

MASTER OF SCIENCE (M.S.) IN MOLECULAR AND CELLULAR BIOLOGY

College: College of Science and Health

Department: Biological Sciences

Student Type: Graduate Semester

Degree: Master of Science (M.S.)

Campus: Lisle Campus

Introduction

Benedictine University's Master of Science in Molecular and Cellular Biology program is a two-year graduate degree program with a full-time curriculum designed for graduates of bachelor's program in Biology and other related sciences. The program provides skills that will improve or broaden abilities in the field and use current technologies to culminate in a Master's degree. Students seeking careers in research, academics or interested in honing their lab skills will be provided valuable and marketable experience. They would benefit from the core courses of our program that will establish the fundamentals of molecular and cellular biology and common techniques, hands-on lab experience with typical and newer techniques, critical analyses of literature in the field, and experience with scientific writing. The program also serves students interested in applying to doctoral programs in biomedical research. Students with diverse interests are encouraged to apply and will be provided with the right tools and a meaningful path to succeed in their future endeavors.

Program Overview

The M.S. in Molecular and Cellular Biology program is part of the Department of Biological Sciences, College of Science and Health. The curriculum will provide students a chance to show their abilities in advanced coursework and lab work suitable for pursuing careers in the field or PhD degrees.

The proposed program is centrally related to the Mission Statement of the institution: "Benedictine University is an inclusive academic community dedicated to teaching and learning, scholarship and service, truth and justice..." The expansion of science offerings with the MSMCB program in biological sciences further develops students in their preparation to serve the scientific community so they can be well-informed citizens and provides them specialized knowledge to advance in the molecular biology arena.

In this program, students will:

- Develop critical thinking and molecular and cellular biology competencies through course and lab experiences
- Demonstrate ability to code for bioinformatics applications and use common molecular biology databases
- Compose written and oral technical communications of molecular and cellular biology
- Apply ethics to current issues in the field.

Students must maintain a "B" average to successfully complete the program.

Recommended Curriculum Planner

| Course | Title | Hours |
|------------------------|---|--------------------|
| First Year | | |
| First Semester | | |
| BIOL 5371 | Molecular Biology ¹ | 3 |
| BIOL 5701 | Advanced Molecular Biology Techniques I ¹ | 3 |
| Elective ² | | 3 |
| | | Hours |
| | | 9 |
| Second Semester | | |
| BIOL 6340 | Advanced Cell Biology ¹ | 3 |
| BIOL 6701 | Advanced Molecular Biology Techniques II ¹ | 3 |
| Elective ² | | 3 |
| | | Hours |
| | | 9 |
| Third Semester | | |
| BIOL 5750 | On Being a Scientist ¹ | 2 |
| | | Hours |
| | | 2 |
| Second Year | | |
| First Semester | | |
| Elective ² | | 3 |
| Elective ² | | 3 |
| | | Hours |
| | | 6 |
| Second Semester | | |
| Elective ² | | 3 |
| BIOL 6720 | Scientific Communications ¹ | 3 |
| | | Hours |
| | | 6 |
| | | Total Hours |
| | | 32 |

¹ Core Course

² One elective **must** be an approved quantitative course. Some electives options include: BIOL 5350 Molecular Pharmacology, BIOL 5372 Genomics and Bioinformatics, BIOL 5347 Medicinal Chemistry, and BIOL 6663 Exercise Pharmacology.

Order and number of elective courses in a semester may be adjusted based on the needs of the student.

Courses

BIOL 5228 Developmental Biology. This course covers the cellular and molecular processes involved in generating an embryo, in creating various tissues and organs, and the effect of external stimuli on development. Topics include: pattern formation, gametogenesis, organogenesis, stem cells, and methods used in studying developmental biology. Laboratory exercises will involve the observation, staging, image analysis, and manipulation of live embryos. Prerequisite is "C" or better in BIOL 2250 and 4340. 4 semester credit hour/s.

Campus: LISLE

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BIOL 5319 Histology. (Formerly 319) The microscopic anatomy of the tissues and organs of vertebrates. Lecture and lab. 4 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5325 Biology of Complex Systems. (Formerly INPH 525) Survey of emergent and organizing principles in complex biological systems modeled as networks. Topics include genome and cellular interaction networks, anatomical networks such as brain and cardiovascular systems, social, linguistic, cultural, and technological networks, and ecological networks. Graph theory and computer software are used to visualize and analyze system properties. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5340 Advanced Integrative Human Physiology I. (Formerly INPH 540) 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5344 Gross Dissection Anatomy. (Formerly 344) Dissection of the human cadaver. Prerequisite: "C" or better in CHEM 1123 and "B" or better in BIOL 3203. 3 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5345 Gross Dissect Anatomy II: Head and Neck. (Formerly INPH 345/545) 3 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5346 Gross Dissect Anatomy III: Lower Body. (Formerly INPH 346/546) 3 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5347 Medicinal Chemistry. (Formerly 347) This course will investigate the role of organic chemistry in the design and mechanism of drugs. The principles of drug discovery, drug development, drug/receptor interactions and structure/activity relationships will be covered. Prerequisite: "C" or better in CHEM 2247. CHEM 4347 is cross-listed with BIOL 5347. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5350 Molecular Pharmacology. A course introducing students to the molecular foundations of drug action with an emphasis on molecular structure-function relationships. Includes receptor-ligand interactions, agonists and antagonists, and signal transduction pathways. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5354 Immunology. (Formerly INPH 554) Includes structural and functional components of the immune system, as well as types and control of immune response. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5355 Molecular Pharmacology. (Formerly INPH 555) A course introducing students to the molecular foundations of drug action with an emphasis on molecular structure-function relationships. Includes receptor-ligand interactions, agonists and antagonists, and signal transduction pathways. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5356 Cellular and Molecular Mechanisms of Human Disease II. (Formerly 356) Mechanisms of human disease that occur in the neurological, endocrine, reproductive hematologic, musculoskeletal and integumentary systems. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5358 Exercise Physiology. (Formerly EXPH/INPH/HLSC 358/558) Provides an in-depth overview of how the body's physiological, hormonal, and biochemical systems acutely and chronically respond to various forms of physical activity and environmental conditions in untrained and trained individuals. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall, Spring, and Summer Terms)

BIOL 5359 Pathophysiology. (Formerly INPH 359/559) Integrates the pathological processes of human disease with those of the normal functioning body. Cellular and organismal disease mechanisms are studied with reference to specific diseases, with opportunity to apply this learning to actual case studies. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5360 Physiological Regulatory Systems: Endocrinology. An integrative study of basic medical endocrinology through case studies and the primary literature. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5368 Biomechanics. (Formerly INPH 568) Principles from the fields of physics, engineering, anatomy and physiology are used to analyze motion of the human body and to describe the forces acting upon the various body segments during normal daily activities. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5369 Neurobiology. (Formerly INPH 569) Introduction to the nervous system including the human brain and its specialized functions. Topics covered include pathophysiology of the brain, how and why psychotic and other drugs affect the nervous system, and how and why memories are formed. 3 semester credit hour/s.

Designation: Writing Intensive Class

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5371 Molecular Biology. (Formerly INPH 571) An advanced study of mechanisms controlling gene and genome organization, expression, regulation, and evolution. Includes viral, prokaryotic, and eukaryotic systems. Exposure to fundamental bioinformatics and programming, and readings from the primary literature. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5372 Genomics and Bioinformatics. (Formerly INPH 572) A survey of the fields of genomics, proteomics, and metabolomics, and systems biology with an emphasis on using bioinformatics resources and understanding the computational and mathematical basis behind many of the tools used for data mining and analysis. Student project involves programming. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5385 Principles of Infectious Disease. Survey of infectious microorganisms and their diseases through team-based case studies. Topics covered throughout the semester include infectious disease epidemiology, clinical presentations, diagnostics, and treatments. Students will focus on primary and secondary literature to interpret their case study files. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5387 Neurophysiology. (Formerly INPH 576) Introduction to the function of nervous systems at the molecular, cellular, and network level. Topics will include the electrical properties of excitable cells, cell-to-cell communication in the nervous system, and network level processing and modulation of neural circuits. Special attention will be paid to current and developing techniques in the field. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5408 Microbiomes. This course explores microbiomes and the link between microbes and their hosts. There will be an introduction on the methodology used to study microbiomes allowing students to use primary literature to discuss and evaluate primary literature investigating the link between microbiomes and host health processes. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5502 Stem Cell Biology. (Formerly 502) Stem cell basic biology, including stem cells, their microenvironment, regulatory control of proliferation/differentiation, clinical applications, FDA regulation, and ethical considerations. 4 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall and Spring Terms)

BIOL 5503 Stem Cell Laboratory. (Formerly 503) Hands-on training with different stem cell platform technologies including minimal HPC processing, "rare event" Flow Cytometry analysis, cell selection and isolation devices, automated cell counting. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall and Spring Terms)

BIOL 5504 Stem Cell Studies. (Formerly 504) Journal readings and discussions for stem cell studies, cell therapy approaches, novel platform technologies, and clinical laboratory applications. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall and Spring Terms)

BIOL 5505 Global Challenges for the Health Services Professional: Using a Critical Reflection Platform. (Formerly INPH 505) Global Challenges for the Health Services Professional: Using a Critical Reflection Platform. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5520 Great Ideas in Physiology. (Formerly INPH 520) A study in the original articles from some of the great physiologists to understand basic concepts and current writings on advances in the field of physiology. Students are exposed to original research publications from various physiological systems. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5521 Clinical Exercise Testing and Prescription I. (Formerly EXPH 521) Laboratory exercise testing and training covering: pre-exercise screening procedures, indications and contraindications for exercise testing, exercise testing procedures and protocols, interpretation of the exercise response. 1 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 5522 Electrocardiography. (Formerly EXPH/HLSC 322) Practice in the measurement and interpretation of the 12-lead ECG normal, changes with disease, changes with exercise and stress testing. Recognition of the most common abnormalities. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 5550 Advanced Integrative Human Physiology II. (Formerly INPH 550) A thorough study of the normal functioning of immune, urinary, digestive, endocrine and reproductive systems. Emphasis is placed on integrative nature of physiology, highlighting the molecular and cellular basis behind normal functions. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5560 Advanced Cardiovascular and Respiratory Physiology. In depth study of the normal functioning of the cardiovascular and respiratory systems. Emphasis is placed on the adaptations that occur as a result of pathology, exercise, and other phenomena. Prerequisite: a human physiology course. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Periodically)

BIOL 5565 Advanced Biochemistry and Metabolism. (Formerly INPH 565) The major metabolic pathways and cellular bioenergetics are discussed. An emphasis is placed upon the chemistry of these processes. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5566 Essential Medical Biochemistry. (Formerly INPH 566) Course will focus on principles of molecular recognition and on the study of human metabolism in health and disease. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5577 Cancer Biology. Classic and modern papers will be used to study experimental methods for analysis of oncogene and tumor suppressor functions in cancer. Particular emphasis will be on DNA repair, cell cycle checkpoints, apoptosis, and signal transduction. Students will be expected to select and discuss primary literature in a seminar setting. 3 semester credit hour/s.

Campus: LISLE

BIOL 5581 Professional Experiences in Clinical Exercise Physiology. (Formerly EXPH/HLSC 381) This course is an introductory course to clinical exercise physiology, related professional organizations, licensure, and certifications. Research designs and library research resources are covered, providing the basis for literature discussion in other courses. Students will gain exposure to the field through observation visits where clinical exercise physiologists are employed, leading to a class presentation and a paper. 1 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term, 1st 8 Weeks)

BIOL 5590 Comprehensive Exam. (Formerly INPH 590) Comprehensive exam is designed to assess the depth and breadth of understanding, synthesis and integration of knowledge, written and oral communications skills of the students acquired through the program. All program class course work must be completed. 1 quarter credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5591 Special Topics. (Formerly INPH 591) Special courses on various topics with which the student has not become acquainted in formal course work. May be an extension of or a supplement to material previously encountered, or lectures from a completely new area. 1-3 semester credit hour/s. Course Repeatable. Maximum number of units allowed: 9.

Campus: LISLE

BIOL 5701 Advanced Molecular Biology Techniques I. Students will learn practical laboratory skills relevant to basic and applied research questions in molecular and cellular biology. Labs will provide practical experience with genomic DNA and cDNA amplification, cloning, and library construction; analysis of genomic polymorphisms; in vitro mutagenesis using CRISPR/Cas9 systems; transformation and expression systems; quantitation and structural analysis of mRNA and regulatory RNAs; conventional and next generation sequencing analysis of genomic and cDNA, including large dataset analysis. Students will work with model microorganisms and learn tissue culture techniques. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 5729 Biostatistics II. This course is a continuation of the fundamentals of biostatistics with the discussion and application of more advanced techniques. Topics will include person-time data analysis, survival analysis topics including Kaplan-Meier estimation, Cox-proportional Hazard models, and censoring, logistic regression and will discuss clinical trials. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 5750 On Being a Scientist. Ethical foundations of scientific practices and some personal and professional issues that researchers encounter in their work. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 6340 Advanced Cell Biology. This course covers structures, processes and systems of eukaryotic cells and tissues. Primary literature will be used to study experimental methods and current understanding of cellular organelles, intracellular traffic, cell-cell communication, cellular responses to environmental/developmental cues (cell cycle regulation, signal transduction, transcriptional response pathways, repair/apoptosis pathways). 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6600 Professional Insights into Health Care Clinical

Experience. (Formerly INPH 600) The Practicum requires observation hours for a specific health care career, along with structured readings and written reflections. The observation is in a variety of clinical sites and/or private practice offices. Students have unique opportunity to be exposed to current advances in therapeutics, including stem cell research. 1-3 semester credit hour/s.

Campus: LISLE

BIOL 6623 Graded Exercise Testing. (Formerly EXPH 623) Consideration of the implication of exercise for persons in rehabilitative programs.

Discussion of performing diagnostic stress testing and understanding the contraindications involved in these actions. Practical Experience conducting exercise tests with ECG monitoring. Prerequisite: BIOL 5522. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 6625 Comprehensive Clinical Exercise Physiology Exit Exam and Skills Examination. (Formerly EXPH 625) Comprehensive written and skills based program exam. This exam will be designed so that students

can demonstrate, prior to graduation, competency in the content requirements of the ACSM Certified Clinical Exercise Physiologist exam. Prerequisites: completion of all first year coursework, co-registration with BIOL 6642. 1 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 6642 Applied Nutritional Physiology w/metabolism. Study of the role of nutrition in chronic disease including CVD, diabetes, hypertension, obesity, and systemic inflammation. Coverage of endocrine regulation of fuel turnover with particular reference to exercise, diabetes and obesity. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 6662 Advanced Exercise Physiology. (Formerly EXPH 662)

Advanced topics in 1) musculoskeletal system, 2) cardiopulmonary function, 3) Nervous system and neuromuscular function, 4) macronutrient metabolism, 5) endocrine and immune systems, 6) integrated exercise responses, and 7) environmental exercise physiology. Prerequisite: BIOL 5521, BIOL 5358 or equivalent. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Fall Term)

BIOL 6663 Exercise Pharmacology. (Formerly EXPH 663)

Pharmacokinetics and pharmacodynamics of commonly prescribed drugs (e.g., antibiotics/antivirals, anti-inflammatory drugs, pain medications, muscle relaxers, asthma medications, antihistamines, GI tract medications, hypertension and heart disease medications, antipsychotic medications, diabetes medication). Emphasis on current use of therapeutic drugs and their effects on the various systems and risk factors involved in the exercise state. Prerequisite: BIOL 6623, co-registration in BIOL 5359. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6664 Clinical Exercise Testing and Prescription II. (Formerly EXPH 664) Exercise prescription for clinical diseases or conditions

(e.g., cardiovascular, pulmonary, obesity/metabolic, orthopedic/musculoskeletal, neoplastic, frailty, neuromuscular). Prerequisite: BIOL 5521, co-registration in BIOL 5359. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6681 Behavior Modification. (Formerly EXPH 681) Application of current approaches to modifying health impaired habits, lifestyles and beliefs including stress theories of disease, health behavior change and techniques of stress management. 2 semester credit hour/s.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 6690 Internship I. (Formerly EXPH 690) Practical experience in exercise physiology in various settings such as hospitals and rehabilitation centers under the supervision of an experienced on site professional. Internships available in wellness/fitness, rehabilitation, diagnostics or research. Prerequisite: BIOL 6662, BIOL 6623, co-registration in BIOL 5359. 1-2 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6691 Selected Topics. (Formerly EXPH 691) Special courses on various topics with which the student has not become acquainted in formal course work. May be an extension of or a supplement to material previously encountered, lectures from a completely new area, or independent study. 1-3 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Periodically)

BIOL 6692 Internship II. (Formerly EXPH 692) Practical experience in exercise physiology in various settings such as hospitals, and rehabilitation centers, under the supervision of an experienced on site professional. Internships available in wellness/fitness, rehabilitation, diagnostics or research. 3 semester credit hour/s. Department Consent Required.

Campus: LISLE (Typically Offered: Summer Term)

BIOL 6701 Advanced Molecular Biology Techniques II. Students will continue developing practical laboratory skills with emphasis on protein expression and cellular responses. Methods will include inducible protein expression and purification systems (native and fusion proteins; immunoprecipitation and tagged protein purification systems); Western and ELISA analysis of protein expression levels and modifications; mobility shift and supershift assays; protein expression in tissue culture cells, with emphasis on growth rates, cell migration assays, and flow cytometry analysis of cell cycle/apoptosis states; immunofluorescence analysis of cellular responses to protein expression, DNA damage, genomic demethylation, and ribosylation inhibition. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6720 Scientific Communications. Participants will hone essential skills in scientific writing and public presentations for professional and lay audiences. Students will practice reading and presenting primary literature in molecular biology, giving scientific platform talks for fellow students with various backgrounds, giving mock press interviews, preparing publication-quality manuscripts, posters, and grant proposals. 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

BIOL 6790 Research Experience. Practical experience in a research laboratory utilizing molecular biology, bioinformatics, or cellular biology techniques in a project. Research may be on site or at another approved institution. Prerequisite: BIOL 5701 1-3 semester credit hour/s. Course Repeatable. Maximum number of units allowed: 5.

Campus: LISLE (Typically Offered: Periodically)

BIOL 6799 Thesis. Culmination of dedicated research on a project approved by committee that demonstrates proficiency in techniques associated with molecular biology, bioinformatics, and/or cellular biology in addition to critical analyses of a research project. Students will disseminate work in both written and oral forms. A thesis defense of the work will be evaluated by a committee. Prerequisite: BIOL 6701 3 semester credit hour/s.

Campus: LISLE (Typically Offered: Spring Term)

Faculty Faculty

Preston Aldrich (2004), Ph.D.

Biological Sciences

Professor, Biological Sciences - MCB

Ph.D., 1997, Botany, University of Georgia, Athens

M.S., 1991, Botany, University of Minnesota, St. Paul

B.A., 1987, Chemistry, St. Olaf College

James Fackenthal (2017), Ph.D.

Biological Sciences

Associate Professor, Biological Sciences - MCB

Ph.D., 1993, Molecular, Cellular, and Developmental Biology, Indiana University

B.S. 1983, Biology-Geology, University of Rochester

Leigh Anne Harden (2015), Ph.D.

Biological Sciences

Associate Professor, Biological Sciences - MCB

Ph.D. 2013, Marine Biology, University of North Carolina Wilmington

B.S. 2007, Biology, Davidson College

Cheryl Heinz (2004), Ph.D.

Department Chair, Biological Sciences

Associate Professor, Biological Sciences - MCB

Ph.D., 2002, Entomology, Cornell University

B.S., 1993, Honors Biology, University of Illinois at Urbana

Mark Poch (2013), Ph.D.

Biological Sciences

Associate Professor, Biological Sciences - MCB

Ph. D. 1990 Biochemistry, Rush University, IL

B.A. 1984, Biology, Ripon College, WI

Jayashree Sarathy (2010), Ph.D.

Director of Graduate Programs, Biological Sciences

Professor, Biological Sciences - MCB

Ph.D. 1999, Physiology, University of Illinois at Chicago

M.Phil. 1991, University of Madras, India

M.S. 1990, University of Madras, India

B.S. 1988, University of Madras, India

Lee Ann Smith (2004), Ph.D.

Biological Sciences

Professor, Biological Sciences - MCB

Ph.D. 2004, Biomedical Science, University of Connecticut Health Center

B.S. 1997 Biochemistry, Benedictine University