BIOCHEMISTRY

This degree program is designed to provide the student with an understanding of the structural and functional relationships between the chemical constituents of cells and their roles in life processes. The requirements include courses in biological sciences and chemistry, and appropriate courses in mathematics and physics. The degree in biochemistry prepares a student for careers in industry, medicine, teaching and research.

Dearborn Discovery Core (General Education)

All students must satisfy the University's Dearborn Discovery Core requirements (https://catalog.umd.umich.edu/undergraduate/gen_ed_ddc/), in addition to the requirements for the major. Students must also complete all CASL Degree Requirements. (https://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/)

Prerequisites to the Major

A solid background in mathematics is essential to success in any of the scientific disciplines. Incoming students who intend to choose a major in Biochemistry should have completed at least three years of high school mathematics. First year students should plan to enroll in MATH 105, MATH 115 or MATH 116 based on the results of their math placement tests. The CHEM 134 and CHEM 136 or CHEM 144 and CHEM 146 sequence is a prerequisite to many other courses in the Natural Sciences Department; students should complete this sequence as early as possible.

Code	Title	Credit Hours
BCHM 210	Biochemistry Laboratory Techniques	2
BIOL 130 & BIOL 140	Intro Org and Environ Biology and Intro Molec & Cellular Biology	8
Select one of the following:		8
CHEM 134 & CHEM 136	General Chemistry IA and General Chemistry IIA	
CHEM 144 & CHEM 146	Gen Chemistry IB and General Chemistry IIB	
CHEM 225 & CHEM 226 & CHEM 227	Organic Chemistry I and Organic Chemistry II and Organic Chemistry Laboratory	10
MATH 115 & MATH 116	Calculus I and Calculus II	8
Select one of the following:		8
PHYS 150 & PHYS 151	General Physics I and General Physics II	
PHYS 125 & PHYS 126	Introductory Physics I and Introductory Physics II	
Total Credit Hours		**44**

Major Requirements

Code	Title	Credit Hours
Biochemistry Core		**18**
BCHM/BIOL/ CHEM 470	Biochemistry I	
BCHM/BIOL/ CHEM 471	Biochemistry II	
BCHM/BIOL/ CHEM 472	Biochemistry Laboratory I	
BCHM/BIOL/ CHEM 473	Biochemistry Laboratory II	
BCHM/BIOL 474	Molecular Biology	
BCHM 475	Molecular Biology Laboratory	
Chemistry		**4**
CHEM 368	Physical Chemistry I	
Biochemistry Electives		**8**
Any BCHM upper level courses (excluding BCHM 370, BCHM 495, BCHM 498, and BCHM 499)		
Statistics		**3-4**
Select one of the following:		
STAT 301	Biostatistics I	
STAT 325	Applied Statistics I	
STAT 455	Environmental Statistics	
Total Credit Hours		**33-34**

Notes:

1. A maximum of 65 hrs. in BCHM, BIOL, CHEM may count towards the 120 hours for degree.
2. At least 24 of the 33 upper level hours must be elected at UM-Dearborn.
3. A maximum of 6 hrs. of independent study/research in any Dept. of Natural Sciences discipline may count towards the 120 hours required to graduate.
4. BCHM 370 cannot be used in the major.

Honors Designation in Biochemistry

The Biochemistry program seeks to recognize exceptional biochemistry majors who are exemplary in coursework and productive in research.

Honors in Biochemistry will be earned by meeting all of the following criteria:

- cumulative GPA of 3.5 or higher in Biochemistry courses
- cumulative GPA of 3.3 or higher in all university courses
- completion of a minimum of 6 six credit hours of Independent/ Directed Research (BCHM 495/498/ 499), spread over 2 or more years, under the supervision of one principal investigator, who will serve as thesis advisor. This research must have a biochemical (broadly defined) focus.
- presentation of the research in a public forum (e.g. scientific meeting, College of Arts, Sciences, and Letters (CASL) Research Day, Department of Natural Sciences Poster Day)

- completion of a thesis-like document that thoroughly describes the background, experimental design, methodology and discussion of data generated in the context of the scientific literature.

In order to be considered for Honors in Biochemistry, a student must complete and submit an honors application to the Biochemistry Program committee Chair via his/her advisor no later than the end of the term prior to graduation.

Also see Biochemistry for Medical and Health Professions (https://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/biochemistry-medical-health-professions/) Minor or Integrative Studies Concentration as another option.

Minor or Integrative Studies Concentration Requirements

A minor or concentration consists of 12 credit hours of upper-level courses in biochemistry (BCHM) from the following:

Required: BCHM 370 **or** BCHM 470 **and** BCHM 471

Additional biochemistry (BCHM) courses: 6-9 credits BCHM to equal 12 credits total.

A maximum of 3 credit hours of independent study/research (BCHM 495 ,BCHM 498, or BCHM 499) can be applied to meet the requirements of the minor or concentration.

If BCHM 370 is completed, BCHM 470 and BCHM 471 cannot be used in the minor/concentration. If BCHM 470 and BCHM 471 is completed, BCHM 370 cannot be used in the minor/concentration.

At least 9 of the 12 credits must be elected at UM-Dearborn.

- A minimum GPA of 2.0 is required for the minor/concentration. The GPA is based on all coursework required within the minor (excluding prerequisites).
- The use of transfer credit, field placements, internships, seminars, S/E graded courses, and independent study/research courses is limited to 3 credits in a 12 credit hour minor/concentration and 6 credits in a 15 credit hour and above minor/concentration.
- Courses within a minor/concentration cannot be taken as Pass/Fail (P/F).
- Minors requiring 12 credits may share one course with a major. Minors requiring 15 credits or more may share two courses with a major. This does not apply to concentrations for the Integrative Studies major.

Learning Goals

1. Demonstrate an understanding of the underlying laws of Chemistry, Biology and Physics and their applications to organisms.
2. Demonstrate proficient knowledge of the biochemical reactions that sustain life.
3. Demonstrate an understanding of how biochemical reactions are regulated and integrated, and the flux and exchange of energy and matter between organisms and their surroundings.
4. Understand the biochemical foundations for the unity and the diversity of the living organisms.
5. Understand and employ the methods and techniques of biochemical research.
6. Understand how to analyze, interpret and communicate biochemical data.
7. Possess the skills and knowledge to collaborate with researchers in related and interdisciplinary fields.

BCHM 113 Medicinal and Aromatic Plants in Culture and Practice 3 Credit Hours
Medicinal and aromatic plants have been used for thousands of years to treat illness, create aromatic atmospheres, enhance food flavors, and in ritual ceremonies. Recently, use of plants as alternative therapy has increased in medical practices leading to initiatives to regulate and assess their safety and effectiveness. This course is designed for students interested in health-related careers, food, culture and nutrition. The course explores the history, cultural practices, everyday use, and current research on medicinal and aromatic plants. (YR).
Prerequisite(s): BIOL 130 or BIOL 140 or CHEM 134

BCHM 210 Biochemistry Laboratory Techniques 2 Credit Hours
Biochemical Laboratory Techniques in an introduction to the equipment, procedures, and concepts used in the biochemistry laboratory. The class will cover topics such as scientific literature, keeping a laboratory notebook, statistical analysis and computer programs, as they relate to biochemistry. (W,YR)
Prerequisite(s): (CHEM 134 or CHEM 144) and (CHEM 136 or CHEM 146) and BIOL 140
Restriction(s):
Can enroll if Major is Biochemistry

BCHM 352 Introduction to Toxicology 3 Credit Hours
An introduction to the principles of toxicology with an emphasis on environmental toxicology. Major topics include toxic agents, toxicological mechanisms, and use of toxicological reference literature. Discussion of chemical carcinogenesis, genetic toxicology, immunotoxicology, teratology, and toxic responses of the skin, eyes and nervous system. Three hours lecture. (AY,W).
Prerequisite(s): CHEM 225

BCHM 370 Principles of Biochemistry 4 Credit Hours
A concise yet comprehensive survey of biochemistry designed for non-biochemistry majors. The structure of biological molecules and enzyme - catalyzed events are presented in a eukaryotic cellular context. Topics include the structure of macromolecules, enzymology, bioenergetics, regulation, intermediary metabolism, signaling, and the flow of cellular information from DNA to RNA to proteins. Homeostasis and evolution are overarching concepts. Students cannot take both BCHM 370 and 470 or 471 for any combination of concentration, cognate or minor requirement. Four hours lecture. (F).
Prerequisite(s): BIOL 140 and CHEM 226

BCHM 390 Current Topics in Biochemistry 1 to 3 Credit Hours
Special topics current to the field of biochemistry. Topics and format for the course may vary. See Schedule of Classes for current topic. Permission of instructor. (OC).
Prerequisite(s): (BCHM 370* or BIOL 370* or CHEM 370*) or (BCHM 470* or BIOL 470* or CHEM 470*)

BCHM 404 Mechanisms of Chronic Human Disease 4 Credit Hours
This course focuses on the biochemical, molecular and cellular mechanisms underlying the progression of chronic diseases, such as diabetes mellitus and atherosclerosis. Techniques in epidemiology, pathology, genetics, molecular biology, and biochemistry are used to understand how relevant physiological processes become pathological. The examination of chronic diseases provides an opportunity to understand biological processes across many scales of life, from extracellular matrix proteins to cells in blood vessel walls to risk factors in patient populations to the pharmacology of treatments. Use of primary literature is emphasized. Four hour lecture. (AY).
Prerequisite(s): BIOL 301 or BIOL 306 or BIOL 357 or BCHM 370 or BIOL 370 or CHEM 370 or BCHM 471 or BIOL 471 or CHEM 471
Restriction(s):
Can enroll if Class is Junior or Senior

BCHM 413 Extraction, purification, and characterization of Medicinal and Aromatic Plants 4 Credit Hours
Students will learn the techniques behind essential oil extraction and the biological uses of medicinal plants. Independent work throughout the semester will allow students to grow, extract, and analyze an oil from a medicinal plant of their choosing. Through working in groups, students will collaboratively produce a final product of diffusing oils, candles, or soaps with aromatherapy uses. Uses and case studies throughout the semester will appeal to the pre-health student interested in learning about holistic medicine while manufacturing techniques and discussions will interest scientists with an industrial career outlook. (W).
Prerequisite(s): CHEM 227 and (BCHM 370 or BIOL 370 or CHEM 370 or BCHM 470 or BIOL 470 or CHEM 470)

BCHM 430 Bioinorganic Chemistry 4 Credit Hours
This course examines the roles that metals play in biological systems, including the chemical principles that make metal ions well-suited for roles in protein structure, in redox catalysis and in acid base chemistry. The physical and experimental techniques that are applied to explore the structure and function of metals in natural systems will be introduced using case studies from the primary scientific literature iin the field. BCHM 370 or its quivalent are strongly recommended but not required. (F, AY).
Prerequisite(s): CHEM 136 and BIOL 140

BCHM 470 Biochemistry I 4 Credit Hours
Biochemistry I explores the structure/function relationships of the four major types of biomolecules, including carbohydrates, nucleic acids, and lipids, with an emphasis on proteins and enzyme kinetics. (F).
Prerequisite(s): BIOL 130 and BIOL 140 and CHEM 226

BCHM 471 Biochemistry II 4 Credit Hours
BCHM 471 delves into advanced biochemical processes vital to life. Covering biomolecule structure and function, enzymatic reactions, metabolic pathways, and cellular signaling, the course starts with life's chemical basis and progresses to complex biochemical topics. It emphasizes practical skills like data analysis, problem-solving, and biochemical research techniques. Students undertake a research project on a biochemical disease and an oral presentation on recent biochemical research, enhancing their independent research and communication skills. This course prepares students for advanced academic or professional roles in biochemistry. (W).
Prerequisite(s): BCHM 470 or CHEM 470 or BIOL 470

BCHM 472 Biochemistry Laboratory I 2 Credit Hours
Biochemistry Laboratory I combines a blend of theoretical knowledge and hands-on experience. Students will explore advanced biochemical techniques including chromatography, gel electrophoresis, and spectroscopy. The course also includes molecular biology techniques such as site-directed mutagenesis. Aimed at fostering critical thinking, problem-solving, and scientific communication, BCHM 472 prepares students for advanced roles in biochemistry and medical research, emphasizing the application of laboratory skills to real-world challenges in personalized medicine. (F).
Prerequisite(s): (BIOL 470* or BCHM 470* or CHEM 470*) and BCHM 210

BCHM 473 Biochemistry Laboratory II 2 Credit Hours
This advanced laboratory class further develops experimental skills to examine receptors, ligands, and signal cascades. These cellular factors are critical to metabolic homeostasis, gene regulation and neurochemistry. This course will teach skills and techniques to understand drug development, signaling, biochemical assays, genomics, and ligand binding affinity, specificity, and competition. (W).
Prerequisite(s): (BCHM 471* or BIOL 471* or CHEM 471*) and (BCHM 472 or BIOL 472 or CHEM 472)

BCHM 474 Molecular Biology 4 Credit Hours
This course emphasizes the cellular mechanisms of information flow and regulation from DNA to RNA to proteins in eukaryotes. Topics will include chromatin structure, DNA replication, transcription, RNA modification, regulatory RNA, translation, DNA repair, genetic rearrangement, and genome organization. Experimental design, data interpretation and data analysis are emphasized. Four hours lecture (F). (F).
Prerequisite(s): (BCHM 470 or BIOL 470 or CHEM 470 or BCHM 370 or BIOL 370 or CHEM 370) and CHEM 227

BCHM 475 Molecular Biology Laboratory 2 Credit Hours
This laboratory provides instruction and experience in a variety of molecular biology techniques while performing a semester long project to address a question regarding molecular mechanism. Literature searching and creativity will guide students in designing experiments that together form the project. Skills addressed include experimental design, sample handling and manipulation, instrument use, data analysis, and scientific communication. One hour lecture, three hours laboratory (F).
Prerequisite(s): BCHM 210 or CHEM 227 and (BCHM 474* or BIOL 474*)

BCHM 480 Biochemical Pharmacology 4 Credit Hours
Pharmacology is a study of drugs and medications, and the biochemical and molecular basis of drug action. Pharmacological agents will be emphasized, including drug sources and doses. In additional to traditional drug development and medications, the course will explore nutritional supplements and diagnostic tools which impact therapeutic medication intervention. Different categories of drugs, their use, abuse, and side effects will be presented, including information about nutritional pathways and toxicology. This is a PBL course and requires a collaborative research proposal presentation. Four hours lecture. (OC).
Prerequisite(s): CHEM 370 or BCHM 370 or BIOL 370 or BCHM 470 or CHEM 470 or BIOL 470

BCHM 485 Nutrition and Metabolism 4 Credit Hours
Full Course Title: The Biochemistry of Human Nutrition and Metabolism
Human Nutrition and Metabolism is an introduction to the relationship between food and nutrients, and their integration in the metabolic pathways. An understanding of the molecular basis of nutrition, related diseases, and overall health will be built on previous knowledge of cell biology and biochemistry. (AY)
Prerequisite(s): (BCHM 471 or BIOL 471 or CHEM 471) or (BCHM 370 or BIOL 370 or CHEM 370)

BCHM 490 Topics in Biochemistry 1 to 3 Credit Hours
A course in special topics that examines research problems of current interest in biochemistry. Topics and format may vary. See current Schedule of Classes. One to three hours seminar. (W).

BCHM 495 Off-Campus Research in Biochem 1 to 3 Credit Hours
Participation in ongoing research at an off-campus laboratory. No more than 6 hours combined from any Natural Science courses numbered 495, 498, and 499 may be credited toward the 120 hours required for a degree. Four to twelve hours laboratory. Permission of concentration advisor. (F,W,S).

BCHM 496 Complex Systems 4 Credit Hours
In this course, we delve into the intricate world of biochemistry, exploring how large-scale interactions and nonlinear dynamics lead to self-organization in biological systems. This course extends beyond traditional academic boundaries by integrating the American Society for Biochemistry and Molecular Biology's on-demand resources, providing students with access to contemporary webinars and presentations at the forefront of biochemical research. A significant focus is placed on the vital skills of grant writing and research proposal development, equipping students with the tools necessary for success in the competitive field of scientific research. The course promotes an interactive learning environment through an enhanced peer-review process, encouraging collaborative learning and critical engagement with course materials. Students will apply their theoretical knowledge to practical challenges, designing and proposing original research projects that mirror real-world scientific inquiries. The course not only imparts a profound understanding of complex biochemical systems but also prepares students for the dynamic and evolving landscape of biochemical research. (W, YR).
Prerequisite(s): (BCHM 470 or BIOL 470 or CHEM 470) and (BCHM 471 or BIOL 471 or CHEM 471) and (BCHM 474 or BIOL 474)
Restriction(s):
Can enroll if Class is Senior

BCHM 497 Seminar in Biochemistry 1 Credit Hour
A seminar course that examines research problems of current interest in biochemistry. The course format may include training students to read and present scientific papers, guest lecturers, and lectures by the instructor on a selected topic. One hour seminar. Permission of instructor. (W).
Prerequisite(s): (BCHM 470 or BIOL 470 or CHEM 470) and (BCHM 474 or BIOL 474)

BCHM 498 Directed Reading in Biochem 1 to 3 Credit Hours
Library research in a specific area of biochemistry performed under the direction of a faculty member. No more than six hours combined from departmental courses numbered 495, 498, and 499 may be credited toward the 120 hours required for a degree. Four to twelve hours readings. Permission of instructor. (F,W,S).

BCHM 499 Laboratory Research in Biochem 1 to 3 Credit Hours
Directed laboratory research performed under the supervision of a faculty member. Research training is encouraged. No more than six hours combined from departmental courses numbered 495, 498, and 499 may be credited toward the 120 hours required for graduation. Four to twelve hours laboratory. Permission of instructor. (F,W,S).

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally