

## Molecular Biology and Biotechnology Program (BS)

The development of recombinant DNA technology, sometimes referred to as genetic engineering, has radically altered the biomedical sciences. Recombinant DNA techniques have triggered the exponential growth of a new biological field- molecular genetics, or, more generally, molecular biology, which only two decades ago was in its infancy. Fundamental biological problems, untenable only a decade or two ago, are now being addressed using new molecular genetic methods. Recombinant DNA techniques are also revolutionizing disease diagnosis, as genetic bases for cancer, muscular dystrophy, Alzheimer's and other diseases are being discovered and making news almost daily. Applications of recombinant DNA methods, collectively called biotechnology, are yielding new approaches to disease treatment, drug development, forensics, and even the study of evolution.

The Program in Molecular Biology and Biotechnology provides students with a rigorous curriculum designed to prepare them for a career in this exciting and expanding area of biology. Students in this program are exposed to state of the art molecular techniques, and students completing this program will be highly qualified to seek employment at academic, industrial, or government laboratories engaged in molecular biology endeavors, or pursue graduate studies in molecular biology and related fields such as microbiology, immunology, or cell biology.

### Requirements.

- A. At least 40 credits in biology, with no more than 16 below the 300 level, including the biology core sequence of BIO 111, BIO 113, BIO 326, BIO 327, BIO 328, with grades of C- (1.7) or better in all used as prerequisites, and BIO 425, BIO 405/406 (or BIO 435), BIO 467, BIO 468
- B. MTH 120 or equivalent proficiency by examination.
- C. PHY 143 or PHY 243, PHY 145 or PHY 245.
- D. Completion of one of the following concentrations:

#### ***Research Concentration***

1. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450 and CHM 452.
2. Electives, chosen with an advisor may include, but are not limited to, these recommended courses: BIO 301, BIO 491.

#### ***Pre-Medical Concentration***

1. BIO 167, BIO 168, or BIO 432.
2. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450 and CHM 452.
3. HCR 362.
4. PSY 100, PSY 309 (*recommended*) or PSY 316, PSY 315.
5. SOC 100.
6. Electives, chosen with an advisor may include, but are not limited to, these recommended courses: BIO 418, BIO 419, BIO 433, BIO 445, HCR 300, PHS 315, PHL 101, PHL 168, PHL 338, other courses toward the philosophy of neuroethics minor.

### ***Pre-Dental Concentration***

1. BIO 167, BIO 168; BIO 432.
2. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450 and CHM 452.
3. Electives, chosen with an advisor may include, but are not limited to, these recommended courses: BIO 418, BIO 419; BIO 433 or BIO 445.

### ***Pre-Veterinary Concentration***

1. BIO 167, BIO 168; or BIO 432.
2. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450 and CHM 452.
3. NSC 209.
4. Electives, chosen with an advisor may include, but are not limited to, these recommended courses: BIO 408, BIO 418, BIO 419; BIO 421, BIO 431, BIO 433, BIO 455, BIO 484.

### ***Pre-Physical Therapy Concentration***

1. BIO 167, BIO 168; or BIO 432, BIO 433.
2. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450, CHM 452.
3. MTP 320 or MTP 321.
4. PSY 100, PSY 313.
5. PTP 201, PTP 413.
6. BIO 301 (*recommended*) or PSY 322 or SOC 215.
7. Electives, chosen with an advisor may include, but are not limited to, these recommended courses: BIO 447, HCR 300.

### ***Pre-Physician Assistant Concentration***

1. BIO 167, BIO 168; or BIO 432, BIO 445.
  2. CHM 260, CHM 261, CHM 262, CHM 263 or CHM 265, CHM 330, CHM 331, CHM 332, CHM 333; CHM 350, or CHM 450 and CHM 452.
  3. NSC 209.
  4. PSY 100, PSY 313.
  5. BIO 301 (*recommended*) or PSY 322 or SOC 215.
- E. All requirements of the College of Arts and Sciences Bachelor of Science degree, including:
1. General Education requirements.
  2. Completion of a minimum of 124, including at least 33 in upper division courses (numbered 300 or above).
  3. A cumulative grade point average of 2.0 or better in biology and at UM-Flint overall.

Students planning to enter a graduate or professional school should investigate requirements of the specific graduate or professional programs to which they intend to apply to avoid missing requirements beyond those covered in their biology degree.

## Example Curricular Plan for the Molecular Biology and Biotechnology Program

Semester						Credit hrs.
Fall	BIO 111 (4) Organismal Bio.	UNV 100 (3) First-Year Experience.	ENG 111 (3) College Rhetoric	MTH 120 (4) <i>fq</i> Pre-calculus	HCR 101 (1) Physical Fitness	15
Winter	BIO 113 (4) Principles of Bio.	CHM 260 & 261 (4) Inorganic Chem. I	ENG 112 (3) English Comp.	PHY 143 (4) College Physics I		15
Spring						0
Summer		CHM 262 & 263 (4) Inorganic Chem. II				4
Fall	BIO 326 (4) Cell Biology	CHM 330/331 (4) Organic Chem. I	PSY 100 (3) <i>s</i> Principles of Psych.	PHY 145 (4) College Physics II		15
Winter	BIO 328 (4) Genetics	CHM 332/333 (4) Organic Chem. II	General Ed. (3) Social Science	General Ed. (3) Fine Arts		14
Spring			PHL 168 (3) <i>h</i> Bioethics	General Ed. (3) Global Studies		6
Summer						
Fall	BIO 405/406 (4) Microbiology	BIO 467 (4) Molecular Bio. I	General Ed. (3) <i>t</i> Technology	General Ed. (3) Health & Well-Being	HCR 103 (1) Aerobic Conditioning	15
Winter	BIO 327 (4) Ecology	BIO 468 (4) <i>capstone</i> Molecular Bio. II	Elective (3)	COM 210 (3) <i>h</i> Intro Public Speaking		14
Spring						
Summer						
Fall	BIO 453 (4) <i>cap</i> Evolution & Adaptation	CHM 450 (3) Biochemistry I	BIO 301 (4) Biostatistics	BIO 491 (1) Independent Study	HCR 103 (1) Aerobic Conditioning	13
Winter	BIO 425 (3) Immunology	CHM 452 (3) Biochemistry II	Elective (3)	BIO 491 (1) Independent Study	Elective (3)	13
					Total credit hrs.	124

### Biology Courses Referenced in this Program:

**111. Organismal Biology.** (4) *n,nl*. Introduction to basic principles of biology relating to biodiversity. Survey of microorganisms, fungi, plants and animals, including aspects of classification, development, structure (anatomy) and function (physiology). Lecture and laboratory emphasizing guided discovery and critical thinking.

**113. Principles of Biology.** *CHM 140 or equivalent.* (4). Introduction to basic principles of biology relating to cell structure and function, cell reproduction and mechanisms underlying patterns of inheritance, ecology and evolution. Lecture and laboratory emphasizing guided discovery and critical thinking.

**135. Microbiology Basics.** (4) *n*. Elementary treatment of basic microbiological principles. Lecture and laboratory.

**167. Human Anatomy and Physiology I.** *MTH 111 with a grade of C (2.0) or better.* (4). Study of the structure and function of cells, tissues and four human body systems; emphasis on the integumentary, skeletal, muscular, and nervous systems. Lecture and laboratory.

**168. Human Anatomy and Physiology II.** *BIO 167 with a grade of C- or better.* (4) *hw*. Study of the structure and function of the human endocrine, cardiovascular, digestive, excretory, reproductive, and respiratory systems. Lecture and laboratory.

**301. Biostatistics.** *Strong preparation in high school or college algebra and eight credits of biology.* (4). Analysis of quantitative data from biological sources, using basic statistical procedures to elucidate biological phenomena. Mathematical derivations and probabilistic theory not stressed; emphasis on the selection and interpretation of statistical tests commonly used by biologists. Prior knowledge of statistics not necessary. Lecture and discussion. *Also listed as HCR 302.*

**326. Cell Biology.** *BIO 111, 113 with grades of C- (1.7) or better; prior or concurrent election of CHM 262, or grade of C (2.0) or better in CHM 220 or CHM 252; or consent of instructor.* (4) Biological systems from molecular to gross cell structure: such concepts as energy conversion, organization, growth, homeostasis, and cellular interactions. Examples from both animal and plant kingdoms. Lecture and laboratory.

**327. Ecology.** *BIO 111, 113; or consent of instructor. (4)n.* Study of the ecological interactions that determine the distribution and abundance of organisms. Includes evolutionary principles, abiotic and biotic limiting factors, population growth and regulation, community structure and change, and energy flow and nutrient cycling. Lecture and laboratory.

**328. Genetics.** *BIO 111, 113; CHM 140 or its equivalent; or consent of instructor. (4).* Principles of inheritance from molecular through population levels. Gene action, cytoplasmic inheritance, parthenogenesis, mutation, and homeostasis. Lecture and discussion.

**405. Microbiology Lecture.** *BIO 111, 113, 326. BIO 328 highly recommended. (3).* Biology of microorganisms with emphasis on prokaryotes and viruses. Includes microbial anatomy, physiology, growth, genetics, control and medical aspects of host-parasite relationships. Not open to students with credit for BIO 435 without instructor consent.

**406. Microbiology Laboratory.** *BIO 405 with a grade of C- (1.7) or better or concurrent election of BIO 405. (1).* Laboratory study of microbial life, building skills in fundamental microbiological laboratory techniques to include microscopy, aseptic and pure culture techniques, and an introduction to the identification, control and characterization of, as well as applied uses for, microbial species. *Not open to students with credit for BIO 435 without instructor consent.*

**418. Lectures in Histology and Organology.** *BIO 111, 113, 326; concurrent election of BIO 419. (3).* Microscopic structure and function of mammalian cells, tissues, and organs. Lecture.

**419. Histology and Organology Laboratory.** *BIO 111, 113, 326; concurrent election of BIO 418; or consent of instructor. (2).* Identification of mammalian cells, tissues and organs. Laboratory.

**425. Immunology.** *BIO 111, 113, 326, 328; or consent of instructor. (3).* Physiology and chemistry of resistance to infection and responses to foreign biological substances of a potentially harmful nature. Includes natural immunity, antigen-antibody reactions, immunosuppression and tolerance, the complement system, hypersensitivity, immune deficiencies, autoimmunity, and tumor immunology. Applications include serology. Lecture.

**432. Mammalian Physiology.** *BIO 111, 113, 326; or consent of instructor. (4).* Detailed study of organ and organ-system function in mammals; emphasis on human function. Lecture and laboratory.

**433. Premedical Gross Anatomy.** *BIO 167 and BIO 168 with grades of C+ or better; or BIO 432 with a grade of C+ or better; or consent of instructor. Not open to students with credit for BIO 434(5).* Detailed study of the gross structure of the human body. Laboratory involves cadaver dissection. Lecture and laboratory.

**444. Neuroscience.** *BIO 167, BIO 168 with grades of C+ (2.3) or better, or BIO 432 with a grade of C+ (2.3) or better, or PSY 380 with a grade of C+ (2.3) or better; or consent of instructor. (3).* Study of the structure and function of the human nervous system from ion channels to neural pathways. Lecture and laboratory.

**445. Regional Anatomy.** *BIO 167, BIO 168 with grades of C+ (2.3) or better, or BIO 432 with a grade of C+ (2.3) or better, or consent of instructor. (3).* Study of regional human anatomy with emphasis on neurovascular relationships of the head, neck,

thoracic cavity and limbs. Lecture and laboratory involving cadaver dissection.

**453. Evolution and Adaptation.** *BIO 111, 113, 327, 328; or consent of instructor. (3).* Fundamentals of plant and animal evolution. Includes genetics of populations, selection models, geographic variation, adaptation, population structure, mating systems, species concepts, and molecular evolution. Emphasis on evolutionary mechanisms in populations. Lecture.

**477. Biology Senior Seminar.** *Biology major, senior standing; or consent of instructor. (3).* Critical analysis of current biological research. Students learn to communicate biological concepts to other scientists and to the public using written (papers and posters) and oral (presentation) formats.

## Cognate Course Titles:

**CHM 260 Principles of Chemistry I (3)**

**CHM 261 General Chemistry Laboratory (1)**

**CHM 262 Principles of Chemistry II (3)**

**CHM 263 Intro Quantitative Analysis Lab (1)**

**CHM 265 Intro Quantitative Analysis Lab-Honors (1)**

**CHM 330 Organic Chemistry I (3)**

**CHM 331 Organic Chemistry Lab I (1)**

**CHM 332 Organic Chemistry II (3)**

**CHM 333 Organic Chemistry Lab II (1)**

**CHM 350 Fundamentals of Biochemistry (3)**

**CHM 450 Biochemistry I (3)**

**CHM 452 Biochemistry II (3)**

**HCR 362 Cultural Competence in Health Care (3)**

**MTH 120 Pre-Calculus Mathematics (4)**

**MTP 320 Medical Terminology for Health Professionals (2)**

**MTP 321 Introduction to Medical Terminology (1)**

**PHL 101 Intro to Philosophy (3)**

**PHL 168 Philosophy of Bioethics (3)**

**PHL 338 Philosophy of Health, Disease and Illness (3)**

**PHL 344 Philosophy of Medical Ethics (3)**

**PSY 100 Principles of Psychology (3)**

**PSY 309 Abnormal Psychology (3)**

**PSY 313 Developmental Psychology (3)**

**PSY 315 Survey of Social Psychology (3)**

**PSY 316 Biological Psychology (3)**

**PHY 143 College Physics I (4)**

**PHY 145 College Physics II (4)**

**PHY 243 Principles of Physics I (5)**

**PHY 245 Principles of Physics II (5)**

**PTP 201 Intro to Physical Therapy (1)**

**PTP 413 Physiology of Exercise (4)**

**SOC 215 General Statistics (3)**