instruction in the preparation of a research proposal and thesis in the biotechnology track of the M.S. in Biochemistry and Molecular Biology.
- BIOC-B 822 Research in Biotechnology (1-5 cr.) Research for biotechnology track in M.S. thesis.
- BIOC-B 835 Neurochemistry (3 cr.) P: Two semesters of organic chemistry, one semester of biochemistry, or consent of instructor. Metabolism of nervous system tissue. Neurochemical techniques.
- BIOC-B 836 Advanced Topics in Neurochemistry (2 cr.) P: B835 or equivalent. Selected topics in neurochemistry dealing with specialized functions of the nervous system.
- BIOC-B 842 Instrumentation and Methods of Analysis II (3 cr.) P: Two semesters of organic chemistry, one semester of biochemistry.
- BIOC-B 854 Introduction to Research (1 cr.) P: Two semesters of organic chemistry, two semesters of physical chemistry, one semester of biochemistry, or consent of instructors. Tutorial and laboratory instruction in biochemistry. Purpose is to introduce students in biochemistry to three different research programs.
- BIOC-B 855 Research (arr cr.)
- BIOC-B 868 Advanced Molecular Biology (1-3 cr.) P: ~~G865 or equivalent~~. Tutorial instruction in specialized area of molecular biology.
- BIOC-B 890 Seminar (1 cr.)
- BIOC-G 749 Introduction to Structural Biology (1 cr.) An introduction to structural biology including the fundamentals of macromolecular structure and interactions, methods used to determine three-dimensional structures, the relationship between protein sequence and structure, and prediction and analysis of macromolecular structure.

- BIOC-G 804 Cellular and Molecular Biology (3 cr.) P: One semester of organic chemistry. Cellular and molecular biology that emphasizes the structural organization, biochemistry, and molecular biology of cells. Includes cellular processes, development, and differentiation and their relationship to medicine.
- BIOC-G 805 Diabetes and Obesity (2 cr.) P: One semester of biochemistry. Biochemistry, cell biology, molecular biology, genetics, immunology, and pathophysiology of diabetes and obesity. Topics include metabolic regulation, signal transduction, insulin resistance, insulin production, beta-cell function, animal models, complications, nutrition, prevention, and therapy.
- BIOC-G 807 Structural and Chemical Biology (2 cr.) Fundamentals of structural and chemical biology focused on state-of-the-art approaches to inhibitor discovery, use of inhibitors in elucidating biological function, and computational and structural approaches to rational inhibitor design.
- BIOC-G 817 Molecular Basis of Cell Structure and Function (2 cr.) Organization and function of subcellular structures. Intracellular coordination of cell activities, including protein and RNA processing/trafficking/quality control, chromatin dynamics, and cell division.
- BIOC-G 823 Methods in Cell Biology (3 cr.) P: B500 or equivalent. Discussion and laboratory instruction in modern methods for cell culture, microscopy, flow cytometry, and the use of cell culture to study cellular metabolism.
- BIOC-G 825 Advanced Topics in Molecular Biology (2 cr.) The course will highlight selected topics adjusted each year to reflect the most current advancements in molecular biology and will include lectures and paper discussions on: chromatin structure and regulation; transcriptional control; RNA structure and processing; RNAi and miRNA; RNA decay; translational control and its integration in gene expression.
- BIOC-G 828 Concepts in Biotechnology (3 cr.) P: B500 or equivalent. Case studies exploring topics on the cutting edge of biotechnology and tutorials in biotechnology calculations.
- BIOC-G 841 Methods of Proteomics (3 cr.) P: B500 or equivalent. Discussion and laboratory instruction in modern methods for protein purification, analysis of purity, peptide mapping, and amino acid sequencing.
- BIOC-G 848 Bioinformatics, Genomics, Proteomics, and Systems Biology (2 cr.) Biology has been transformed by various high-throughput technologies (genomics, proteomics, metabolomics, etc.), which in turn have led to a large number of massive databases and software analysis packages. This course focuses on the "omics" technologies, on the resulting databases, and on the computational tools used to analyze the data.

- BIOC-G 852 Concepts of Cancer Biology: Signaling Gone Awry (2 cr.) Fundamentals of cancer biology; the signaling of events that regulate cell growth, survival, and differentiation; how mutation/dysregulation of signaling molecules leads to cancer and might be exploited for treatment.
- BIOC-G 865 Fundamental Molecular Biology (3 cr.) P: B800 or equivalent. Principles of molecular structure, function, and biosynthesis; core information regarding prokaryotic and eukaryotic gene continuity and metabolic coordination; introduction to multicellular systems and problems. (Joint program: biochemistry, medical genetics, microbiology.)
- BIOC-G 890 Methods in Molecular Biology and Pathology (3 cr.) P: ~~CG865 and/or J838~~, and consent of instructor. Basic principles and techniques in molecular biology and pathology. Particular emphasis will be on molecular techniques that can be used to study problems related to biochemistry and pathology.
- BIOC-G 910 Advanced Molecular Biology Methods (3 cr.) P: ~~CG865 and/or G890~~ and consent of instructor. Advanced theory and techniques in molecular biology. The focus of the course will be on techniques related to manipulation of cloned DNA to study their expression, structure, and function.