

# BIOCHEMISTRY AND MOLECULAR BIOLOGY

<https://med.miami.edu/departments/biochemistry>

**Dept. Code: BMB**

(Code for the major is either Track 1: BCHM or Track 2: BCHN)

## Introduction

Biochemistry is the chemistry of life. It includes or has large areas of overlap with molecular biology, biophysics, structural biology, cell biology, metabolism, neuroscience, nutrition, genetics, etc. It tries to explain what happens in living organisms and how biological processes are regulated. It is a relatively young science. Our understanding is still developing and students can learn something new every day. An Undergraduate Major in one of our two tracks, Track 1: Biochemistry and Molecular Biology (BCHM) or Track 2: Biochemistry and Nutrition (BCHN), provides an excellent preparation for:

1. Medical School
2. Graduate Studies in all basic medical sciences: Biochemistry, Molecular Biology, Cell Biology, Genetics, Neurobiology, Microbiology, Immunology, Pharmacology, Biophysics, Physiology, Bio-informatics, Biology, Nutrition, Environmental Science, and others.
3. Industry: Biotechnology, Pharmaceutical, Food Production, Food processing, and others.
4. Allied Health Professions: Nutrition, Dentistry, Forensics, Veterinary Medicine, Toxicology, Clinical Chemistry, Environmental Science, and others.
5. Non-Health Professions: Chemistry, Physics, Scientific Publishing, Patent Law, and others.

## Educational Objectives

The undergraduate program in Biochemistry & Molecular Biology strives to provide

1. superior training in nutrition, biochemistry and molecular biology and
2. encouragement for self-study and research to students seeking a BS degree.

As part of a research-oriented university, the department, through its students, creates new knowledge. As a result of our teaching efforts, the new BS's created will be able to matriculate into professional and graduate schools or to find positions in teaching professions and/or industry. In addition, the department serves the community by providing expertise in matters related to nutritional and medical biochemistry. For example, it teaches biochemistry to pre-medical and other pre-health students across a wide variety of life science related majors including biology, microbiology, neuroscience, and biomedical engineering.

## Degree Programs

As a member of the College of Arts & Sciences, the Department of Biochemistry and Molecular Biology offers an undergraduate BS degree. As a member of the Miller School of Medicine, it offers the following graduate degrees: PhD, Executive PhD, and dual MD-PhD. Also, it offers a Molecular Medicine Pathway for MD students.

## Departmental Honors

*Departmental honors can be earned by biochemistry majors who have:*

1. Successfully completed at least six (6) units of BMB 545. This research must be described in a brief thesis that needs to be approved by (i) their faculty research mentor, (ii) BMB 545 course instructor, and (iii) Director of Undergraduate Studies in BMB.
2. A 3.5 or higher grade point average in all BMB courses.
3. A 3.3 or higher grade point average in all courses taken at the University of Miami.

### **BMB 145. Introduction to BMB Research. 2 Credit Hours.**

Students will collaborate on a research project and learn valuable laboratory skills. The goal for this course is to make students "research-ready" through an active, inquiry-based, platform for developing core competencies in biology, genetics, BMB (biochemistry & molecular biology), bioinformatics, scientific discourse and ethics.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 245. Foundations in BMB Research. 2 Credit Hours.**

Students shadow a research assistant in the lab of a BMB faculty member and learn about the research projects and techniques used by the group. Students will assist in preparing reagents, conducting experiments, analyzing data and generating brief reports. Attendance in lab group meetings is expected. Students maintain a weekly online journal and will write a paper describing the research in the lab and proposing a research problem and approach to solve in BMB545.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 401. Biochemistry for the Biomedical Sciences. 4 Credit Hours.**

The biochemical composition, structure, and cellular metabolism of proteins, carbohydrates, lipids, and nucleic acids are rigorously described, emphasizing problem solving strategies required of biomedical field applications.

Prerequisite: CHM 222 And with a grade of C- or higher.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 402. Principles of Experimental BMB. 2 Credit Hours.**

An active, inquiry-based, platform for developing core competencies in biochemistry & molecular biology, making students "research ready".

Corequisite or Prerequisite: BMB 401.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 411. Readings in BMB. 1 Credit Hour.**

Students read and discuss one BMB primary research article each week and answer a set of questions meant to provoke critical evaluation of the work. The course introduces students to critical reading of the primary literature in BMB and is open to students at any level. Peer-mentoring and informal student-led instruction is central to the course.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 417. Metabolic Regulation. 3 Credit Hours.**

Students will learn to formulate mechanisms of enzyme catalysis and inhibition. Next, students will learn how to plot and analyze enzyme kinetic and binding data. Data analysis will be extended to more complicated, but realistic scenarios, to more rigorously examine metabolic flux control points.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BMB 501. Senior Seminars. 1 Credit Hour.**

Students attend seminars of their own choice, presented by either visiting/residing faculty or graduate/postdoctoral students on recent research topics in BMB or any other discipline in the basic biomedical sciences. Students write short reports on these seminars and critically evaluate the presentations. This course can be taken more than once.

Prerequisite: BMB 401.

**Components:** SEM.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 506. Biomedical Case Studies. 1 Credit Hour.**

Students explore topics in BMB in the context of solving problems presented in a clinical/biomedical framework. Students work in small groups and independently to acquire, critically evaluate, synthesize and present information.

Corequisite or Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 507. Protein Structure, Function and Biology. 3 Credit Hours.**

The physical characteristics and behavior of proteins are described, including structure, folding, dynamics, modifications, and interactions. In addition, experimental approaches to protein structure and function are addressed. Readings include both textbook assignments and current research articles, and a term paper is written and submitted for writing credit.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 509. Molecular Biology of the Gene. 3 Credit Hours.**

Biochemical processes involved in the flow of genetic information in both prokaryotes and eukaryotes are described, including DNA replication, repair, genetic recombination, RNA transcription and processing, protein synthesis, control of gene expression, cell differentiation, and recombinant DNA technology. Extensive classroom discussion is mandatory. Reading includes BMB primary research papers, course notes and a textbook.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BMB 511. Topics in BMB. 3 Credit Hours.**

Students independently explore the literature in BMB with guidance by a BMB Faculty mentor. BMB primary research literature in an area of mutual interest to the student and the Faculty mentor (usually a content expert in that area) is discussed. Students prepare a paper or other appropriate product (e.g. computer software, a structural model, a dynamic simulation) for evaluation. Writing credit is available for papers.

Prerequisite: BMB 401.

**Components:** IND.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 514. Genetics and Genomics: Principles, Mechanisms, and Use. 3 Credit Hours.**

The quantitative and analytical problem solving, as well as spatial reasoning in genetics. The course will propose genetic hypotheses, identify genetic predictions, create genetic systems for challenging these predictions, and analyze genetic data to solve practical problems.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BMB 518. Nanomedicine. 3 Credit Hours.**

Students will learn how various nanomaterials are synthesized, characterized, and utilized in various medical applications, including imaging, drug delivery, gene therapy, and tissue engineering. Student abilities to read and comprehend advanced research topics and applications in nanotechnology and applications to medicine will be considerably enhanced.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BMB 519. Epigenetics and Nutrition. 3 Credit Hours.**

How epigenetic mechanisms control gene expression and (ii) how epigenetic modifications are propagated. Then, students explore how such epigenetic control and inheritance can be modulated through diet and nutrition. Class participation and attendance are required, since in class discussion will be largely based on emerging and late-breaking topics from recent literature.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**BMB 521. Molecular Pathology and Clinical Diagnostics. 3 Credit Hours.**

Basic science principles underlying development, testing, and utilization of biosensors, including various examples of glucose monitoring, immunoassays, and gene expression analyses. Particular attention will be focused towards clinical use and validation. Late-breaking technological aspects of microfluidics will be central to all applications.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**BMB 545. Research Problems in BMB. 3-12 Credit Hours.**

Participation in the research laboratory of a faculty mentor to work on an independent research project. Students develop abilities to formulate good questions and sound hypotheses, design practical experiments, collect and analyze useful data, and make justifiable conclusions. Students maintain a weekly online journal, write a paper, and present their research in the lab. Two semesters of BMB 545 are required to write a thesis (pre-requisite for graduating with honors in BMB).

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**BMB 555. Cellular Structure, Function, and Biology. 3 Credit Hours.**

Students learn composition and function of cellular organelles, and closely examine their biogenic and degradative pathways. Next, students learn cell signaling pathways and mechanisms controlling mitosis, meiosis, and cytokinesis that account for inherited traits. Studies of the molecular basis of cell-cell and cell-matrix interactions provide students with better understanding of tissue stability and function. Modern perspectives regarding stem and cancer cell biology are explored, along with new cell-based therapeutic strategies.

Prerequisite: BMB 401.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.