# HEALTH SCIENCES

## Graduate Programs

- Biomedical Sciences (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/)
  - Biochemistry and Molecular Biology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/biochemistry-molecular-biology-ms/)
  - Biochemistry, Molecular and Cancer Biology (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/biochemistry-molecular-biology-phd/)
  - Biochemistry and Molecular Biology (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/biochemistry-molecular-biology-md-phd/)
  - Cell and Molecular Physiology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/cell-molecular-physiology-ms/)
  - Cell and Molecular Physiology (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/cell-molecular-physiology-phd/)
  - Cell and Molecular Physiology (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/cell-molecular-physiology-md-phd/)
  - Cellular and Molecular Oncology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/cellular-molecular-oncology-ms/)
  - Clinical and Applied Proteomics (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/clinical-applied-proteomics-ms/)
  - Health Professions Education (MHPE) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/master-health-professions-education/)
  - Health Professions Leadership and Education Certificate (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/health-professions-leadership-education-certificate/)
  - Infectious Disease and Immunology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/infectious-disease-immunology-ms/)
  - Integrative Cell Biology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/integrative-cell-biology-ms/)
  - Integrative Cell Biology (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/integrative-cell-biology-phd/)
  - Integrative Cell Biology (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/integrative-cell-biology-md-phd/)
  - Medical Physiology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/medical-physiology-msmp/)
  - Microbiology and Immunology (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/microbiology-immunology-ms/)
  - Microbiology and Immunology (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/microbiology-immunology-phd/)
  - Microbiology and Immunology (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/microbiology-immunology-md-phd/)
  - Molecular Pharmacology and Therapeutics (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/molecular-pharmacology-therapeutics-ms/)
  - Molecular Pharmacology and Therapeutics (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/molecular-pharmacology-therapeutics-phd/)
  - Molecular Pharmacology and Therapeutics (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/molecular-pharmacology-and-therapeutics-md-phd/)
  - Neuroscience (MS) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/neuroscience-ms/)
  - Neuroscience (PhD) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/neuroscience-phd/)
  - Neuroscience (MD/PhD) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/neuroscience-md-phd/)
  - Pharmacology/Business (MS/MBA) (https://catalog.luc.edu/graduate-professional/dual-degree-programs/pharmacologybusiness-ms-mba/)
  - Pharmacovigilance Certificate (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/biomedical-sciences/pharmacovigilance-certificate/)
- Neiswanger Institute of Bioethics and Healthcare Leadership (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/)
  - Bioethics and Health Policy (DBe) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/bioethics-dbe/)
  - Bioethics and Health Policy (MA) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/bioethics-health-policy-ma/)
  - Bioethics and Health Policy Certificate (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/bioethics-health-policy-certificate/)
  - Healthcare Mission Leadership (DHCML) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/healthcare-mission-leadership-dhcml/)
  - Healthcare Mission Leadership (MA) (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/healthcare-mission-leadership-ma/)
  - Healthcare Mission Leadership Certificate (https://catalog.luc.edu/graduate-professional/graduate-school/health-sciences/neiswanger-institute-bioethics/healthcare-mission-leadership-certificate/)

# Graduate & Professional Standards and Regulations

Students in graduate and professional programs can find their Academic Policies in Graduate and Professional Academic Standards and Regulations (https://catalog.luc.edu/academic-standards-regulations/graduate-professional/) under their school. Any additional University Policies supersede school policies.

# Biochemistry & Molecular Biology (BMB)

**BMB 400 Special Topics: Molecular Biology (1-3 Credit Hours)**
Courses of half a semester to a semester on different topics of molecular biology, treated in depth with readings of the current literature.
*Outcomes:*
To learn about diverse areas of Molecular Biology which are not treated in regular courses

**BMB 417 Molecular Biology (3 Credit Hours)**
The Biochemistry and Molecular Biology course will cover diverse subjects of importance to modern cell an organismal biology from a molecular biology perspective.

**BMB 471 Comp Molecular Genetics (3 Credit Hours)**
This course introduces advanced students to the importance of genetics to a wide range of biological problems.
*Outcomes:*
Students will demonstrate an ability to read, think, write, and speak critically about various genetic approaches used to identify essential genes, mutagenesis and recombination, transcription, development, symbiosis, and pathogenesis

**BMB 490 Special Topics in Molecular Biology (1-3 Credit Hours)**
This course covers a specific topic in molecular biology. The topics can vary among different special topics courses.

**BMB 499 Research in Molecular Biology (1-9 Credit Hours)**
The students do mentored work in a laboratory on a research project. Their performance is evaluated by their mentor at the end of the year, and is given a pass/not pass grade.
*Outcomes:*
To develop the ability to organize a research project proposing hypotheses and testing them in the laboratory and against the current literature

**BMB 501 Molecular Biology Journal Club (0-1 Credit Hours)**
This is a weekly course where students take turns to present a scientific paper. Following the presentation there is a discussion by students and faculty. Students prepare the presentation under the supervision of a faculty mentor.
*Outcomes:*
To develop the ability to read and analyze a scientific paper and to develop oral presentation skills and appropriate visual aids

**BMB 502 Seminar in Molecular Biology (0 Credit Hours)**
Biweekly seminars where invited speakers from outside the institution present their work. The presentation is followed by a discussion by students and faculty.
*Outcomes:*
To become familiar with current research in different molecular biology areas by listening to the actual scientist developing the work

**BMB 524 Molecular Biology & Genetics of Development (2 Credit Hours)**
This is a weekly course on Molecular aspects of Developmental Biology, with a mixture of lectures, discussions of original papers and presentations by external speakers.
*Course equivalencies:* X-BICH524/MBIO524
*Outcomes:*
An understanding of the principles of developmental biology with emphasis in the molecular genetics of development

**BMB 526 DNA Repair & Recombination (2 Credit Hours)**
This is a weekly course on mechanisms of mutagenesis, genetic repair and recombination. The course uses a mixture of lectures and discussions of original scientific papers.
*Course equivalencies:* X-MBIO526/BICH526
*Outcomes:*
An understanding of the basic mechanisms of mutagenesis, genetic repair, homologous recombination, and non-homologous end joining

**BMB 590 Molecular Biology of Oncogenesis (3 Credit Hours)**
The course will cover different subjects in cancer molecular biology with a combination of lectures and discussions of original scientific papers.
*Outcomes:*
A basic knowledge about mechanisms of oncogenesis and the biology of cancer, and an ability to search and understand the classic as well as modern literature on the subject

**BMB 595 Thesis Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the masters of science thesis and degree.

**BMB 600 Dissertation Supervision (0 Credit Hours)**
The students work on their dissertation under the supervision of their mentor and of their dissertation committee. Their progress is evaluated by their mentor and is given a letter grade.
*Outcomes:*
Development of the dissertation project, writing and defense of the dissertation

# Bioethics & Healthcare Leadership (BEHL)

**BEHL 401 Clinical Topics in Bioethics (3 Credit Hours)**
This course will provide an overview of the major areas of clinical biomedical ethics. Issues will be examined and analyzed including problem-solving, theory and practice, end-of-life decision making, etc. Extensive use of case discussion and analysis will help to develop participants' ethical problem-solving skills.
*Course equivalencies:* IPS 651/BEHP 401/BEHL 401
*Outcomes:*
Participants will gain familiarity with terminology, resources, and major frameworks of ethical analysis in biomedical ethics

**BEHL 402 Justice & Health Care (3 Credit Hours)**
This course provides an overview of justice and health care with a special emphasis upon the developing world by examining prevailing theoretical frameworks and how justice is played out in various health care systems.
*Outcomes:*
Participants will gain a better understanding of what justice means with regard to health care

**BEHL 403 Ethics Care Continuum (3 Credit Hours)**
This course prepares students to identify biomedical ethical issues in settings such as long-term care, rehabilitation care, mental health, and hospice, and to develop moral frameworks for addressing these issues.
*Outcomes:*
Participants will be able to analyze cases and issues regarding health-care delivery and adapt principle frameworks of biomedical ethics to these settings

**BEHL 404 Biomedical Ethics and Law (3 Credit Hours)**
This course serves as an introduction to biomedical ethics and the law and will introduce the history of bioethics and the US legal system by surveying a number of seminal legal cases.
*Outcomes:*
Participants will have a better understanding of how bioethics has been shaping legal decisions and legislation throughout history

**BEHL 405 Research Ethics (3 Credit Hours)**
This interactive seminar will explore the responsible conduct of science with a focus on ethical issues in clinical research involving human participants. We will review federal research policies related to investigator responsibilities and institutional review board (IRB) function.
*Outcomes:*
Students will become familiar with the history, terminology, and resources of research ethics as well as key debates that have occurred/are occurring in the research ethics literature

**BEHL 406 Principles of Health Care Ethics (3 Credit Hours)**
This course provides an overview of important ethical theories in bioethics. We will mainly examine major works in the field by leading bioethics scholars to become better familiar with different approaches in the field.
*Outcomes:*
Students should be able to identify and analyze ethical theories and become familiar with various ethical approaches

**BEHL 407 Social Determinants of Health and Bioethics (3 Credit Hours)**
This course will review the theoretical work on social science (anthropology, sociology) and moral reasoning as it pertains to the discipline of bioethics, its philosophical roots, and the body of social science works in bioethics.
*Outcomes:*
Students will learn how to use the technique of self-reflexivity to understand cultural values

**BEHL 408 Ethics, Genetics and Health Policy (3 Credit Hours)**
This course will provide an introduction to genetic ethics and a survey of topics that constitute the professional and popular literature in the field. Topics to be considered include, but are not limited to, gene patenting, human cloning, and race and genetics.
*Outcomes:*
Students will have an understanding of ethical questions that genetic technological advances pose to our understanding of human identity and social justice

**BEHL 409 Religion and Bioethics (3 Credit Hours)**
This course is a thematic exploration of religion and bioethics with a specific concentration on its implications at the end of life.
*Outcomes:*
Students will better understanding of suffering and death, and meaning that underlie these issues in bioethics, and the practice of healthcare at the end of life

**BEHL 410 Ethics Consultation Simulation Seminar (1-3 Credit Hours)**
This is a two-month course of online learning (June-July) including a 3-day on-campus intensive experience for students including didactic sessions and ethics consultation skills development.
*Outcomes:*
Students will improve communication and interaction skills while doing ethics consultation

**BEHL 411 Systems Ethics Frameworks (3 Credit Hours)**
The course introduces current ethical issues in public health research, practice, and policy. Public health frameworks and approaches will be used to explore prevention, social justice, and health equity.
*Outcomes:*
Participants will be familiar with key readings, ethical frameworks, and practical tools for assessing public health challenges

**BEHL 412 Organizational Ethics I: Business, Professionalism, and Justice (3 Credit Hours)**
This course examines ethical issues in health care from the vantage point of decision makers who shape the system, e.g., physicians within a group practice, administrators within a health system, or advocates within a community.
*Course equivalencies:* IPS 652/BEHP 412/BEHL 412
*Outcomes:*
Participants will understand responsibilities social justice entails to self, one's profession, various institutions which a healthcare profession is a member, one's patients, and the underserved

**BEHL 413 History of Medicine and Bioethics (3 Credit Hours)**
This course seeks to situate and examine the emergence and development of the field of bioethics within the history of medicine and the ethical concerns embodied in medicine¿s practice.
*Outcomes:*
Participants will have an understanding of how bioethics emerged within the broader history of medicine and and continues today as a distinct discipline

**BEHL 414 Moral Theology for Bioethics (3 Credit Hours)**
This course provides an introduction to Catholic moral theology through a historical review of its development and a consideration of key documents, events, arguments and concepts beginning with the scriptural witness of Christ and concluding with the moral teaching of John Paul II as it bears upon contemporary Catholic moral theology.
*Outcomes:*
Its goal is to assist in establishing an historical and theoretical foundation for those who are interested in bioethics as it is considered and practiced in the Catholic tradition

**BEHL 415 Ethical & Religious Directives for Catholic Healthcare Leadership (3 Credit Hours)**
This course offers a topical survey of bioethical issues pertinent to clinical practice in the Catholic context. The United States Conference of Catholic Bishops' document, Ethical and Religious directives for Catholic Health Care Services, 5th Edition, serves as the guiding document of the course. Topics and concepts considered include abortion, contraception, sterilization, nutrition and hydration, withdrawal of life support, care of the dying, cooperation, conscience, human dignity and personhood.
*Course equivalencies:* IPS 654/BEHP 415/BEHL415
*Outcomes:*
This course aims to assist students in establishing a substantive familiarity with the positions and moral reasoning of the Catholic tradition in clinical bioethics through a consideration of Church documents, scholarly texts and articles and formative debates within contemporary Catholic bioethics

**BEHL 416 Catholic Bioethics and Social Justice (3 Credit Hours)**
This course involves an historical study of the development of the body of official Catholic Social Teaching (CST) specific to its impact on healthcare delivery in the United States. Current developments in select key social issues and movements are also addressed insofar as those issues and movements influenced healthcare delivery. The pastoral letters of the U.S. Bishops, especially their teachings on healthcare reform, also receive attention. The interface between religious faith and public policy debates is a constant concern throughout the course. Practical strategies for fostering a social justice consciousness in healthcare settings are also considered.
*Course equivalencies:* IPS 655/BEHP 416/BEHL 416
*Outcomes:*
Extensive use of case discussion and analysis will help to develop the participants' understanding of the principles of CST and their application to the healthcare context

**BEHL 417 Narrative Ethics (3 Credit Hours)**
This course will consider a major theoretical framework in bioethics that has emerged as a serious alternative to principle-based bioethics. In this course, students will gain an understanding of what narrative bioethics is, read theoretical texts related to narrative ethics, and also read a variety of narratives that relate to medicine and health care (stories, films, etc). The role of narrative in the ethics consultation process will also be explored.
*Outcomes:*
This course aims to equip students with a sophisticated understanding of narrative and the role it plays in medicine and bioethics

**BEHL 418 Advancing Health Equity Practice (3 Credit Hours)**
This course introduces the frameworks and practice of health equity as it pertains to the field of bioethics. The tools and materials help students more effectively incorporate health equity into all aspects of their work. Topics include: community health, multi-sector community engagement, and innovative approaches to clinical and community work to improve populations health.
*Course equivalencies:* IPS 656/BEHP 418 / BEHL 418
*Outcomes:*
Effectively incorporate health equity into all aspects of bioethics practice

**BEHL 419 Organizational Ethics II: Ethical Leadership Changing Healthcare Envrnmnt (3 Credit Hours)**
This course examines the theory, role, and elements of leadership that effectively serve non-profit healthcare systems. In particular, the nature of leadership is examined. Questions of leadership style and theories of what constitutes effective leadership are considered.
*Course equivalencies:* IPS 653/BEHP 419/BEHL 419
*Outcomes:*
Key focus on communication strategies and methods of organizational change

**BEHL 420 Advanced Topics in Bioethics and Law (3 Credit Hours)**
This class will explore the historical relationship between law and bioethics and examine how law and bioethics come together or may be at odds. Recognize/discuss changing nature of physician-patient relationship, continuing evolution of informed consent, intersection of commerce and science, changing definition of death, growing complexity of reproduction.
*Outcomes:*
Resolve dilemmas raised by changing biotechnology

**BEHL 421 Practicum in Clinical Ethics (3 Credit Hours)**
*Pre-requisites:* Department Consent Required
The goal of the clinical ethics practicum is to provide doctoral students on the clinical ethics track the opportunity to use knowledge and skills acquired in the academic program in a clinical setting (e.g. community hospital or academic medical center), under the direction of a preceptor at that setting.
*Outcomes:*
This practicum will expose students to the practical applications of clinical ethics

**BEHL 422 Practicum in Organizational/Public Health Ethics (3 Credit Hours)**
*Pre-requisites:* BEHL 419
The practicum will enable the student to work on a project which translates both general and discipline-specific information into organizational ethics or public health practice. Students must demonstrate the capacity to utilize knowledge and make evidence-based decisions regarding these topics, and exhibit leadership, creativity, and the ability to work well with others.
*Outcomes:*
Goal of the practicum is to provide students the opportunity to use knowledge and skills acquired in the academic program in a professional setting under the direction of a preceptor

**BEHL 423 Doctoral Capstone I (3 Credit Hours)**
*Pre-requisites:* Oral and Written Qualifying Exams
This course is an opportunity for doctoral students in our program to further develop a paper from their practicum experience and/or another course and revise it into a manuscript of publishable quality.
*Outcomes:*
Publishable peer-reviewed paper

**BEHL 424 Doctoral Capstone II (3 Credit Hours)**
*Pre-requisites:* BEHL 423
This course is an opportunity for doctoral students in our program to further develop a paper from their practicum experience and/or another course and revise it into a manuscript of publishable quality.
*Outcomes:*
Students will be required to appear on campus for a capstone presentation with faculty

**BEHL 425 Empirical Bioethics (3 Credit Hours)**
Provides an overview of empirical research in the increasingly interdisciplinary field of bioethics. Will examine the relationship between empirical data and normative claims and potential pitfalls that may arise when using information about what (is) to determine what (ought) to be done.
*Outcomes:*
Students will gain familiarity with the range of quantitative and qualitative research methods used in bioethics as well as academic disciplines, understanding of empirical studies on ethical problems in medicine, public health policy, and clinical research; Discussions will be relevant to a range of professional settings

**BEHL 426 Ignatian Spirituality and Medicine (3 Credit Hours)**
This course in will explore the roots of Ignatian Spirituality as presented in the Spiritual Exercise and other writings of Ignatius Loyola and the early Jesuits. From this historical starting point, the course will shift to explore key themes that have emerged from this spiritual tradition as it relates to medicine, paying special attention to the Spiritual Exercises.
*Outcomes:*
This course aims to assist students in establishing a substantive understanding of Ignatian spirituality and the tradition of Jesuit education in which they participate as a means for leading faithful, joyful, and hopeful lives as physicians

**BEHL 427 Professionalism and Professional Ethics (3 Credit Hours)**
This course will review and critically examine the professional codes of ethics of a variety of health-related professions: medicine, nursing, dentistry, social work, chaplaincy, risk management, and allied health. We will examine the growth of professionalism as a movement and answer questions related to this topic.
*Outcomes:*
Understand what is a profession, what are professional ethics; Difference between common morality and professional ethics, and difference between applied ethics and professional ethics; We will also discuss whether a pan-professional ethics code is needed for the health care professions

**BEHL 428 Writing and Scholarship Skills (3 Credit Hours)**
Writing skills are an essential form of communication not only between the instructor and students but also among and between the students themselves. Topics covered: Academic Integrity; Grammar; Resource Development/Citation; Clarity/Formality; Development of a Thesis and Writing of a Thesis Statement; Organization and Outlining; Critical Thinking/ Analysis/Reasoning; and Development of a Conclusion.
*Outcomes:*
This course will provide a review of basic writing skills as well help students develop analytical and communication skills that are critical to scholarly writing in the multidisciplinary field of bioethics

**BEHL 429 Pediatric Ethics (3 Credit Hours)**
This course will introduce ethical topics in the areas of pediatric medicine and research. Topics to be addressed may include decision making, neonatal issues, teens and decisional authority, research with minors.
*Outcomes:*
Discover aspects of the pediatric population that raise unique concerns, create novel moral environments, and thus require nuanced and sensitive attention to and tools of ethical inquiry

**BEHL 430 Advanced Clinical Ethics Skills (3 Credit Hours)**
*Pre-requisites:* BEHL 410 Ethics Consult Simulation Seminar
Two-month blended course of online learning and two-day intensive experience on Health Sciences Campus in Maywood. Course provides an opportunity for advanced graduate students to improve and refine clinical ethics skills. Participants will practice consultation skills, evaluate performance of others, and receive feedback from faculty reviewers.
*Outcomes:*
Students will develop their own portfolio for quality attestation

**BEHL 431 Current Debates in Research Ethics (3 Credit Hours)**
*Pre-requisites:* BEHL 405 or permission from instructor
This course will focus on unique ethical issues that arise in research with special populations. Included but not limited to children; women, fetuses, and embryos; prisoners; indigenous and racial/ethnic minority communities; healthy volunteers. Research in emergency and international settings as well as research at the end-of-life will be discussed.
*Outcomes:*
Material covered in this course will be relevant for ethicists, IRB members, and clinical investigators

**BEHL 432 Global Bioethics (3 Credit Hours)**
This course will survey major topics in global bioethics. Students will be introduced to global bioethics frameworks, practices, and governance bodies in order to place bioethical problems in a global context. Attention will be given to how the global realities of health disparities and neoliberal economic policies impact bioethical questions. Guest lecturers will share experiences working in clinical ethics, public health, social justice, health care policy, and research across the globe.
*Outcomes:*
Students will gain knowledge regarding clinical ethics, public health, social justice, health care policy, and research across the globe

**BEHL 433 Mastering Clinical Ethics Consultation (3 Credit Hours)**
*Pre-requisites:* BEHL 410 and BEHL 430
This 2 week on-campus course provides an opportunity for advanced bioethics doctoral students in the clinical ethics concentration to refine their clinical ethics skills to a mastery level. Students will participate in simulated ethics consultations, practice communication and interpersonal skills and receive feedback on their performance. With access to LUHS, students will participate in clinical rounds, case discussions, and active ethics consultations and debriefing sessions. This course will require students to reach a predefined mastery level of skill in simulated ethics case consultations using the Assessing Clinical Ethics Skills (ACES) evaluation tool. They will also be required to write chart notes for ethics consultations.
*Outcomes:*
Students will achieve mastery of clinical ethics consultation skills, written chart notes, and improve communication and interpersonal skills

**BEHL 434 Oral Health Ethics (3 Credit Hours)**
According to the CDC, "Oral health affects our ability to speak, smile, eat, and show emotions. It also affects self-esteem, school performance, and attendance at work and school. Oral diseases - which range from cavities to gum disease to oral cancer - cause pain and disability for millions of Americans." As with other areas of healthcare, ethical issues arise in oral health. Issues to be addressed in this course will include access to care, confidentiality, professional obligations of dentists, informed consent, treatment planning, and the importance of oral health to overall health and well-being.
*Outcomes:*
Participants will have a better understanding of ethical issues that arise within oral health care

**BEHL 491 Special Topics (1-3 Credit Hours)**
Provides an opportunity to introduce new courses.

**BEHL 492 Master's Research - Capstone (3 Credit Hours)**
The capstone course is the final course which provides an opportunity for the student to develop a paper of publishable quality.

**BEHL 493 Independent Study (1-3 Credit Hours)**
This course will provide students with a broad introduction to the history and role of mission leadership in Catholic health care and will introduce students to the five main competency areas: theology/ministry, spirituality, ethics, organizational management/finance, and leadership. Guest faculty lecturers will share experiences working in mission integration in Catholic health care.
*Outcomes:*
Students will be introduced to the CHA "Competencies for Health Care Mission Leadership" in order to understand the scope of the position and how the various competency areas interact

**BEHL 500 Introduction to Healthcare Mission Leadership (3 Credit Hours)**
This course will provide students with a broad introduction to the history and role of mission leadership in Catholic health care and will introduce students to the five main competency areas: theology/ministry, spirituality, ethics, organizational management/finance, and leadership. Guest faculty lecturers will share experiences working in mission integration in Catholic health care.
*Outcomes:*
Students will be introduced to the CHA "Competencies for Health Care Mission Leadership" in order to understand the scope of the position and how the various competency areas interact

**BEHL 501 Church and Mission (3 Credit Hours)**
In the 21st century the Church is a concept best understood within a global context. We will explore the biblical and apostolic concept of Church progressing through Vatican II. We will also examine the four marks of the Church from both historical and contemporary perspectives.
*Course equivalencies:* X -IPS 402/ BEHL 501
*Outcomes:*
Articulate a vision of Church, evaluate and critique different ecclesiologies, and understand the development and structure of the Church from biblical times through Vatican II and contemporary times

**BEHL 502 Christian Doctrine (3 Credit Hours)**
This course surveys the historical evolution of Christian doctrine and its theological interpretations from the early church through the 21st century. It assists students in understanding how theological doctrines apply to contemporary ministry contexts, particularly the work of Catholic health care. The course explores the early Christological controversies, the Trinity, Grace, liberationist theologies, and the role of dialogue as a fundamental feature of the development of doctrine.
*Outcomes:*
Students will understand theological doctrine and apply to contemporary ministry contexts in Catholic health care

**BEHL 503 Foundations of Christian Spirituality (3 Credit Hours)**
Christian spirituality (the 'lived experience of Christian faith') is a separate but partnered academic field with theology today. Key issues are: defining 'spirituality', methods in the field, spirituality vs. institutional religion, Jesus Christ (christology), major figures and movements in Christian spirituality's 2000 year history, and classical and contemporary themes.
*Course equivalencies:* X -IPS 545 / BEHL 503
*Outcomes:*
Facility defining spirituality and Christian spirituality, and an informed understanding of the person Jesus Christ, the history of Christian spirituality, and the relationship of spirituality to theology and institutional religion

**BEHL 504 Spiritual Paths in World Religions (3 Credit Hours)**
This course explores the spirituality, theology, and practice of the major religious traditions. You will encounter other faith traditions by entering into their sacred prayer and worship experiences and learning from practitioners of that tradition how they encounter the sacred in their own lives.
*Course equivalencies:* X -IPS 403/BEHL 504
*Outcomes:*
Recognize the vast complexity of every religious tradition, resisting the urge to oversimplify; Engage those who practice other traditions in conversation; Experience the spiritual practice of other religious traditions

**BEHL 505 Advanced Concepts in Health Systems Management (3 Credit Hours)**
The course is structured around a framework that links strategic management with health care outcomes for today and tomorrow. Areas covered include: leadership, team building, planning, customers, markets, information and analysis, communication skills, conflict resolution, resource management, budgeting and organizational performance.
*Course equivalencies:* X-CMAN 468/BEHL 505/IPS 657
*Outcomes:*
Analyze major strategic management processes, describe how evidence-research practice can be applied in health systems management, and integrate a framework for strategic management with the key concepts of outcomes-based performance management

**BEHL 506 Fiscal Management for Health Care Organizations (3 Credit Hours)**
The course explores the relationship between the national economic environment and the financial context for current models of health care delivery. A variety of fiscal concepts and techniques such as cost accounting, cost behavior, budgeting, cost benefit/cost effectiveness analysis, cost-volume-profit analysis, cost variance analysis, and performance budgeting are explored.
*Course equivalencies:* X-IPS 658/CMAN 533/BEHL 506
*Outcomes:*
Students will develop a framework for understanding key issues in health care financial management; Students will develop a quantitative approach to decision making in health care administration through application of concepts

**BEHL 510 Integrated Doctoral Seminar in Ethics, Theology, and Healthcare (3 Credit Hours)**
The Integrated Seminars in Ethics, Theology and Healthcare (ISETH) are the core of the Doctorate in Healthcare Mission Leadership (D.HMCL) degree program. Students in the DHCML program are required to complete three of these seminars, which will be offered every Fall and Spring term with variable topics, as part of their degree program. These courses will be primarily theoretical and methodological in focus, rather than practical.
*Outcomes:*
This course is designed to build on and integrate students' prior graduate coursework in theology and bioethics with their ongoing work in Catholic healthcare

**BEHL 511 Mission, Leadership, and Spiritual Formation Seminar (3 Credit Hours)**
This course explores the theology, traditions, and current practices foundational for understanding and achieving formation as an essential offering of Catholic health care ministries. By examining a Face to Face Online Hybrid (greater than 75% online) Blended (30%-70% online) variety of methods and models of formation programs of Catholic healthcare in the United States, students will cultivate personal practices that enhance their ability to design and operationalize experiences for persons in various roles within the ministries they serve - from new associate orientation to senior leadership.
*Outcomes:*
Gain an understanding and practical ability to ensure the programs, resources, and encounters they design and facilitate are grounded in tradition of Catholic ministry, inviting to diverse participant populations, and support the achievement of specified outcomes; In so doing, understand and develop skills necessary to implement integrative, professional, and valued programs of formation

**BEHL 512 Canon Law, Sponsorship, and Church Relations (3 Credit Hours)**
This two-month course explores the theology, traditions, and practical applications of canon law in the context of Catholic health care. The course will provide an overview of canon law, the emerging theology of sponsorship and ministerial juridic persons, and review a variety of models of church relations current in contemporary Catholic health care.
*Outcomes:*
Students will gain fluency in canon law, gain knowledge of the particular canons in Catholic health care, and develop a deeper understanding of sponsorship in order to understand the specific sponsorship model applicable to their own healthcare context

# Biomedical Sciences (BMSC)

**BMSC 402 Statistical Methods for Biomedical Science (2-3 Credit Hours)**
This course covers a broad array of statistical methods for the biological and medical sciences. Topics include descriptive statistics, non-parametric methods, categorical data analysis, and regression methods for normal, non-normal, and repeated measures data. The course focuses on the analysis of real datasets using RStudio, although no previous programming experience is assumed.
*Course equivalencies:* CRME420/BMSC402/MPBH404

**BMSC 405 Ethics in Biomedical Sciences (1 Credit Hour)**
This is an interactive seminar course where students discuss and debate ethics in biomedical sciences to foster integrity, professional character, and ethical problem solving skills.

**BMSC 406 Special Topics (1-3 Credit Hours)**
This course covers a specific topic in biomedical sciences. The topics can vary among different special topics courses.

**BMSC 410 Biochemistry and Molecular Biology (4 Credit Hours)**
This course will give students a broad understanding of the synthesis and functions of the major macromolecules that comprise a cell, and the biochemical mechanisms by which these molecules interact to contribute to cellular function.

**BMSC 412 Cell Biology (4 Credit Hours)**
This course will provide students with knowledge of the structure and function of cells, including the experimental foundations of cell and molecular biology.

**BMSC 414 Systems Biology (3 Credit Hours)**
This course will provide first year graduate students with an introduction to human physiology. Emphasis is placed on the major organ systems including the nervous, cardiovascular, pulmonary, renal, gastrointestinal and endocrine systems. Basic physiology of blood, skin and bone, as well as introductory concepts in immunology and pharmacology are also covered.

**BMSC 416 Methods Biomedical Science (1 Credit Hour)**
This course will familiarize first year graduate students with various methods that are used in contemporary biomedical research. It will introduce methods relevant to molecular biology, tissue culture, transgenic model systems, imaging, biochemistry, bioinformatics, electrophysiology, and immunology.

**BMSC 418 Presentation skills (1 Credit Hour)**
Scientists must communicate their work in numerous venues, from giving oral presentations in seminars and conferences to writing papers and grant proposals. This course is designed to train students in the design and delivery of effective oral presentations, a skill that can be readily adapted to serve as a starting point for written communications.
*Course equivalencies:* IDIM418/BMSC418
*Outcomes:*
1) Identify elements of an effective oral presentation; 2) Deliver an effective oral presentation; 3) Judge the effectiveness of oral presentations

**BMSC 499 Research (0-2 Credit Hours)**
*Pre-requisites:* First year PhD students will register for one research rotation in the Fall semester (2 credit hours), and two research rotations in the Spring semester (3 credit hours)
Research rotation course for first year students in the Integrated Program in Biomedical Sciences.
*Outcomes:*
Research course will provide laboratory experience during the first year of study, expected to culminate in the selection of a dissertation research laboratory and mentor at the end of the first year

**BMSC 600 Dissertation Supervision (0 Credit Hours)**
Following completion of the required 48 credit hours in the first 2 years, IPBS PhD students maintain registration via BMSC 600.
*Course equivalencies:* BMSC600/MIIM600/PIOL600
*Outcomes:*
IPBS PhD students will complete their degree work while registered for BMSC 600

# Cellular & Molecular Oncology (CMO)

**CMO 499 Research (1-9 Credit Hours)**
*Pre-requisites:* Restricted to students enrolled in CMO MS program
CMO 499 is designed to give credit for laboratory research efforts that will result in a M.S. thesis. Students will learn theoretical and laboratory technical tools to investigate and test a hypothesis. Students will search the literature for background, rationale, and protocols for their research project. Students will communicate results and knowledge through written and oral communications.
*Outcomes:*
1) Clearly communicate, describe, and implement techniques used for a research problem; 2) Describe results-obtained; 3) Draw conclusions based on data-obtained; 4) List future directions; and 5) Understand the significance of the work

**CMO 502 Seminar (0 Credit Hours)**
A seminar will be held on a rotating basis once per week. CMO M.S. students will be required to attend seminars as part of the CMO 502 course. This course is designed to help students stay abreast of current topics in oncology. Students will attend weekly seminars, and are encouraged to interact with both invited and current faculty speakers by asking questions and contributing to group discussions. Upon completion of this course CMO 502, students will have gained a better understanding of current oncology research. Restricted to students enrolled in CMO MS program
*Outcomes:*
1) Describe results or conclusions from a given seminar presentation; 2) Understand how research is advancing knowledge in a given field covered by a representative seminar, 3) Question new data or their interpretation

**CMO 503 Special Topics in Oncology (0-1 Credit Hours)**
CMO 503 will be a new journal club course-discussing and analyzing papers from presenters in CMO 502 Seminar Series one week in advance of their seminar. CMO 503 and CMO 502 will be aligned to expose students to oncology-focused scientists presenting a seminar the following week. Students will read an article by the seminar speaker, participate in discussion sessions, and ask questions during the seminars. Restricted to students enrolled in CMO MS program
*Outcomes:*
1) Describe cutting edge research in the particular area of investigation covered by the course; 2) Discuss limitations to experimental approaches; 3) Discuss real-world application of the research topic being studied; and 4) Critically read scientific literature on cancer biology

**CMO 595 Thesis Supervision (0 Credit Hours)**
*Pre-requisites:* Completion of required coursework
Thesis supervision course for CMO MS students who have completed the required credit hours.
*Outcomes:*
Allows completion of thesis research and defense, required for degree

# Clinical and Applied Mass Spectrometry (CAMS)

**CAMS 401 Theory and Physics of Mass Spectrometry (4 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will cover the fundamental physical principles that are used in mass spectroscopy, with a primary focus on basic electricity and magnetism theory. This course will not be calculus based.
*Outcomes:*
At the end of this course students will be able to: 1) Describe the fundamental principles of Newton's Laws and Conservation of Energy; 2) Describe basic interactions between charged particles and electric fields; 3) Define electric potentials; 4) Describe the relationship between electric and magnetic fields; 5) Identify the direction a charged particle will move in a magnetic field; and 6) Derive the relationship between charge, mass and velocity

**CAMS 402 Chemistry of Protein Separation (4 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will cover the fundamentals of separating biological agents in solution for analysis by mass spectrometry.
*Outcomes:*
At the end of this course students will be able to: 1) Describe the composition of typical biological collections including blood and waste; 2) Describe best-practices for preparing collections for mass spectrometry; 3) Describe fundamentals of separating biomolecules according to size, charge and other physiochemical factors; and 4) Describe mechanisms and tradeoffs behind common approaches for separating biological samples via chromatography (liquid and gas)

**CAMS 403 Introduction to Mass Spectrometry Instrumentation (2 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will introduce the mass spectrometry instrumentation that is utilized in clinical, pharma, and academia, including HPLC and other sample preparation instrumentation.
*Outcomes:*
At the end of this course students will be able to: 1) Describe the basic technologies and instrumentation currently used for mass spectrometry; 2) Understand the basics in how to operate this instrumentation (theory, no hands on); 3) Appreciate the similarities and differences in the different technologies, and in what situation each instrument would be most appropriate; and 4) Describe the instrumentation used in sample preparation

**CAMS 411 Computation and Bioinformatics for Proteomics (3 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will cover the governing principles of analyzing proteomics data, with a special emphasis on data derived from mass spectrometry (MS). Computational methods and tutorials will complement the theoretical material.
*Outcomes:*
At the end of this course students will be able to: 1) Describe key approaches for matching MS spectra to known proteins, as well as identifying and quantifying protein content in analyzes samples; 2) Describe methodologies and limitations thereof for labeling and quantifying proteins of interest; 3) Perform routine computational analyses of MS data using python; and 4) Describe best-practices for objective data analysis and reproducibility

**CAMS 412 Clinical Considerations and Biomarker Development (3 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will cover fundamental concepts about the criteria for something to qualify as a biomarker and how they are analyzed by mass spectrometry from a variety of biological fluids and/or tissues. We will also discuss the broader uses of mass spectrometry in a clinical or hospital setting.
*Outcomes:*
At the end of this course students will be able to: 1) Compare and contrast aspects of good vs bad biomarkers and the utility of mass spectrometry for their detection in biological samples; 2) Describe best practices for sample collection and the limitations of using biological samples; 3) Describe current regulations and standards for biomarker use in the clinic; 4) Identify and describe biohazard safety issues when working with biological samples; 5) Describe analytical approaches for quantification of biomarkers; and 6) Describe the type of mass spectrometry assays typically used in a clinical or hospital setting

**CAMS 413 Advanced Mass Spectrometry Approaches (2 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will cover advanced MS approaches to address specialized needs. These approaches will frequently require specific instrumentation, and bioinformatics approaches, but sometimes only involve changes to sample preparation and interpretation.
*Outcomes:*
At the end of this course students will be able to: 1) Understand the need for specialized mass spec approaches; 2) Appreciate the theory behind specialized mass spec approaches; 3) Describe the technical and practical considerations when utilizing specialized MS approaches; and 4) Be able to choose the correct advanced MS approach for a particular situation

**CAMS 491 Mass Spectrometry Lab Rotation A (5 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will be a hands-on intensive laboratory rotation. Students will learn how to prepare samples that are "mass spec ready" from a variety of liquid and solid tissue biological samples. Students will learn quality control parameters and will produce high quality samples for use in the HPLC and mass spectrometer.
*Outcomes:*
At the end of this course students will be able to: 1) Process liquid and tissue biological samples for analysis by mass spectrometry; 2) Perform gel electrophoresis on prepared samples and excise selected gel bands; 3) Perform in in-gel digestions using standard enzymatic approaches; 4) Perform in-solution digestions using standard enzymatic approaches; 5) Quantify protein samples before and after digestion; and 6) Use column chromatography to generate high purity samples

**CAMS 492 Mass Spectrometry Lab Rotation B (5 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
This course will be a hands-on intensive laboratory rotation. Students will learn how to perform normal LC-mass spectrometer general upkeep including HPLC setup, mass spectrometer calibration, quality control, etc. Students will then learn the process of running mass spectrometers for two types of approaches: discovery and targeted mode.
*Outcomes:*
At the end of this course students will be able to: 1) Setup HPLC, mass spectrometer and software; 2) Perform normal instrument upkeep including calibration, quality control, solution changes; 3) Be able to troubleshoot common instrument issues; 4) Analyze sample on mass spectrometer for discovery (two group comparison); 5) Analyze sample on mass spectrometer for targeted quantification (in simple solution); 6) Use bioinformatics software packages to analyze data from mass spectrometers; and 7) Understand how to present mass spectrometry data

**CAMS 493 Capstone Design - Applications in Mass Spectrometry A (2 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
During the course students will develop a written research proposal using mass spectrometry as the primary experimental approach to test their hypotheses. Students can choose from any relevant topic of interest such as the analysis of clinical biomarkers in disease, environmental endocrine disruptors, industrial pollutants, waste water contamination, etc. The topic must be approved by the student's advisor in advance.
*Outcomes:*
At the end of this course students will be able to: 1) Design quantitative experiments using mass spectrometry; 2) Describe and identify appropriate experimental positive and negative controls; 3) Describe statistical analyses relevant for their experimental design; 4) Discuss limitations and pitfalls of their research approach and describe alternatives; and 5) Critically evaluate the current literature and describe the rationale for their research study

**CAMS 494 Capstone Design - Applications in Mass Spectrometry B (2 Credit Hours)**
*Pre-requisites:* Enrollment in CAMS-MS program
During the course students will develop a written research proposal using mass spectrometry as the primary experimental approach to test their hypotheses. Students can choose from any relevant topic of interest such as the analysis of clinical biomarkers in disease, environmental endocrine disruptors, industrial pollutants, waste water contamination, etc. The topic must be approved by the student's advisor in advance.
*Outcomes:*
At the end of this course students will be able to: 1) Design quantitative experiments using mass spectrometry; 2) Describe and identify appropriate experimental positive and negative controls; 3) Describe statistical analyses relevant for their experimental design; 4) Discuss limitations and pitfalls of their research approach and describe alternatives; and 5) Critically evaluate the current literature and describe the rationale for their research study

# Healthcare Professions Education (HPE)

**HPE 400 Research Methods in Health Professions Education (4 Credit Hours)**

Introduction for Health Professions Education (HPE) students to the fundamentals of research design for education and scholarship in teaching and learning. This course offers a deep dive into educational research, covering problem identification, literature review, research question formulation, and the critical evaluation and synthesis of existing studies. It provides a solid foundation in quantitative research (including reliability, validity, survey construction, and validation), qualitative research (focusing on interviews and focus groups), and mixed methods research. The course emphasizes ethical principles in research and teaches effective data interpretation and presentation. Additionally, students will be introduced to grant development and introduced to their capstone project which is a research proposal. This course will equip students with the skills needed to excel in educational research., reliability, validity, survey construction, and survey validation), qualitative research (as it relates to interviews and focus groups) and mixed methods research (how to manage and use more than one method of data collection); Analyze data and ethical research practices that guide educational research; Illustrate grant development with an introduction of the capstone project research proposal.

*Outcomes:*

Identify a research problem and method of literature review; Formulate research questions and hypothesis; Distinguish between quantitative, qualitative, and mixed methods research; Describe fundamentals of quantitative research (e.g

**HPE 401 Fundamentals of Learning and Teaching Modalities in Health Professions (3 Credit Hours)**

Introduction to a range of teaching modalities, including large group lectures, small group teaching, case-based, problem-based, and team-based learning, flipped classrooms, standardized patients, simulation, e-learning, procedural, chalk talks, and clinical and bedside teaching. Ignatian Pedagogy will be threaded throughout the course. Rooted in adult learning theories and human cognition, students will review these fundamental concepts and seamlessly apply them throughout the course. There is a strong focus on practical application, enabling participants to create innovative and engaging learner-centered experiences, establish supportive learning environments, and adeptly integrate feedback. As a culmination of their learning, students will craft a final project, utilizing one of these teaching modalities to instruct peers on a relevant topic, applying the skills in a real-world educational context., large group lecture, small group teaching, cased-based, problem based and team-based learning, flipped classroom, standardized patients, simulation, e-learning and clinical and bedside teaching); Define the concepts of adult learning theories (e.g., learning theory, human cognition); Apply knowledge and understanding of androgyny to class work during this course; Demonstrate course skills, including the creation of innovative and engaging learner-centered experiences which will be showcased in the teaching portfolio project; Appraise experience with teaching modalities in education through reflective writing.

*Outcomes:*

Categorize different teaching modalities (e.g

**HPE 402 Technology in Education and Effective Lecture Skills (4 Credit Hours)**

In this engaging course, through a series of hands-on activities, participants will design and produce an electronic lecture that skillfully incorporates critical components of effective instruction. Students will not only create an educational presentation, but also assess its effectiveness through peer review, showcasing their critical evaluation skills and the ability to use feedback for continuous improvement. By the course's conclusion, participants implement peer-reviewed feedback and integrate best practices to refine their lecture into a polished, pedagogically effective resource.

*Outcomes:*

Produce an engaging and impactful electronic lecture that incorporates critical components of effective instruction; Demonstrate critical evaluation skills through peer review of educational content; Use peer feedback to revise and enhance their lecture; Appraise use of technology in education with discussion posts

**HPE 403 Principles of Curriculum Design (4 Credit Hours)**

The course will focus on the formal process of curriculum development. Much of the course will cover the standard medical education curriculum development process developed by Kern and Thomas (Thomas PA, Kern DE et al. Curriculum Development for Medical Education: A Six-Step Approach. 3rd ed. The Johns Hopkins University Press). Throughout this course, students will delve into essential theoretical literature specific to healthcare education, equipping participants with a solid foundation. They will learn to pinpoint educational challenges through needs assessment and distinguish between learning goals and objectives. Furthermore, students will master the art of crafting effective learning objectives using Bloom's Taxonomy and selecting fitting evaluation designs. Participants will learn educational strategies that will allow them to achieve their curriculum objectives. Finally, students will gain practical strategies for collecting and leveraging educational data to continuously enhance pedagogy, ensuring their healthcare education practices are informed, effective, and patient centered.

*Outcomes:*

Develop familiarity with essential theoretical literature of Kern's Six-Step Approach to Medical Education curriculum development; Identify curricular problems; Formulate a needs assessment; Recall the fundamental differences between learning goals and objectives; Illustrate how to create learning objectives for courses and educational sessions utilizing Bloom's Taxonomy; Select an appropriate evaluation design based on the identified objectives; Evaluate the effectiveness and impact of various educational technologies on learning outcomes and instructional design; Develop strategies to gather, review, and utilize educational data to improve pedagogy

**HPE 404 Statistical Methods for Educational Research (4 Credit Hours)**
This course offers a foundational understanding of statistical analysis within the context of research in clinical and health professions education. Through a blend of theoretical knowledge and hands-on practice, students will become proficient in defining core statistical concepts, applying statistical methods to diverse data types, and recognizing statistical analysis as a versatile toolkit for uncovering insights in data. Additionally, they will explore how statistical thinking enhances problem-solving skills in health professions education research and gain an understanding of the purpose and proper application of statistical techniques. Practical skills include conducting statistical tests, interpreting their outcomes, and translating results into meaningful conclusions. By the course's conclusion, students will be well-prepared to engage in evidence-based research, make informed decisions, and contribute to advancements in both clinical practice and medical education.
*Outcomes:*
Define basic statistical concepts; Analyze statistics from clinical and educational data; Classify statistical analysis as a collection of techniques that are intended to uncover information in data; Discuss how statistical methodology is used to aid thinking in health professions education research; Describe proper use of the statistical techniques that are presented in this course; Compute statistical tests of research hypotheses using methods presented in this course; Interpret the meaning of tests of hypotheses and other statistical computations

**HPE 405 Strategies in Assessment, Implementation, and Evaluation in HPE (4 Credit Hours)**
This course is designed to equip students with the advanced skills and knowledge required to navigate the evolving landscape of healthcare education. This program offers a dynamic blend of theory and practice. Dive deep into the art and science of designing effective assessment strategies, implementing innovative educational techniques, and rigorously evaluating the outcomes in health professions education. Through critical analysis and synthesis, students will gain the skills to create holistic, evidence-based educational approaches.
*Outcomes:*
Apply advanced theoretical knowledge to real-world scenarios within the evolving landscape of healthcare education; Employ a blend of theory and practice to effectively address complex challenges and opportunities; Analyze the art and science of effective assessment strategies, innovative educational techniques, outcomes evaluations in health professions education; Demonstrate an understanding of various assessment and testing methods; Appraise educational practices, leveraging advanced skills and knowledge to lead positive change and innovation in healthcare education

**HPE 406 Leadership in Health Professions Education (3 Credit Hours)**
This course is designed to provide students with an understanding of the various theories that underpin leadership education and practice within the context of health professions education. As an active participant in this class, students will explore the presented leadership theories to shape their approach as an educator but also examine how these theories inform their interactions and engagement with the world within and beyond the healthcare and education domains. Participants will gain insights into how leadership principles can be applied to address the unique challenges and opportunities faced by health professions educators, helping them become a more effective leader and educator in the healthcare field, ultimately contributing to the advancement of healthcare education and practice.
*Outcomes:*
Review the fundamental concepts of leadership and the theories in the context of health professions education; Analyze ideas, arguments, and viewpoints related to leadership theories within healthcare and educational settings; Assess the effectiveness of different leadership styles, change agent qualities, and approaches in various organizational contexts, especially in the context of driving change; Articulate how one's personal developmental perspective influences both philosophical beliefs and practical applications in healthcare leadership and education

**HPE 407 Administrative Skills and Organizational Change (3 Credit Hours)**
This course has a clear focus on two main aspects: understanding how organizations undergo transformations and equipping individuals to drive change within an organization. It covers several key areas, including the driving forces behind change, the process of implementing change, the qualities, and skills necessary for effective change agents, and the behavioral theory explaining how both individuals and organizations evolve. A comprehensive grasp of the various theoretical frameworks shaping the organization and structure of higher education is integral to achieving proficiency in these areas. The goal of this course is to provide students with valuable insights into the major functions and structures within higher education. In essence, it's not focused on teaching administrative or faculty tasks but rather on helping participants understand the context within which they operate within higher education. This course introduces students to important concepts, theories, and fiscal practices in higher education. Moreover, it offers opportunities for students to analyze, test, and receive feedback on their financial decision making and its impact on critical higher education issues.
*Outcomes:*
Explain the significance of theoretical frameworks in shaping the structure of higher education and organizational dynamics; Apply knowledge of organizational change forces; Analyze real-world scenarios of organizational transformation; Examine the various factors contributing to the success or failure of change initiatives within organizations; Demonstrate competence in financial decision-making processes by making informed decisions that address critical higher education issues; Develop innovative approaches for implementing change within an organization

**HPE 408 Health Professions Education Capstone Project (3 Credit Hours)**
In this course students craft a research proposal primed for submission to the Institutional Review Board (IRB). Guided by seasoned educators and researchers, participants skillfully construct essential components of a robust research proposal that fills a current gap in the literature. Proposals will include an introduction, background, significance, thorough literature review, research methods, budget, and thoughtful implications and conclusions. By course end, students will not only have a well prepared research proposal but also the knowledge and confidence to undertake impactful research in the dynamic landscape of health professions education.
*Outcomes:*
Demonstrate a grasp of health professions education research principles; Construct an effectively structured research proposal that includes a well-defined introduction, background/significance, and literature review; Develop the research methods, implications, and conclusion sections of a health professions educational research proposal; Generate a coherent, complete, well-structured, and insightful proposal ready for IRB submission

# Infectious Disease & Immunology (IDIM)

**IDIM 400 Infections and Immunology (3 Credit Hours)**
IDIM 400 integrates basic knowledge of infectious microorganisms with an understanding of innate and adaptive immune systems that react against them. Following a review of infections caused by specific infectious organisms, IDIM 400 will focus on specific aspects of immune systems and how they interact to remove these infectious microorganisms.
*Outcomes:*
1) Explain the cellular basis of immune development; 2) Differentiate between the mechanisms of activation of immune systems; 3) Analyze the mechanisms involved in combating bacterial and viral infections

**IDIM 401 Conceptual Bases of Infectious Diseases (2 Credit Hours)**
IDIM 401 integrates a basic science understanding of microorganisms with an understanding of their role in human health. Following a review of bacterial physiology and gene expression, the focus will be on bacterial disease, including basic strategies used to cause disease and details of pathogenesis by medically important bacterial pathogens.
*Outcomes:*
1) Describe differences between bacteria and eukaryotes; 2) Understand mechanisms by which bacteria cause disease; 3) Understand limitations of current antimicrobial therapies; 4) Differentiate between similar diseases with different causes

**IDIM 403 Parasitology and Virology (2 Credit Hours)**
*Pre-requisites:* IDIM 400
The Parasitology and Virology course IDIM 403 is designed to describe infections caused by microorganisms and animal diseases transmissible to man, with a primary focus on parasites and viruses. We will emphasize the pathophysiology of these diseases in humans of various ages. This course will promote an understanding of how the properties of certain infectious agents can in some cases avoid an adequate immune response.
*Outcomes:*
1) Explain the mechanisms of pathogenicity of various infectious agents; 2) Analyze the mechanisms by which emerging viruses arise; 3) Apply knowledge to viral vaccine development

**IDIM 418 Presentation skills (1 Credit Hour)**
Scientists must communicate their work in numerous venues, from giving oral presentations in seminars and conferences to writing papers and grant proposals. This course is designed to train students in the design and delivery of effective oral presentations, a skill that can be readily adapted to serve as a starting point for written communications.
*Course equivalencies:* IDIM418/BMSC418
*Outcomes:*
1) Identify elements of an effective oral presentation; 2) Deliver an effective oral presentation; 3) Judge the effectiveness of oral presentations

**IDIM 492 Research (1-8 Credit Hours)**
A major component of the M.S. degree in Infectious Disease and Immunology is the successful completion of a research project integrating basic and clinical science. IDIM 492 is designed to give credit for the research efforts that will result in the Master's thesis.

**IDIM 501 Seminar (1 Credit Hour)**
IDIM 501 is designed to help students stay abreast of current topics in infectious disease and immunology. Students will attend weekly seminars and are encouraged to interact with invited seminar speakers by asking questions and contributing to group discussions. Upon completion students will have enhanced their understanding of current research.
*Outcomes:*
1) Describe the results or conclusions from a given seminar presentation; 2) Understand how research is advancing knowledge in a given field covered by a representative seminar; 3) Question new data or their interpretation

**IDIM 502 Special Topics in Infectious Disease and Immunology (0-5 Credit Hours)**
IDIM is designed to immerse students in current literature, with new topics chosen each year. Students will read the primary literature and participate in discussion sessions. The course will enhance the ability of the student to critically read and interpret scientific literature in infectious disease and immunology.
*Outcomes:*
1) Critically read and discuss scientific literature in the area covered by the course; 2) Discuss experimental approaches, their limitations, and the conclusions that can be drawn from observed results

**IDIM 595 Thesis Supervision (0 Credit Hours)**
A major component of the M.S. degree in Infectious Disease and Immunology is the successful completion of a research project integrating basic and clinical science. This course is similar to IDIM 492, except that students are expected to perform at an advanced level in all aspects.
*Outcomes:*
Students will 1) Understand the significance and clearly communicate the research problem; 2) Describe the approaches used and results obtained; 3) Draw conclusions and identify future directions

# Integrative Cell Biology (ICB)

**ICB 401 Gross Anatomy (6 Credit Hours)**
The student develops a knowledge and understanding of the basic concepts and facts of human gross anatomy as it relates to function and clinical problems. Lectures, clinical case-based and problem-based learning, computer-aided instructional materials, and cadaver dissection serve as guides to laboratory study.

**ICB 403 Graduate Histology (3 Credit Hours)**
The course is designed to provide the student with a basic knowledge and understanding of the structure and function of the human body at the light and electron microscopic level. The interdependence between structure and function in the different tissues and organs of the body is emphasized. Clinical and research application of the course material are also stressed.

**ICB 411 Advanced Gross Anatomy (2 Credit Hours)**
The study of the gross structure of the human body at an advanced level presented at conference sessions. Registrants for this course may include graduate students, advanced medical students, as well as those who hold the M.D. degree and are concurrently registered for advanced work in one of the clinical departments.

**ICB 445 Scientific Literature: Review & Critique (0-1 Credit Hours)**
Students are taught critical evaluation of scientific literature, hypothesis testing and presentations. This course involves attendance at scientific presentations by students and outside speakers and a journal club component. Both staff and students participate and the class is only offered during the fall semester. This course alternates with Review and Seminar 446.

**ICB 446 Review Seminar (0-1 Credit Hours)**
The student participates in a series of seminars and journal clubs that provide a forum for intensive review of scientific topics. Research progress reports of the students is incorporated into this course as a part of the scientific presentation. This course alternates with the Scientific Literature Course 445 and is only offered during the spring semester.

**ICB 459 Research (1-8 Credit Hours)**
Independent research for thesis or dissertation under the supervision of an appointed faculty adviser. Credit various upon assigned effort and time spent in the laboratory. Requires a written report.

**ICB 462 Teaching of Anatomy I (0-2 Credit Hours)**
A practical experience in the teaching of Gross Anatomy to graduate and medical students. Students assist in the planning, preparation, and teaching of laboratory sessions. The course allows students to place the experience of teaching gross anatomy on their transcripts as a graded course indicating to future employers that they have gained teaching experience.

**ICB 463 Teaching Anatomy II (0-2 Credit Hours)**
A practical experience in the teaching of histology to graduate and medical students. Students assist in the planning, preparation and teaching of laboratory sessions. The course allows students to place the experience of teaching histology on their transcripts as a graded course indicating to future employers that they have gained teaching experience.

**ICB 501 Special Topics in Anatomy (1-2 Credit Hours)**
Occasionally specific faculty members may offer a specialized seminar course. The purpose of such courses is to further graduate student's knowledge in a specialized current scientific research area. The graduate students explore in detail one or more areas of special interest through seminars, conferences, library and laboratory work.

**ICB 595 Thesis Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the masters of science thesis and degree.

**ICB 600 Dissertation Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the Ph.D. dissertation and degree.

# Microbiology and Immunology (MIIM)

**MIIM 402 Microbes & Hosts (3 Credit Hours)**
*Pre-requisites:* Cell Biology BMSC 412, and Molecular Biochemistry BMSC 410 or permission from the instructor
Microbes & Hosts conveys important concepts in bacteriology, virology and immunology as well as the interactions of microbes with host organisms. Through a combination of didactic lectures and group discussions, students will come to appreciate fundamental processes which influence microbe-host interactions.
*Outcomes:*
Students will have a strong understanding of basic principles of microbiology, virology and immunology as well as an understanding of key concepts related to microbe-host interactions

**MIIM 411 Basic Molecular Microbiology (2-3 Credit Hours)**
This course is an introduction to fundamental concepts in microbiology
*Outcomes:*
Students will be able to demonstrate an understanding of the morphology, growth, division, development, molecular biology, genetics and physiology of microorganisms

**MIIM 413 Basic Concepts of Immunology (3 Credit Hours)**
This course is an introduction to the concepts of host immunity and defense.
*Outcomes:*
Students will be able to understand the fundamental principles of immunobiology, immunochemistry and immunogenetics, host immunity and defense, and the basic concepts of normal host defense versus the untoward responses (hypersensitivity) and their consequences

**MIIM 414 Virology (3 Credit Hours)**
This is a survey course that examines animal viruses and their interactions with host cells.
*Course equivalencies:* X-MBIO414/MIIM414
*Outcomes:*
Students will be able to demonstrate an understanding of viral structure and multiplication, and molecular interactions of important animal viruses with their host cells

**MIIM 415 Medical Immunology (2 Credit Hours)**
*Pre-requisites:* General Biology and/or Cell Biology Course is open to all Integrated Program in Biomedical Sciences PhD and MS students, graduate Nursing students, medical students, and advanced undergraduate students
The medical immunology course provides an in depth description of the components of the innate and adaptive immune system and how they interact to protect humans against infectious microorganisms. The course will have two 3 hour sessions per week for 8 weeks as well as 2 written exams.
*Outcomes:*
Be able to describe the development and mechanism(s) of activation of the innate and adaptive immune systems, their regulation and outcomes of their inability to do so

**MIIM 420 Methods & Techniques in Microbiology Research (1 Credit Hour)**
This course is an introduction to the theory of techniques used for research in microbiology and immunology.
*Outcomes:*
Students will be able to demonstrate competency with various research techniques including spectrophotometry, centrifugation, chromatography, photography, as well as other methods necessary for the study of microbiology, immunology or virology

**MIIM 431 The Molecular Biology of Viruses (3 Credit Hours)**
*Pre-requisites:* Include undergraduate or graduate-level courses in cell biology and biochemistry, graduate course 402 Microbes and Hosts, and / or prior approval from the course director(s)
The course will cover molecular biology and biochemistry of virus infections. Current understanding of virus-cell entry, replication, and assembly will be prominent themes. Course will include lectures on viral evolution, ecology, pathogenesis and viral immunology. The interactive course will include lectures, review of current virology literature, and student-led presentations.
*Course equivalencies:* MBIO431/MIIM431
*Outcomes:*
Detailed understanding of virology; be able to integrate concepts in this field with chemistry and health science; comprehend and appreciate current literature; be prepared for lab studies

**MIIM 441 Immunology-Immunochemistry (3 Credit Hours)**
This is an advanced immunology course that emphasizes structural concepts in immunology. Review and discussion of current literature exemplifies concepts presented in lecture.
*Outcomes:*
Students will demonstrate an understanding of the chemical definition of antigens, immunogens, structural concepts in immunology, immunoglobulin structure, structure of antigens and their interactions, and recognition of antigen by T-cells and B-cells

**MIIM 442 Cell & Molecular Immunology (3 Credit Hours)**
This is an advanced immunology course that examines the cellular and molecular basis of the immune response.
*Outcomes:*
Students will be able to demonstrate an understanding of the cellular and molecular basis of the immune response, as well as the cellular cooperation essential to the nature of immunology

**MIIM 443 Molecular B-Cell Immunology (4 Credit Hours)**
This is an advanced molecular immunology course with emphasis on proteins, genes and molecular interactions within the B-lymphocyte compartment of the immune system. Course includes critical evaluation of recent literature.
*Outcomes:*
Students will demonstrate an understanding of proteins, genes and molecular interactions within the B-lymphocyte compartment of the immune system

**MIIM 461 Microbiological Cytology & Ultrastructure (3 Credit Hours)**
This is an advanced course that presents the principles and application of light and electron microscopes for the study of cell structure and function.
*Outcomes:*
Students will demonstrate an understanding of the principles of light and electron microscopes and their use as tools in cellular and molecular biology

**MIIM 471 Molecular Microbial Genetics (3 Credit Hours)**
This course introduces advanced students to the importance of genetics to a wide range of biological problems.
*Outcomes:*
Students will demonstrate an ability to read, think, write, and speak critically about various genetic approaches used to identify essential genes, mutagenesis and recombination, transcription, development, symbiosis, and pathogenesis

**MIIM 490 Molecular Biology of Oncogenesis (2 Credit Hours)**
This course is an advanced course that provides a detailed analysis of molecular events that result in the tumorigenic transformation of eukaryotic cells.
*Outcomes:*
Students will demonstrate an understanding of oncogenesis by DNA and RNA tumor viruses, the role of oncogenesis and their relationship to normal genes, hormonal effects, and chromosomal abnormalities

**MIIM 492 Research (1-12 Credit Hours)**
Independent research for thesis or dissertation under the supervision of a faculty research advisor. Credit varies based upon assigned effort and time spent in the laboratory. Students receive a letter grade from their research advisor.
*Outcomes:*
Students will learn how to perform laboratory work, including how to appropriately control their experiments, how to interpret results, and what conclusions they may draw

**MIIM 501 Seminar (0 Credit Hours)**
This course provides opportunities for students to hear about cutting-edge research being conducted nationally and internationally.
*Outcomes:*
Students will be able to demonstrate a general awareness of current research in the area of microbiology, immunology and virology

**MIIM 502 Special Topics (1-4 Credit Hours)**
This course is covers a specific topic in microbiology, immunology or virology.
*Outcomes:*
Students will be able to able to articulate a general understanding of the selected topic

**MIIM 503 Current Literature (0-1 Credit Hours)**
This course is a paper-driven course in which papers of current interest are read and discussed.
*Outcomes:*
Students will demonstrate an ability to identify, critically analyze and articulate key concepts of scientific papers

**MIIM 595 Thesis Supervision (0 Credit Hours)**
This course allows the student to pursue a research topic under the mentorship of a faculty advisor.
*Outcomes:*
Students will contribute to the existing body of scientific knowledge and/or methodology in their thesis area; They will defend their results to their committee members

**MIIM 600 Dissertation Supervision (0 Credit Hours)**
This course allows the student to pursue a research topic under the mentorship of a faculty advisor. They will defend their results in a public forum.
*Course equivalencies:* BMSC600/MIIM600/PIOL600
*Outcomes:*
Students will add new knowledge to the existing body of scientific knowledge in their dissertation area

# Neuroscience (NRSC)

**NRSC 410 Cellular & Molecular Neurobiology (3 Credit Hours)**
This course will review current knowledge of the morphological, biophysical and biochemical properties of neurons. Fundamental neuronal network processes such as stimulus transduction, neuronal plasticity, information processing, and learning and memory will be reviewed.
*Outcomes:*
An advanced knowledge of the biophysical and biochemical properties of nerve cells and fundamental aspects of more global central nervous system function

**NRSC 415 Neurochemistry (3 Credit Hours)**
This course is a team-taught neurochemistry course that integrates basic biochemical mechanisms of neurotransmitter synthesis, storage, reuptake, and inactivation with applied correlates to central and peripheral nervous system neurodegenerative disorders. Organic chemistry and neurobiology/neurophysiology are required prerequisite courses. Emphasis is placed on student participation including a student-held lecture series covering a contemporary neurochemical topic of their choosing.
*Interdisciplinary Option:* Neuroscience

**NRSC 421 Neuroscience Teaching (1 Credit Hour)**
This course consists in serving as a Teaching Assistant in the medical Neuroscience course labs and proctoring the medical neuroscience course exams. It also includes a weekly pre-lab meeting in which the material for that week's lab is discussed.
*Outcomes:*
Experience in teaching neuroanatomy for Neuroscience Graduate Program students

**NRSC 422 Behavioral Neuroscience (2 Credit Hours)**
This course discusses the brain's role in sensory perception, higher perceptual functions, attention, learning and memory, executive function, and emotion. It consists of weekly lectures given by the professor or by one or two students.
*Outcomes:*
An understanding of higher brain function and experience giving presentations

**NRSC 423 Special Topics in Neuroscience (3 Credit Hours)**
Restricted to Graduate level students. This course explores a wide spectrum of neuroscience-related topics, and the subject matter will vary with each offering.
*Outcomes:*
Measures include exam performance, in-class participation, and student presentation

**NRSC 499 Research (1-9 Credit Hours)**
Independent research for thesis or dissertation under the supervision of a faculty research advisor. Credit varies based upon assigned effort and time spent in the laboratory. Students receive a letter grade from their research advisor.

**NRSC 502 Neuroscience Journal Club (0-1 Credit Hours)**
*Pre-requisites:* Must be member of the Neuroscience Graduate Program
One hour weekly course during which all students in the Neuroscience Graduate Program meet to discuss and critically evaluate recent, high impact journal articles covering varied neuroscience topics under the direction of two faculty mentors with neuroscience expertise.
*Outcomes:*
Students advance their knowledge of new neuroscience concepts and methods, gain experience in presenting in front of a group, and gain confidence in their abilities to critically evaluate experimental design and statistical methods

**NRSC 503 Neuroscience Seminar (0-1 Credit Hours)**
In both the fall and spring this course includes monthly Neuroscience seminar presentations by internal and external speakers. In the fall, the course also includes weekly journal club presentations by the graduate students: in the spring the course also includes weekly research progress reports by the graduate students.
*Outcomes:*
A broad overview of current topics in the field and experience giving research presentations

**NRSC 595 Thesis Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the masters of science thesis and degree.

**NRSC 600 Dissertation Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the Ph.D. dissertation and degree.

# Pharmacology (PHAR)

**PHAR 405 Pharmacology Journal Club (0-1 Credit Hours)**
This course involves students in reading and presenting the scientific literature in journal club format with the goals of learning to, i) evaluate the pharmacological literature and voice a critique in a constructive manner, ii) present such literature in a peer-context, and iii) assimilate information presented by other speakers and formulate, ask, and discuss around relevant appropriate questions.

**PHAR 406 Special Problems in Pharmacology (1-4 Credit Hours)**
This course covers a specific topic in pharmacological or biomedical sciences. The topics can vary among different special topics courses.

**PHAR 407 Fundamentals of Drug Discovery and Development (3 Credit Hours)**
This course introduces the process of drug discovery, and students will explore the theoretical and practical aspects of the entire process from concept to clinical trials. Topics include selection, design and use of disease models, current methods and strategies of drug target identification, lead molecule identification, the clinical trial process and pre- and post-market safety.
*Outcomes:*
Upon completion of this course, the students will have sufficient understanding of the drug discovery process to: 1) Discuss the methods and strategies used to identify potential drug targets; 2) Describe approaches used to screen for lead molecules; 3) Articulate the general FDA regulatory requirements encountered in bringing a new drug to market; 4) Identify requirements for pre-clinical assessment of potential compounds; 5) Define and describe the steps of the clinical trials process; and 6) Articulate and discuss ethical aspects in drug development, including, but not limited to, animal use, clinical trials, intellectual property and research design and integrity

**PHAR 408 Molecular Basis of Disease and Therapeutics (3 Credit Hours)**
The course focus is on understanding contemporary research in the pathophysiology of major human diseases and in the development of respective therapeutic treatment strategies. Emphasis will be on cutting edge studies in molecular medicine, including topics in cardiology, endocrinology, oncology, inflammatory diseases and in the neurosciences. There are no prerequisites, but students should have a solid understanding of cell and molecular biology, biochemistry and systems physiology.
*Outcomes:*
Understand contemporary research strategies applicable to investigating the molecular basis of disease and therapeutics and develop critical thinking and writing skills in hypothesis testing, experimental design and data analyses

**PHAR 409 Principles of Pharmacology (3 Credit Hours)**
This course introduces students to the fundamental principles of pharmacology and the clinical use of the major classes of drugs currently used with a focus upon fundamental concepts. Topics include drugs and their receptors, molecular aspects of drug targets and drug action, pharmacodynamics and the quantitative aspects of drug-receptor interactions, pharmacokinetic properties of drugs influencing drug distribution and drug dosing, drug metabolism and the effects of genetics on drug action, mechanisms of drug toxicity, and scientific approaches to the discovery of new drugs. Finally, the pharmacology and clinical uses of the major classes of drugs, including drugs used to treat diseases of various systems including cardiovascular, central nervous system, endocrine/reproductive systems, and cancer are covered.

**PHAR 410 Signal Transduction (3 Credit Hours)**
This course is open to all Ph.D., M.D./Ph.D., and M.S. students. Students will gain a theoretical and practical understanding of how extracellular signals are transduced through receptors into metabolic events. It is designed for second year PhD students who have completed the Biomedical Sciences core curriculum. The format is one lecture followed by one research paper discussion for each topic. Students will also gain in-depth knowledge of the signal transduction topics covered in the course.
*Outcomes:*
Students will be able to interpret data and design experiments examining signal transduction pathways

**PHAR 415 Current Topics in Pharmacology and Epidemiology of Disease (2 Credit Hours)**
This advanced graduate level course will cover an up-to-date overview of topics directly relevant to pharmacovigilance, pharmacoepidemiology, and the factors that play a role in success or failure of approved therapeutic agents.
*Outcomes:*
Students who complete this course will gain knowledge of major epidemiology concepts and statistical principles used in epidemiology and pharmacovigilance

**PHAR 420 Pharmacovigilance: A Practical Approach (4 Credit Hours)**
This advanced graduate level course will provide an up-to-date and in-depth understanding of pharmacovigilance in the context of modern pharmaceutical drug development and pharmacology. Pharmacovigilance is the pharmacological science relating to the detection, collection, assessment, monitoring, and prevention of adverse effects associated with pharmaceutical products. Enrollment Condition: Drug Discovery (PHAR 407), recommended but not required Students will be able to identify and describe the regulatory environment and product safety as it pertains to the collection, assessment, reporting and analysis of adverse events.
*Outcomes:*
Upon completion of this course, students will demonstrate an understanding of pharmacovigilance and patient safety

**PHAR 453 The Teaching of Pharmacology (0-1 Credit Hours)**
This course teaches the practice and pedagogy of graduate level teaching. Students work under supervision to prepare and present a didactic lecture which is reviewed by faculty and students.

**PHAR 499 Research (1-12 Credit Hours)**
Independent research for thesis or dissertation under the supervision of a faculty research advisor. Credit varies based upon assigned effort and time spent in the laboratory. Students receive a letter grade from their research advisor.

**PHAR 595 Thesis Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the masters of science thesis and degree.

**PHAR 600 Dissertation Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the Ph.D. dissertation and degree.

# Physiology (PIOL)

**PIOL 401 Physiology (4 Credit Hours)**
This course integrates the contents of two sections of the medical school (M1) course Function of the Human Body course (PIO L301); with additional meetings to present discuss papers at graduate level (2 paper presentations per graduate student). In the Fall semester, students will review cell physiology and autonomic neuroscience, and will learn cardiovascular and renal physiology in depth. The course topics will include introductory cell & neurophysiology, skeletal and smooth muscle, cardiac electrophysiology, EKG, cardiac muscle mechanics, circulation, special circulations, and renal physiology. In the Spring semester, students will learn pulmonary, acid-base balance, gastrointestinal, endocrine, and reproductive physiology. Instructor Consent Required.
*Outcomes:*
Students familiar with introductory physiology are expected to learn and understand cardiovascular, reproductive and endocrine systems in an integrative fashion in this course; Emphasis will be placed on understanding key concepts of normal physiological and biochemical systems in healthy humans; Selected aspects of pathophysiological processes will be discussed to illustrate how an understanding of normal function can be applied to clinical medicine

**PIOL 410 Intro to Research (1-3 Credit Hours)**
This course provides an introduction to a wide variety of commonly used techniques in cell and molecular physiology research, with concomitant laboratory rotations to learn those techniques.

**PIOL 412 Research (1-6 Credit Hours)**
Independent research for thesis or dissertation under the supervision of a faculty research advisor. Credit varies based upon assigned effort and time spent in the laboratory. Students receive a letter grade from their research advisor.

**PIOL 414 Graduate Colloquy (1-8 Credit Hours)**
Special advanced topics course with variable credit. Paper discussion and instructor-led presentations.

**PIOL 416 Research Seminar (1 Credit Hour)**
Seminar presentation on PhD candidate's dissertation topics advance.

**PIOL 417 Cellular Physiology (3 Credit Hours)**
*Pre-requisites:* Restricted to Master of Physiology Program students
The major goal of the Cellular Physiology course is to define the molecular and cellular basis of systems Physiology and Pathophysiology. The course consists in distinct sessions of teaching, problem solving, and reviews.
*Outcomes:*
- Understand the relationships among molecular, cellular and systems physiology; - Understand membrane structure and function; - Understand distinct metabolic and signaling pathways

**PIOL 418 Teaching of Physiology (0 Credit Hours)**
Teaching training and practice opportunities for upper level PhD candidates.

**PIOL 420 Methods/Technical in Physiological Research (2 Credit Hours)**
This course is intended for students seeking advanced knowledge of cutting-edge experimental approaches currently used in cardiovascular, metabolic, and neuroscience research. These topics will be discussed in both a technical/methodological sense, and in the context of the current scientific literature.

**PIOL 421 Function of the Human Body I (4 Credit Hours)**
This course will present the basic concepts and principles of human physiology. The course topics will include: introductory cell & neurophysiology, skeletal and smooth muscle, cardiac electrophysiology, EKG, cardiac muscle mechanics, circulation, special circulations and pulmonary physiology. The format will be lectures, simulations, small group problem sessions and scheduled reviews. Small group problem sessions will be held after each subject area and will focus on clinical application and integration of conceptual information presented in lectures. Small group sessions and reviews also will provide the student with the opportunity to obtain clarification from instructors of any outstanding questions and are designed to encourage active learning, as well as develop critical thinking and problem solving skills. Students will be evaluated by multiple choice and essay exams given after each of the 5 major topic areas. Course material will be geared toward non-thesis Masters students. Given that physiology is the basis of medicine, this course will prepare students with the basic science knowledge to successfully continue their professional development in future biomedical programs.
*Outcomes:*
Students will be able to describe the cellular mechanisms responsible for cardiac, skeletal and smooth muscle contraction and the factors that regulate their activity

**PIOL 422 Function of the Human Body II (4 Credit Hours)**
Enrollment limited to Masters of Science in Physiology students. This course presents the basic concepts and principles of human physiology. The course will be presented over one semester and the topics include: renal, acid-base balance, gastrointestinal, endocrine, and reproductive physiology. The format will be lectures, small group problem sessions and scheduled reviews.
*Outcomes:*
Students will be able to explain the cellular mechanisms responsible for normal renal, acid-base, endocrine, gastrointestinal and reproductive physiology

**PIOL 423 Biochemical Physiology (3 Credit Hours)**
Biochemical Physiology will give students knowledge of foundational processes that dictate cellular physiologic processes. Topics include the structure and properties of nucleic acids, amino acids, protein structure and folding, enzyme kinetics, metabolic pathways and intracellular signal transduction. The course will present the biochemical physiology.
*Outcomes:*
Student completing this course should: - Understand the biochemical mechanisms which underlie physiological processes; - Understand protein structure dynamics and how these structures are dictated by second

**PIOL 425 Physiology of Aging (3 Credit Hours)**
*Pre-requisites:* BMSC 410, BMSC 412, BMSC 416
The focus of this special topics course is on the unique physiological changes that occur with aging. Didactic instruction will be supplemented with readings from current primary literature in the field. Students will be responsible for reading and presenting articles for group discussion.
*Outcomes:*
1) Acquire advanced knowledge of aging processes; 2) Identify key gaps in knowledge in the aging field; 3) Engage in transformational/critical discussion of seminal papers in the aging field

**PIOL 426 Biophysical Research Methods (3 Credit Hours)**
*Pre-requisites:* IPBS Core curriculum The focus of this special topics course is to introduce students to the field of biophysics, with special focus on practical applications of biophysical methods in research Didactic instruction will be supplemented with readings from current primary literature in the field. Students will be responsible for reading and presenting articles for group discussion.
*Outcomes:*
Demonstrate a general understanding of the field of biophysics; Demonstrate deep knowledge and understanding of fundamental aspects cell mechanics, muscle mechanics, and integrated biomechanics; Demonstrate knowledge of current biophysical methods used in research; Demonstrate knowledge of fluorescence spectroscopy; Demonstrate knowledge of microscopy; Demonstrate understanding of computational biology approaches; Critically evaluate biophysical data from the literature; Interpret biophysical data for a general audience and effectively communicate biophysical information in both oral and written forms; Incorporate high standards of ethics into data interpretation and presentation

**PIOL 430 Basic Human Anatomy (2 Credit Hours)**
Enrollment limited to Masters of Science in Physiology students. This course will provide students with the basic concepts and facts of human gross anatomy as they related to physiology and function. Specific sections include the musculo-skeletal components of the extremities, trunk and head, the peripheral nervous system to include both the somatic and autonomic systems, the cardiovascular system, respiratory system, digestive system, urinary system and reproductive system. Each system will integrate embryology, radiology and basic clinical applications.
*Outcomes:*
Students will be able to describe and integrate basic human anatomy of the major organ systems to physiology and clinical medicine

**PIOL 446 Cardiovascular Journal Club (1 Credit Hour)**
Presentation and discussion of original research papers with focus on cardiovascular physiology topics.

**PIOL 450 Fundamentals Of Neurophysiology (4 Credit Hours)**
This course imparts the basic concepts and fundamentals of Neurophysiology, with emphasis on concepts relevant to human neuroscience. Students will learn Neurophysiology fundamentals at the cellular, structural and physiological levels of various complex systems in the brain, with specific discussion of clinical correlates of Pathophysiological conditions.
*Outcomes:*
Students successfully completing this course will be able to understand and explain neurophysiological mechanisms relevant to normal and abnormal conditions

**PIOL 461 Introduction to Human Pathophysiology (5 Credit Hours)**
Restricted to students in the Masters of Science in Physiology program. This course presents the basic concepts and principles of human pathophysiology. The course will be presented over one semester and the topics include: clinical evaluation of cardiac structure and function followed by a review of the major disorders of cardiovascular function.
*Outcomes:*
Students will be able to critically evaluate basic pathophysiological mechanisms underlying the most common forms of adult human cardiovascular disease

**PIOL 468 Neurophysiology Journal Club (1 Credit Hour)**
Presentation and discussion of original research papers with focus on neurophysiology topics.

**PIOL 470 Excitability & Ion Transport (1-4 Credit Hours)**
The course focuses on basic concepts of the physical movement of ions during activation of voltage- and ligand- gated ion channels.

**PIOL 472 Structure/Function Membrane Proteins (3 Credit Hours)**
The course explores basic and advanced concepts of membrane proteins structure, cell biology and function.

**PIOL 500 Professional Development I (3 Credit Hours)**
Must be enrolled in the MSP program. Professional Development will meet once/month throughout the one-year MSP program. Students will receive information about the options available for a career in the health sciences and will enhance their professional portfolio by participating in a variety of workshops designed to better equip them for a health science career.
*Outcomes:*
Students will be able to understand the curriculum and admission requirements of the various professional health programs and gain an understanding of the interview process

**PIOL 501 Professional Development II (1 Credit Hour)**
*Pre-requisites:* PIOL 500
Professional Development will meet and have self-directed study time throughout the spring semester of the MSMP program. Students will receive bi-weekly, specific individualized one-on-one mentoring from their academic advisors and also meet with the course director for specific lectures on their AMCAS and AACOMAS applications for medical and DO schools. Students will continue to enhance their knowledge of the admissions process by having general lectures and individual sessions discussing their motivation, enhancing their self-awareness, writing their personal statements, their selection of appropriate medical schools, selection of activities (community and medical volunteering, health care exposure (shadowing, scribing, etc.), research for their application, overall discussions on writing their secondary statements, choice of letters of recommendation, etc. MSMP students only.
*Outcomes:*
Following successful completion of this course, the MSMP student will: 1) Demonstrate enhanced ability for self-awareness and analysis regarding their medical school application; 2) Demonstrate self-reflection in the selection of target medical schools, discussing their fit in terms of each medical school's mission statement; 3) Continue working with their academic advisor to prepare a well-written personal statement appropriately tailored to the professional program of choice; 4) Demonstrate understating of the application process and preparation of application forms

**PIOL 595 Thesis Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the masters of science thesis and degree.

**PIOL 600 Dissertation Supervision (0 Credit Hours)**
Supervised research and writing leading to the completion of the Ph.D. dissertation and degree.
*Course equivalencies:* BMSC600/MIIM600/PIOL600

**PIOL 605 Physiology Study (0 Credit Hours)**
Must be enrolled during fall semester of MS program in Physiology. Holding course to keep the student active in the program while completing MS degree requirements.