



College of OSTEOPATHIC MEDICINE

Andrea Amalfitano,
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The College of Osteopathic Medicine, established by charter in 1964 as the private Michigan College of Osteopathic Medicine, became a component college of Michigan State University by action of the state legislature in 1969. The college provides a professional osteopathic physician educational program leading to the Doctor of Osteopathic Medicine (D.O.) degree. In addition, the college has a dual degree program that allows students who wish to become medical scientists to pursue a D.O. and a Ph.D. simultaneously. A separate program enables students to complete dual degrees, the D.O. and the Master of Business Administration via the MSU Broad College of Business. The college offers its pre-clinical education (first two years) at three sites: the East Lansing campus, the Detroit Medical Center, and the Macomb University Center in Clinton Township.

The basic science departments of the college are Biochemistry and Molecular Biology, Microbiology and Molecular Genetics, Pharmacology and Toxicology, and Physiology. Students in these departments may earn M.S. and Ph.D. degrees. A Master of Science degree and graduate certificate are also available in Global Health. The clinical departments are Family and Community Medicine, Neurology and Ophthalmology, Orthopedics, Osteopathic Manipulative Medicine, Osteopathic Medical Specialties, Osteopathic Surgical Specialties, PA Medicine, Pediatrics, Physical Medicine and Rehabilitation, Psychiatry, and Radiology.

The college is integrated with health care systems, community hospitals, federally qualified health centers and clinical practices across the State of Michigan. The college's Statewide Campus System has been a nationally recognized leader in pre- and postdoctoral medical education.

THE MISSION OF THE COLLEGE

Preparing physicians in the science of medicine, the art of caring and the power of touch with a world view open to all people.

PROFESSIONAL PROGRAM IN OSTEOPATHIC MEDICINE

The College of Osteopathic Medicine at Michigan State University (MSUCOM) offers a professional graduate program leading to the degree of Doctor of Osteopathic Medicine (D.O.). The program is accredited by the Commission on Osteopathic College Accreditation (COCA).

The D.O. program is organized to develop the knowledge, skills, attitudes and behaviors consistent with the competent practice of osteopathic medicine. The four-year program is divided into preclerkship and clerkship phases. In the preclerkship phase, the foundational biomedical sciences and clinical disciplines are presented through an integrated curriculum. Students are introduced to clinical skills, including professional development, data gathering, physical examination, diagnostic reasoning, and osteopathic principles and their application to patient care. Early clinical experiences and patient encounters are interwoven to promote connections. The clerkship phase provides immersive training across core clinical disciplines in the MSUCOM Statewide Campus System, as well as options for elective rotations throughout Michigan and elsewhere. Throughout the program, there is longitudinal integration of the osteopathic core competencies, including development of professionalism and communication skills for interprofessional patient care; strategies for self-directed, lifelong learning; and application of principles of research and scholarly inquiry.

Admission

The science and practice of osteopathic medicine require an understanding of the relationships among the physical, biological, psychological, cultural, and environmental aspects of human behavior. Thus osteopathic education requires preparation in the natural, social, and behavioral sciences and the humanities. Candidates are expected to demonstrate their ability to work and think independently and in a scholarly manner. The mean grade-point average of students who are admitted to the program is 3.5 to 3.6.

OSTEOPATHIC MEDICINE
Professional Program in Osteopathic Medicine

Applicants for admission to the first-year class in the college must meet the following minimum requirements:

1. Completion of at least 90 semester credits in a college or university accredited by a regional accrediting commission of higher education.
2. Completion of 8 semester credits of biology with no grade below 2.0, including both course work and laboratory work in general biology or general zoology.
3. Completion of 16 semester credits of chemistry, including three semester credits of biochemistry, with no grade below 2.0.
4. Completion of 6 semester credits of English—including both oral and written English, with no grade below 2.0.
5. The Medical College Admission Test (MCAT) must be taken by the end of September of the year application is being made. Scores cannot be more than 3 years old.
6. Suggested science course electives include anatomy, physiology, microbiology, histology, and statistics at the 300-400 level.
7. Suggested medical humanities and ethics electives include course work in philosophy, history of medicine and medical ethics.

An application must be completed and all official transcripts submitted to the American Association of Colleges of Osteopathic Medicine Application Service (AACOMAS). It is highly recommended that the application be submitted no later than June 1 of the application year for students who wish to begin classes the following spring. The Michigan State University College of Osteopathic Medicine forwards to all applicants a secondary application. Early application is essential because the college admits its students on a rolling basis. Michigan State University College of Osteopathic Medicine classes begin in June. Most Admissions Committee reviews are conducted between September and March. Selection of students for the class and for the waiting list is generally completed by early April.

Requirements for the Doctor of Osteopathic Medicine Degree

The standard duration of the D.O. degree program is four years. A student may be granted up to six years to complete all degree requirements, as defined in the MSUCOM Policy for Retention, Promotion, and Graduation. Specific program requirements leading to conferral of the D.O. degree include:

1. Completion of each required course in the preclerkship and clerkship phase with a passing grade or successful remediation.
2. Passing score on the National Board of Osteopathic Medical Examiners (NBOME) COMLEX-USA Level 1, COMLEX-USA Level 2 Cognitive Evaluation (CE), and COMLEX-USA Level 2 Performance Evaluation (PE) licensure examinations, with no more than three (3) attempts permitted on each examination.
3. Compliance with annual training requirements of the Responsible Conduct of Research (RCR) program.
4. Achievement of the academic requirements and professional conduct expectations of the D.O. program as outlined in the policies and procedures of MSUCOM and MSU.

Preclerkship Curriculum

The preclerkship curriculum consists of 98 required credit hours across seven semesters, representing years one and two of the four-year program. The courses are offered in a predefined sequence. Successful completion of each course in a semester is required to advance to the following semester. The following courses are required:

CREDITS

ANTR	510	Clinical Human Gross Anatomy and Palpatory Skills	8
BMB	516	Metabolic Biochemistry: Nutrients and Products	1
BMB	528	Molecular Biology and Medical Genetics	2
FCM	640	Principles of Family Medicine I	1
FCM	650	Principles of Family Medicine II	1
MMG	531	Medical Immunology	2
MMG	532	Medical Microbiology	2
OMM	511	Osteopathic Manipulative Medicine I	1
OMM	512	Osteopathic Manipulative Medicine II	1
OMM	513	Osteopathic Manipulative Medicine III	1
OMM	514	Osteopathic Manipulative Medicine IV	1
OMM	515	Osteopathic Manipulative Medicine V	1
OST	551	Osteopathic Patient Care I	2
OST	552	Osteopathic Patient Care II	2
OST	553	Osteopathic Patient Care III	3
OST	554	Osteopathic Patient Care IV	3
OST	555	Osteopathic Patient Care V	3
OST	556	Pediatrics I	1
OST	557	Pediatrics II	1
OST	558	Pediatrics III	1
OST	571	Neuromusculoskeletal System	10
OST	572	Genitourinary System	3
OST	573	Endocrine System	3
OST	574	Female Reproductive System	3
OST	575	Gastrointestinal System	6
OST	576	Integumentary System	2
OST	577	Psychopathology	2
OST	578	Hematopoietic System	2
OST	579	Cardiovascular System	9
OST	580	Respiratory System	6
OST	582	Transitions I – Board Preparation	6
OST	583	Geriatrics	1
OST	598	Evidence-Based Health Science	1
PHM	564	Basic Principles of Medical Pharmacology	2
PSL	539	Principles of Cell Biology and Pathophysiology	4

Clerkship Curriculum

The clerkship curriculum consists of 133 required credit hours in years three and four of the four-year program. Students may advance to clinical rotations after successful completion of the COMLEX-USA Level 1 examination. During the clerkship curriculum, students will complete 77 credits, among six semesters, of required clinical clerkship core rotation courses and an additional 56 credits, among six semesters, to be selected from available required clinical clerkship elective rotation courses. Core rotation courses are scheduled by the COM Clerkship Office and Base Hospital training site and may occur in different sequences. Most core rotation courses are completed during year three. Two required longitudinal courses span each of the third and fourth year.

CREDITS

Required Clinical Clerkship Core Rotation Courses:

FCM	620	Core Family Medicine Clerkship	6
FCM	622	Core Family Medicine Sub-Internship	6
Or			
IM	658	Core Internal Medicine Outpatient Clerkship	6
IM	650	Core Internal Medicine In-Patient Clerkship	6
IM	657	Core Emergency Medicine Clerkship	6
IM	658	Core Internal Medicine Out-Patient	6
Or			
FCM	622	Core Family Medicine Sub-Internship	6
IM	660	Core Internal Medicine Sub-Internship	6
NOP	656	Core Neurology Clerkship	6
OMM	602	Osteopathic Principles and Practice Clerkship	2
OSS	651	Core Obstetrics and Gynecology Clerkship	6
OST	602	Primary Care Ambulatory	5
OST	603	Core Clinical Concepts	9
OST	604	Essential Clinical Skills for Senior Medical Students	1
OST	653	Core Surgery Clerkship	6
PED	600	Core Pediatrics Clerkship	6
PSC	608	Psychiatry and Behavioral Science Clerkship	6

Required clinical elective clerkship rotation courses: the student must complete 56 credits (or 40 weeks) of additional clinical elective clerkship rotation courses; 18 credits (12 weeks) must be chosen from the medicine category and 12 credits (8 weeks) must be chosen from the surgery category. The additional 10 weeks can be chosen from either the medicine or surgery category.

A complete list of required clinical clerkship elective rotation courses includes:

ANTR	685	Directed Study in Clinical Prosection	1 to 6
FCM	621	Family Medicine Specialty Rotation	1 to 24
HM	610	Pathology Clerkship	3 to 6
IM	621	Clinical Tropical Medicine Clerkship	1 to 20
IM	651	Cardiology Clerkship	1 to 20
IM	652	Gastroenterology Clerkship	1 to 20
IM	653	Oncology and Hematology Clerkship	1 to 20
IM	654	Pulmonary Disease Clerkship	1 to 20
IM	655	Nephrology Clerkship	1 to 20
IM	659	Medical Critical Care Clerkship	1 to 20
IM	661	Internal Medicine Specialty Clerkship	1 to 20

IM	662	Urgent Care Clerkship	1 to 20
IM	663	Emergency Medicine/Wilderness/Austere Medicine Clerkship	1 to 20
IM	664	Pediatric Emergency Medicine Clerkship	1 to 20
IM	665	Emergency Medicine Advanced Clerkship	1 to 20
IM	666	Emergency Medicine Toxicology	3 to 18
IM	667	Emergency Medicine Hyperbaric Medicine and Wound Management	3 to 18
IM	668	Emergency Medicine EMS and Disaster Management	3 to 18
IM	669	Emergency Medicine Ultrasound	3 to 18
NOP	657	Neurology Specialty Clerkship	1 to 24
OMM	601	Osteopathic Manipulative Medicine Clerkship	1 to 20
OST	615	Biomedical Research Clerkship	3 to 18
OST	685	International Clerkship Rotations	1 to 20
OST	686	Global Health: Mexico – Clinical Immersion	1 to 20
OST	687	Global Health: Peru – Clinical Immersion	1 to 20
OST	688	Global Health: Cuba – Clinical Immersion	1 to 20
OST	689	Global Health: Haiti – Clinical Immersion	1 to 20
OST	690	Global Health: Dominican Republic - Clinical Immersion	1 to 20
PED	601	Pediatric Specialty Clerkship	3 to 24
PMR	601	Physical Medicine and Rehabilitation Clerkship	1 to 18
PSC	609	Adult Psychiatry Clerkship	3 to 6
PSC	610	Child Psychiatry Clerkship	3 to 6
PSC	611	Addiction Psychiatry Clerkship	3 to 6
PSC	612	Geriatric Psychiatry Clerkship	3 to 6
RAD	609	Radiology Clerkship	3 to 12
RAD	610	Core Radiology Clerkship	1 to 20

The following rotation courses are credited toward the surgery requirement:

NOP	620	Ophthalmology Clerkship	1 to 24
OSS	640	Cardio Thoracic/Vascular Surgery Clerkship	1 to 20
OSS	641	Facial and Plastic Reconstruction Surgery Clerkship	1 to 20
OSS	642	Neurosurgery Clerkship	1 to 20
OSS	643	Podiatry Clerkship	1 to 20
OSS	644	Sports Medicine Clerkship	1 to 20
OSS	645	Urology Clerkship	1 to 20
OSS	646	Maternal Fetal Medicine Clerkship	1 to 20
OSS	647	Reproductive Endocrine Clerkship	1 to 20
OSS	648	Anesthesiology Advanced Clerkship	3 to 30
OSS	652	Obstetrics and Gynecology Specialty Clerkship	1 to 20
OSS	654	Core Anesthesiology Clerkship	1 to 20
OSS	655	Pain Management Clerkship	1 to 20
OSS	656	Orthopedic Clerkship	1 to 20
OSS	658	Otorhinolaryngology Clerkship	1 to 20
OSS	663	General Surgery	1 to 20

The number of rotation/course weeks determines the assigned credits.

Transfer Credits

For a student who is pursuing a full-time M.B.A. degree from MSU jointly with a Doctor of Osteopathic Medicine (D.O.) degree from Michigan State University - College of Osteopathic Medicine, a maximum of 12 credits from the MSU College of Osteopathic Medicine may be transferred to the full-time M.B.A. degree program.

GRADUATE STUDY

The college's graduate programs serve the need for trained medical educators and scientists. The college educates graduate students broadly in the basic subject matter pertaining to their chosen fields of study, trains them for teaching and research in specialized aspects of their field, and develops their independent and creative thinking abilities. The graduate study program for each student is arranged to suit individual needs within the general graduate regulations of the unit, college and university.

The college provides an opportunity for graduate study which emphasizes a single discipline or bridges multiple disciplines. The Master of Science and Doctor of Philosophy degrees are attainable separately or together with the Doctor of Osteopathic Medicine degree. A Master of Science degree and Graduate Certificate in Global Health are also available. The college also provides opportunities for postdoctoral research training. Financial aid is available competitively for all levels of graduate study.

Disciplinary graduate degree programs are offered by the departments of Biochemistry and Molecular Biology, Microbiology and Molecular Genetics, Pharmacology and Toxicology, and Physiology. An interdisciplinary program may be arranged by combining the disciplinary graduate degree programs of two departments. Other units in the college may provide tutelage and facilities for graduate training and arrange for a disciplinary

graduate degree in cooperation with one of the departments that offer degree programs.

The four departments, listed above, offering graduate study programs are responsible to the College of Osteopathic Medicine jointly with other colleges. Whether a student's program is administratively associated with the College of Osteopathic Medicine depends on the nature of the proposed program and the career aspirations. A student accepted for admission by a given unit may apply for association with the College of Osteopathic Medicine.

The College of Osteopathic Medicine partners with the Eli Broad College of Business to offer a Master of Business Administration joint-degree program jointly administered by both colleges. For information about the Doctor of Osteopathic Medicine and Master of Business Administration dual-degree program, contact the Associate Dean in either college.

The College of Osteopathic Medicine cooperates with the Colleges of Human Medicine, Nursing, and Social Science in offering the Master of Public Health in Public Health degree (M.P.H.), which is administered by the College of Human Medicine. For information about the Master of Public Health degree in Public Health, refer to the statement in the *College of Human Medicine* section of this catalog.

Students who are enrolled in the professional program that leads to the Doctor of Osteopathic Medicine degree may elect specializations in Infancy and Early Childhood. For additional information, refer to the statement on *Interdepartmental Graduate Specializations in Infancy and Early Childhood* in the *College of Social Science* section of this catalog.

Master of Science

The Master of Science degree is offered by the departments of Biochemistry and Molecular Biology, Microbiology and Molecular Genetics, Pharmacology and Toxicology, and Physiology.

Attainment of a master's degree requires excellence in scholarly motivation and achievement. The programs for the degree emphasize a broad education and an introduction to research in a chosen field of study.

In addition to meeting the requirements of the University, students must meet the requirements specified below.

Admission

Admission to a master's degree program may be granted to a student who has a record of academic excellence and is acceptable to a unit and the college. Units may require applicants to take and submit the results of the Graduate Record Examination. An undergraduate major or its equivalent in an appropriate subject-matter field is required. Normally, a grade-point average of at least 3.00 in previous academic work is required for admission to regular status. Students with incomplete records, incomplete interpretation of available records, or minor deficiencies may be admitted to provisional status.

Requirements for the Degree

A major advisor is appointed, and a guidance committee may be appointed, with the consent of the student to help the student plan a program of study and research. A copy of the approved program is filed with the unit and the college.

The minimum number of credits required for the master's degree is 30, including 4 credits of master's thesis research for students enrolled under Plan A. A maximum of 10 credits may be authorized for thesis research. Upon the completion of the program and a report or thesis on the research, the student takes a final oral examination conducted by a faculty committee appointed by the unit chairperson. A committee report, including recommen-

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Graduate Study

datations about further graduate study by the student, is filed with the unit chairperson and the dean.

Time Limit

The time limit for the completion of the master's degree is six calendar years from the beginning of the first semester in which credit was earned toward the degree.

Doctor of Philosophy

Attainment of the Doctor of Philosophy degree requires excellence in scholarship and comprehensive knowledge in a chosen field of study. Programs for the degree emphasize training for original research and teaching in a specialized aspect of the chosen field of study, the development of independent and creative thinking, and the completion of a dissertation that represents a new and significant contribution to knowledge. The departments of the college which offer programs leading to the Doctor of Philosophy degree are Biochemistry, Microbiology, Pharmacology and Toxicology, and Physiology.

In addition to meeting the requirements of the University, students must meet the requirements specified below.

The College of Natural Science administers an interdepartmental doctoral degree program in cell and molecular biology and an interdepartmental doctoral degree program in genetics.

Admission

Admission to a doctoral program may be granted to a student who has a record of academic excellence and is acceptable to a unit and the college. Units may require applicants to take and submit the results of the Graduate Record Examination. Normally, a grade-point average of at least 3.00 in previous academic work is required for admission to regular status. Students with incomplete records, incomplete interpretation of available records, or minor deficiencies may be admitted to provisional status.

A master's degree in an appropriate subject-matter field may be required for admission to a doctoral program. If a student is admitted without a master's degree, course credits equivalent to those earned for a master's degree are required as part of the doctoral program.

Guidance Committee

The guidance committee files a report with the unit. For the purpose of evaluating the final oral examination and the dissertation, the guidance committee may be supplemented by two additional faculty members appointed by the dean. A committee report, bearing the vote and signature of each member and the comments by any dissenting member, is filed with the unit and the college.

GLOBAL HEALTH

Master of Science

The Master of Science degree in Global Health is an interdisciplinary degree administered by the College of Osteopathic Medicine in partnership with faculty from the Colleges of Arts and Letters, Communication Arts and Sciences, Nursing, Social Science, and Veterinary Medicine. The program stresses the interconnectedness of the animal, environment and human health and is applicable to a broad range of health professionals such as medical, nursing, or veterinary medicine as well as individuals interested in a holistic view of global health. The program prepares

individuals to both manage and lead as global health professionals. Individualized programs of study can be tailored to accommodate individuals with a broad range of academic and professional experience and interests. The program is available online only.

In addition to meeting the requirements of the University and the College of Osteopathic Medicine, students must meet the requirements below.

Admission

To be considered for admission to the Master of Science degree in Global Health, an applicant must submit the following:

- 1. A transcript showing a completed undergraduate degree.
- 2. A personal statement describing interest and experience in global health, including career goals.
- 3. A resume or curriculum vitae.
- 4. A test of English language proficiency for students for whom English is not a first language.

Requirements for the Master of Science Degree in Global Health

The Master of Science degree in Global Health is available online only and only under Plan B (non-thesis). Students must complete 30 credits as specified below:

	CREDITS
1. All of the following courses (27 credits):	
OST 821 One Health – Transdisciplinary Collaborations to Global Health	3
OST 822 Introduction to Global Health Practice	3
OST 823 Global Burden of Disease	3
OST 824 Emerging Topics in Global Health	3
OST 825 Ethical Issues in Global Health	3
OST 827 Global Health Management	3
OST 828 Global Health Capstone	3
OST 829 Global Health Community Assessment	3
OST 831 Evidence-Based Practice in Global Health	3
2. Complete 3 credits from the following courses:	
CAS 826 Health Communication for Diverse Populations	3
OST 686 Global Health: Mexico – Community Medicine and Mayan Culture in the Yucatan	3
OST 687 Global Health: Peru Medical Service	3
OST 688 Global Health: Cuban Healthcare Delivery System	3
OST 689 Global Health: Haiti – Introduction to Global Health and Culture	3
OST 690 Global Health: Dominican Republic – Healthcare Delivery System and Culture	3
OST 691 Global Health: Guatemala – Tropical Medicine and Infectious Disease	1
OST 692 Global Health: Turkish Healthcare Delivery System and Culture	3
OST 693 Global Health: Korean Healthcare Delivery System	3
OST 694 Global Health: One Health in Nepal	3
OST 830 Independent Study in Global Health	1 to 3
3. Successfully complete a capstone professional paper.	

GRADUATE CERTIFICATE IN GLOBAL HEALTH

The Graduate Certificate in Global Health is an interdisciplinary certificate administered by the College of Osteopathic Medicine in partnership with faculty from the Colleges of Arts and Letters, Nursing, and Veterinary Medicine. The certificate stresses the interconnectedness of the animal, environment and human health and is applicable to a broad range of health professionals such as medical, nursing, or veterinary medicine as well as individuals interested in a holistic view of global health. The certificate prepares individuals to both manage and lead as global health professionals. Individualized programs of study can be tailored to accommodate individuals with a broad range of academic and professional experience and interests. The certificate is available online only.

Admission

To be considered for admission to the Graduate Certificate in Global Health, an applicant must submit the following:

1. A transcript showing a completed undergraduate degree.
2. A personal statement describing interest and experience in global health, including career goals.
3. A resume or curriculum vitae.
4. A test of English language proficiency for students for whom English is not a first language.

Requirements for the Graduate Certificate in Global Health

The certificate program is available online only. Students must complete 9 credits from the following:

			CREDITS
1.		Complete the following course:	
	OST 822	Introduction to Global Health Practice	3
2.		Complete 6 credits from the following:	
	OST 821	One Health – Transdisciplinary Collaborations to Global Health	3
	OST 823	Global Burden of Disease	3
	OST 824	Emerging Topics in Global Health	3
	OST 830	Independent Study in Global Health	3

Dual Degree Medical Scientist Training Program

The Dual Degree Medical Scientist Training Program is a special program for students who want to earn both a professional medical doctoral degree (Doctor of Osteopathic Medicine) and a graduate research doctoral degree (Doctor of Philosophy). The program seeks to meet a national need for physicians who are proficient in research as well as in medicine, and who will pursue careers as faculty members in medical schools and institutes.

The program is designed to select, educate, and train highly motivated students having outstanding research and academic qualifications. Trainees pursue medical and graduate studies in parallel, meet regularly with peers in seminars, and engage in medical and graduate level courses and clerkships, as well as in research with highly qualified mentors.

A student who is interested in this program should contact the office of the associate dean for research and advanced study in the College of Osteopathic Medicine.

For additional information, refer to the statement on *Special Programs* in the *Graduate Education* section of this catalog.

Postdoctoral Research Training

Postdoctoral training increasingly is necessary for students who want to pursue careers in biomedical research. The college offers individualized programs for such advanced graduate study in most of its units. Postdoctoral training is normally obtained with a faculty member who is established and productive in a particular area of research. Application, acceptance, and program are arranged by the student and the faculty member with the concurrence of the unit chairperson. Students who hold either the Ph.D or the D.O. degree are encouraged to consider further training in research, which may provide an alternative to a second doctoral degree as preparation for a career as a medical educator and scientist. Substantive financial aid is available competitively through fellowships and traineeships awarded to the student directly and associateships provided by the faculty member from a grant or contract. Usually, postdoctoral research training requires two years or more, and accomplishment is evidenced in the publication of articles in refereed scientific journals.

Facilities for Research and Service

In addition to its disciplinary departments and interdisciplinary programs, the College provides certain specialized facilities such as the Carcinogenesis Laboratory, and the Department of Osteopathic Manipulative Medicine. Students who are pursuing Doctor

of Philosophy degrees may make arrangements through their major departments to study in these facilities. Postdoctoral study in these facilities may be arranged with an appropriate faculty member.

Administration of Research and Graduate Study

A graduate study advisory committee represents the College faculty and provides advice and recommendations to the Dean on graduate study in the college.

The Institute for Research and Advanced Study serves to promote and foster research and graduate and postdoctoral study in the college. This Institute provides general information about predoctoral and postdoctoral study and refers interested persons to appropriate units or facilities for more specific information. This Institute also offers assistance in applying for extramural grants, contracts, and fellowships.

The Office for Graduate Medical Education and the Office of Continuing Medical Education, respectively, provide for medical postdoctoral clinical training and for continuing medical education customarily associated with professional certification and licensing requirements.

DEPARTMENT of BIOCHEMISTRY and MOLECULAR BIOLOGY

Eric Grotewold, Chairperson

GRADUATE STUDY

The Department of Biochemistry and Molecular Biology is administered jointly by the colleges of Osteopathic Medicine, Human Medicine, and Natural Science. These colleges offer Master of Science and Doctor of Philosophy degree programs with a major in biochemistry and molecular biology. In addition, the College of Natural Science offers a Doctor of Philosophy degree program in biochemistry and molecular biology—environmental toxicology along with options for dual majors in a variety of disciplines. For additional information about the department and its graduate degree programs, refer to the statement on the *Department of Biochemistry and Molecular Biology* in the *College of Natural Science* section of this catalog.

BIOMOLECULAR SCIENCE GATEWAY - FIRST YEAR

Students are encouraged to apply for admission to the Ph.D. program through the BioMolecular Science Gateway – First Year, where students choose a doctoral major from any of six Ph.D. programs: biochemistry and molecular biology, cell and molecular biology, genetics and genome sciences, microbiology and molecular genetics, pharmacology and toxicology, or physiology. For additional information refer to the *College of Natural Science* section of this catalog.

DEPARTMENT of FAMILY and COMMUNITY MEDICINE

Amy Jane Keenum, Chairperson

Family medicine is medical care provided by a primary care physician who becomes a partner with all family members to help them understand the ways to achieve comprehensive healthcare. This approach to medical care embraces the concept of, and concern for, the whole patient and the impact of the environment on patient health. A primary care physician becomes a partner with all family members. This approach to medical practice embraces the concept of, and concern for, the whole patient and the impact of the patient's environment upon health. This practitioner stresses health maintenance, diagnoses illness, undertakes treatment, institutes short- and long-term follow-up care, and makes appropriate referrals to other health care providers.

The goal of family medicine is to develop a competent practitioner who can provide total medical care. The curriculum is built on the philosophy of early and continued exposure to both the clinical and didactic aspects of medicine through reinforcement and integration of classroom learning to clinical practice. Student physicians are introduced to a variety of health care settings through clinical training programs designed to provide them with a broad base of skills required to function in the field of family medicine.

The department, a unit within the College of Osteopathic Medicine, is committed to conducting research in both clinical and medical educational settings. Departmental research is broad-based and support for student research is an integral part of the departmental mission.

DEPARTMENT of MICROBIOLOGY and MOLECULAR GENETICS

Victor DiRita, Chairperson

GRADUATE STUDY

The Department of Microbiology and Molecular Genetics is administered jointly by the colleges of Osteopathic Medicine, Human Medicine, Natural Science, and Veterinary Medicine. All four of these colleges offer a Master of Science degree in microbiology and molecular genetics and a Doctor of Philosophy degree in microbiology and molecular genetics. In addition, the College of Veterinary Medicine offers a Doctor of Philosophy degree program with a major in microbiology—environmental toxicology. For additional information about the department and its graduate degree programs, refer to the statement on the *Department of Microbiology and Molecular Genetics* in the *College of Natural Science* section of this catalog.

BIOMOLECULAR SCIENCE GATEWAY - FIRST YEAR

Students are encouraged to apply for admission to the Ph.D. program through the BioMolecular Science Gateway – First Year, where students choose a doctoral major from any of six Ph.D. programs: biochemistry and molecular biology, cell and molecular bi-

ology, genetics and genome sciences, microbiology and molecular genetics, pharmacology and toxicology, or physiology. For additional information refer to the *College of Natural Science* section of this catalog.

DEPARTMENT of NEUROLOGY and OPHTHALMOLOGY

David Kaufman, Chairperson

The Department of Neurology and Ophthalmology, established July 1, 2000, is an outgrowth of the former neuro-ophthalmology unit that has existed on campus since 1986. The department lead is through the College of Osteopathic Medicine. It offers accredited residency programs in neurology; fellowship programs in neuro-ophthalmology, stroke, neuro-intervention, neurophysiology, epilepsy, and neuro-epidemiology; and clinical and research programs for medical and graduate students. The Department has Accreditation Council for Graduate Medical Education (ACGME) approval for its neurology residency and subspecialty fellowships. It also provides academic oversight for multiple ophthalmology residency programs statewide.

Its broad research portfolio is supported by multiple National Institutes of Health (NIH) grants and other extramural funding. Major themes of the department's research are to use the eyes as a model for brain disease. It also has major research interest in stroke, neuro-intervention, muscle and peripheral nerve disease, neuro-degenerative disease, epilepsy, sports concussion and demyelinating disease. The department shares research and clinical faculty with affiliated clinical and research laboratories on the MSU campus, state and worldwide including sub-Saharan Africa.

The clinical responsibilities of the department are fulfilled by on campus neurologists and neuro-ophthalmologists who have subspecialty training in a number of different disciplines of neurology. To enrich its research, clinical and educational programs, the department also collaborates with numerous clinicians statewide, nationally and internationally. MSU's International Neurology, Psychiatry and Epidemiology Programs (INPEP) are administered through this unit and has outposts in several countries in sub-Saharan Africa.

DEPARTMENT of ORTHOPEDICS

Douglas P. Dietzel, Chairperson

The Department of Orthopedics is administered jointly by the colleges of Osteopathic Medicine and Human Medicine. The College of Osteopathic Medicine is the primary administrative unit. The Department of Orthopedics aims to provide the best care with all aspects of bone, joint disorders, and orthopedic disease processes. We seek advanced understanding and treatment options of these conditions through research and other scholarly work, and educate the next generation of physicians, scientists, and providers in the field both locally and globally. The department's responsibilities include: preclinical and clinical medical student teaching, preclinical and clinical physician assistant stu-

dent teaching, Primary Care and Orthopedic Surgery residency training, Primary Care Sports Medicine Fellowship training, Physical Medicine and Rehabilitation Sports Medicine Fellowship training, and Physician Extender Resident training.

DEPARTMENT of OSTEOPATHIC MANIPULATIVE MEDICINE

Lisa A. DeStefano, Chairperson

The Department of Osteopathic Manipulative Medicine represents a specialty discipline within the College of Osteopathic Medicine. The primary responsibility of the department is to provide instruction to osteopathic medical students in the areas of osteopathic principles, practices and methods as part of their preparation for the practice of osteopathic medicine. This responsibility is fulfilled through the delivery of classroom, laboratory, hospital, and clinic programs that provide quality education and experience. The department also participates in the Statewide Campus System, providing clinical training at both the predoctoral and postgraduate medical education levels. In addition, the department is committed to research, high quality patient care, and continuing medical education programs to improve the quality, recognition, and delivery of osteopathic health care to the public.

DEPARTMENT of OSTEOPATHIC MEDICAL SPECIALTIES

Mary Jo Hughes, Chairperson

The Department of Osteopathic Medical Specialties is organized to represent general internal medicine and its major subspecialties in the College of Osteopathic Medicine. In addition, emergency medicine is housed as a section in the department. The basic responsibility of this department is to lead the education of students via a systems biology approach in the maintenance of health and in the recognition and treatment of disease, participate in the curriculum across the continuum of years 1-4 by participation and leadership in course offerings, maintenance of clinical practice venues in which to educate medical students, and participation and leadership in the education of adult learners through the continuum of graduate medical education and beyond. Department members also participate in the administration of the college and university where appropriate. The department is committed to clinical and basic science research on a local, national and international level; the development of continuing medical educational programs for the profession and the public; and to the broad mission of improved and efficient medical care.

DEPARTMENT of OSTEOPATHIC SURGICAL SPECIALTIES

W. Britt Zimmerman, Acting Chairperson

The Department of Osteopathic Surgical Specialties (OSS) include the divisions of anesthesiology, general surgery, obstetrics and gynecology, orthopedics, podiatry, and urology. The MSU Center for Orthopedic Research (MSUCOR) is a research-focused group of faculty. Medical students are trained in the surgical specialties through systems courses and hospital/office-based training. Students are provided with a broad-based surgical curriculum within our Statewide Campus System (SCS) with postgraduate training in the multiple surgical specialties. In addition, OSS is committed to developing and assisting with research programs, community health services, and state and national quality initiatives. These contribute to improving the quality and efficacy of health services for residents in Michigan and the wider community.

DEPARTMENT of PA MEDICINE

John McGinnity, Director

The Department of PA Medicine in the College of Osteopathic Medicine at Michigan State University offers a 27-month curriculum leading to a Master of Science Degree in PA Medicine. PAs are medical professionals who diagnosis illness, develop and manage treatment plans, prescribe medication, and often serve as a patient's principal healthcare provider. PAs practice in every medical specialty and collaborate in a team-based environment to provide medical care to a diverse patient population.

The curriculum leading to the degree includes four semesters of classroom and laboratory course work, and three semesters of community-based clinical courses. The curriculum is divided into two components: the preclinical curriculum, presented in the first four semesters which focuses on the basic medical sciences and detailed coverage of the human body systems, and the development of clinical skills required to practice medicine; and the clinical curriculum during the final three semesters of the 27-month PA Medicine program which includes clinical training in community hospitals, clinics, and private practice offices affiliated with the Michigan State University College of Osteopathic Medicine PA Medicine from across the State of Michigan.

In addition to meeting the requirements of the University and the College of Osteopathic Medicine, students must meet the requirements below.

PA MEDICINE

Admission

To be considered for admission to the Master of Science degree in PA Medicine, an applicant must submit the following:

1. The MSU Graduate School application.
2. The CAPSA (Central Application Service for Physician Assistants) application.
3. A transcript showing a completed undergraduate degree.

OSTEOPATHIC MEDICINE
Department of PA Medicine

4. A personal statement describing interest and experience in PA Medicine, including career goals.
5. Three letters of reference.
6. A test of English language proficiency for students for whom English is not a first language. The minimum requirement TOEFL score may vary from the general university requirements. The exam must be taken by May 1 of the application cycle year and the score received by June 15 of the same year. A score of 100 on the Ibt (Internet based testing) must be attained.
7. A transcript showing completion of prerequisite courses in anatomy, biochemistry, developmental psychology, English composition, general chemistry, human physiology microbiology with laboratory, and statistics. Students are allowed only two course retakes.

Students will be evaluated by an MSU College of Osteopathic Medicine PA Medicine screening team who will employ a rubric inclusive of the evaluation of academic performance, interview outcome, extracurricular experiences, letters of recommendation, and personal statements to determine eligibility for admission. Membership in professional organizations are preferred, but not required. Final admission decisions will be determined by the screening team which consists of PA Medicine and College of Osteopathic Medicine faculty, as well as community healthcare providers.

Requirements for the Master of Science Degree in PA Medicine

CREDITS

The Master of Science degree in PA Medicine is available only under Plan B (non-thesis). Students must complete 108 credits as specified below:

1. Complete all of the following courses (108 credits):

PA 801	PEAK Study Skills	1
PA 810	Clinical Human Anatomy	8
PA 828	Genetics	2
PA 832	Microbiology	2
PA 839	Pathophysiology	2
PA 851	Physical Examination I	3
PA 852	Physical Examination II	3
PA 853	Physical Examination III	3
PA 854	Physical Examination IV	3
PA 855	Procedures and Diagnostics I	1
PA 856	Procedures and Diagnostics II	1
PA 857	Procedures and Diagnostics III	2
PA 858	Procedures and Diagnostics IV	2
PA 864	Pharmacology	2
PA 871	Medicine I	3
PA 872	Medicine II	4
PA 873	Medicine III	4
PA 874	Medicine IV	4
PA 880	Medical History and Documentation	3
PA 881	Medical Ethics	2
PA 882	Primary Care Applications	2
PA 883	Introduction to Clinical Rotations	1
PA 884	Business of Healthcare	2
PA 900	Pediatrics Clinical Practicum	4
PA 908	Behavioral Health Clinical Practicum	4
PA 910	Clinical Elective	4
PA 920	Family Medicine Clinical Practicum	4
PA 940	Internal Medicine Clinical Practicum	4
PA 950	Internal Medicine Subspecialty Elective	4
PA 951	Women's Health Clinical Practicum	4
PA 953	Surgery Clinical Practicum	4
PA 955	Surgical Subspecialty Elective	4
PA 957	Emergency Medicine Clinical Practicum	4
PA 958	Ambulatory Medicine Elective	4
PA 990	PA Medicine Competence Experience	1
PA 992	Public Health and Disease Prevention	1
PA 993	Osteopathic Manipulation Medicine	1
PA 998	Research and Evidence Based Medicine	1
2. Successfully complete a final evaluation.

DEPARTMENT of PEDIATRICS

Joel S. Greenberg, Chairperson

The Department of Pediatrics, a unit of the College of Osteopathic Medicine, is concerned with the health care of the developing infant, child, and adolescent. The primary responsibility of the department is to educate osteopathic students, interns, residents and physicians with didactic and clinical experiences in osteopathic medicine as they relate to this age group. The Department of Pediatrics has a commitment to develop primary care physicians who are responsive to the needs of the community.

The department is involved in many phases of primary pediatric care both locally and throughout the state. It has specialists in pediatric infectious disease and genetics and pediatricians with special interests in sports medicine, attention deficit hyperactivity disorder, asthma, adolescent medicine, substance abuse, and chronic diseases which have broadened the scope of the department. Faculty members are involved in scholarly and research activities which provide opportunities for students and residents to participate in these areas.

DEPARTMENT of PHARMACOLOGY and TOXICOLOGY

Richard R. Neubig, Chairperson

The Department of Pharmacology and Toxicology is administered jointly by the colleges of Human Medicine, Osteopathic Medicine, and Veterinary Medicine. The College of Veterinary Medicine is the primary administrative unit. All three colleges offer a Master of Science degree program in Laboratory Research in Pharmacology and Toxicology, a Doctor of Philosophy degree program in Pharmacology and Toxicology, and a Graduate Certificate in Safety Pharmacology. The College of Osteopathic Medicine offers an online Master of Science degree program in Pharmacology and Toxicology, an online Master of Science degree program in Integrative Pharmacology, and an online Graduate Certificate program in Safety Pharmacology. In addition, the College of Veterinary Medicine offers a Doctor of Philosophy degree program with a major in pharmacology and toxicology—environmental toxicology.

The department is responsible for teaching the fundamental and applied aspects of pharmacology and toxicology and offers courses at the undergraduate, professional, and graduate levels.

A Minor in Pharmacology and Toxicology is available to undergraduates through the College of Veterinary Medicine.

GRADUATE STUDY

The graduate programs in Pharmacology and Toxicology are primarily designed to prepare students for careers in research, teaching, and related activities. Research interests range from the effects of drugs and chemicals on macromolecules to their actions in humans. Research strengths include neuropharmacology, neurotoxicology, cardiovascular pharmacology, cancer pharmacology and prevention, environmental toxicology, drug discovery, drug receptor pharmacology, gastrointestinal pharmacology, immunopharmacology, immunotoxicology, and integrative pharmacology.

The online Master of Science programs are designed for individuals who are seeking additional academic qualifications which will facilitate their advancement in their place of employment or enhance their competitiveness for admission to other advanced degree programs regardless of their geographic location or work schedule.

SAFETY PHARMACOLOGY

Graduate Certificate

The Graduate Certificate in Safety Pharmacology is an online program designed to train individuals in safety pharmacology, a distinct scientific discipline that incorporates the concepts of pharmacology, physiology, and toxicology. Students will examine the potential undesirable pharmacodynamic effects of substances on physiological functions in the cardiovascular, central nervous, and respiratory systems. The program follows the International Conference on Harmonisation (ICH) guidelines for safety pharmacology and is aligned with FDA regulations. By providing advanced science knowledge and training in safety pharmacology guidelines, students will be prepared to face the challenges of risk-benefit assessments required for evaluation of drug safety.

Admission

To be considered for admission to the Graduate Certificate in Safety Pharmacology, students must:

1. Have a bachelor's degree with at least one course in biology and one course in chemistry.
2. Write a reflective essay about why this certificate program would be well-suited for their future work.

Requirements for the Graduate Certificate in Safety Pharmacology

	CREDITS
Students must complete a minimum of 11 credits from the following courses (11 credits):	
1. All of the following courses (7 credits):	
PHM 819 Principles of Drug-Tissue Interactions	2
PHM 858 Drug Development Process	3
PHM 840 Safety Pharmacology	2
Students must attain grades of at least 3.0 in these core courses and an overall grade-point average of 3.00.	
2. At least 4 credits chosen from the following courses (4 credits):	
PHM 431 Pharmacology of Drug Addiction	3
PHM 450 Introduction to Chemical Toxicology	3
PHM 813 Cardiovascular Pharmacology and Toxicology	3
PHM 817 Neurotoxicology	2
PHM 829 Neuropharmacology	2
PHM 830 Experimental Design and Data Analysis	3
PHM 831 Endocrine Pharmacology and Toxicology	2
PHM 833 Gastro-Intestinal and Liver Pharmacology and Toxicology	2
PHM 834 Respiratory Pharmacology	2
PHM 835 Biopharmaceuticals: From Development to Manufacturing	3
PHM 841 Cellular and Molecular Toxicology	3
PHM 857 Project Management	2
3. Create an electronic portfolio.	

LABORATORY RESEARCH IN PHARMACOLOGY AND TOXICOLOGY

Master of Science

In addition to meeting the requirements of the university and of the colleges of Osteopathic Medicine, Human Medicine, or Veterinary Medicine, students must meet the requirements specified below.

Admission

The program leading to the Master of Science degree is usually restricted to those persons who have a medical doctorate or who are concurrently enrolled in a medical doctoral program.

Requirements for the Master of Science Degree in Laboratory Research in Pharmacology and Toxicology

The Master of Science in Laboratory Research in Pharmacology and Toxicology serves to broaden the scope of professional training to encompass scientific inquiry.

The student must complete 30 credits under Plan A (with thesis) as approved by the student's guidance committee.

INTEGRATIVE PHARMACOLOGY

The Master of Science degree in Integrative Pharmacology is an online program designed to train individuals in whole animal and organ systems-level pharmacology as well as to develop knowledge in business acumen. The program provides advanced science and practical knowledge in integrative pharmacology and is designed for individuals who seek career advancement and leadership roles in academic, government or industrial laboratories. The Master of Science degree in Integrative Pharmacology is especially suited to those individuals with some professional experience in laboratory research, but all graduates of biology or chemistry programs will benefit. Course work provides freedom to explore those physiological systems that will allow students to continue to build upon their current research endeavors, while providing skills to interface with colleagues in regulatory affairs, production, and marketing. All courses are offered online in order to provide full opportunity for students regardless of their geographic location or work schedules.

Master of Science

In addition to meeting the requirements of the university and of the College of Osteopathic Medicine, students must meet the requirements specified below.

Admission

Applicants will be accepted into the program after review of application materials by an admissions committee from the department. A faculty member in the Department of Pharmacology and Toxicology will serve as the student's academic advisor.

Applicants must have completed a bachelor's degree from an accredited college or university, with at least 3 credits in chemistry and 3 credits in a biological science. Preference will be given to applicants with undergraduate degrees in biology, chemistry or related sciences and who are currently employed in an academic, government or industrial laboratory. A letter of intent outlining the student's interests and professional goals and two letters of recommendation are required for consideration for admission.

Requirements for the Master of Science Degree in Integrative Pharmacology

		CREDITS
The student must complete at least 31 credits under Plan B (without thesis). Students may not earn more than 9 credits at the 400-level.		
1. All of the following courses (11 credits):		
PHM 819	Principles of Drug-Tissue Interactions	2
PHM 822	Academic and Research Integrity	1
PHM 830	Experimental Design and Data Analysis	3
PHM 832	Applied Integrative Pharmacology Laboratory	3
PHM 850	Communications for Scientists	2
2. One of the following courses (2 to 6 credits):		
PHM 895	Applied Project in Integrative Pharmacology	3 to 6
or		
PHM 982	Master of Science Capstone Literature Review	2
3. Science electives (as needed to total 31 credits for the degree with a minimum of 4 credits at the 800-level):		
BLD 830	Concepts in Molecular Biology	2
HM 803	Epidemiology and Public Health	3
HM 806	Environmental Factors of Health	3
HM 833	Introduction to Pharmaceutical Counterfeiting and Public Health	3
PHM 430	Human Pharmacology	3
PHM 431	Pharmacology of Drug Addiction	3
PHM 450	Introduction to Chemical Toxicology	3
PHM 461	Tropical Medicine Pharmacology	2
PHM 483	Chemotherapy of Infectious Diseases	3
PHM 492	Pharmacotherapy of Human Viral Infections	2
PHM 813	Cardiovascular Pharmacology and Toxicology	3
PHM 817	Neurotoxicology	2
PHM 828	Concepts in Carcinogenesis	2
PHM 829	Neuropharmacology	2
PHM 831	Endocrine Pharmacology and Toxicology	2
PHM 833	Gastro-Intestinal and Liver Pharmacology and Toxicology	2
PHM 834	Respiratory Pharmacology	2
PHM 835	Biopharmaceuticals: From Development to Manufacturing	3
PHM 837	Autonomic Pharmacology	1
PHM 840	Safety Pharmacology	2
PHM 841	Cellular and Molecular Toxicology	3
VM 812	Food Safety Toxicology	3
4. Professional electives (6 to 9 credits):		
BLD 842	Managing Biomedical Laboratory Operations	2
PHM 851	Intellectual Property and Patent Law for Biomedical Sciences	2
PHM 854	Leadership and Team-Building for Biomedical Research	2
PHM 855	The Business of Biomedical Research Organizations	2
PHM 857	Project Management	2
PHM 858	Drug Development Process	3

Academic Standards

Students enrolled in the Master of Science degree in Integrative Pharmacology are expected to maintain a minimum cumulative grade-point average of 3.0. A student who does not maintain a 3.0 grade-point average will be placed on probation. Students will be given one year of enrollment to achieve a 3.0 cumulative grade-point average, otherwise, dismissal from the program may result.

PHARMACOLOGY AND TOXICOLOGY

Master of Science

The program is designed to train individuals in molecular, cellular and organ systems pharmacology and provides advanced science knowledge in pharmacology and toxicology for individuals who are seeking additional academic qualifications that will facilitate their advancement in their place of employment and enhance their competitiveness for admission to degree programs. Online courses provide full opportunity for students regardless of their geographic location, work schedules, or family responsibilities.

In addition to meeting the requirements of the university and of the College of Osteopathic Medicine, students must meet the requirements specified below.

Admission

Applicants will be accepted into the program after review of application materials by an admissions committee from the department. A member in the Department of Pharmacology and Toxicology will serve as the student's academic advisor and will assist the student in planning a program of study related to the student's interests and professional goals.

Applicants must:

1. have completed a bachelor's degree from an accredited institution.
2. have earned at least 3 credits in chemistry and 3 credits in biological science.
3. submit a letter of intent outlining the student's interests and professional goals.
4. submit two letters of recommendation.
5. present evidence of competency in English if English is not the first language. Competency may be assessed with the Test of English as a Foreign Language (TOEFL), International English Language Testing System (IELTS), or Michigan English Language Assessment Battery (MELAB) scores.

Preference will be given to applicants with undergraduate degrees in biology, chemistry, or related sciences.

Requirements for the Master of Science Degree in Pharmacology and Toxicology

The Master of Science degree program is available only under Plan B (without thesis) and is offered entirely online. The student must complete 31 credits as approved by the student's advisor. Optional concentrations are available in pharmacology and in toxicology.

The student must:

		CREDITS
1. Complete all of the following core courses (10 credits):		
PHM 819	Principles of Drug-Tissue Interactions	2
PHM 822	Academic and Research Integrity	1
PHM 830	Experimental Design and Data Analysis	3
PHM 850	Communications for Scientists	2
PHM 982	Master of Science Capstone Literature Review	2
2. Complete up to 21 credits, a minimum of 7 credits of 800-level PHM courses and a maximum of 9 credits of 400-level courses, of science electives chosen from the following:		
BLD 830	Concepts in Molecular Biology	2
HM 803	Epidemiology and Public Health	3
HM 806	Environmental Factors of Health	3
HM 833	Introduction to Pharmaceutical Counterfeiting and Public Health	3
PHM 430	Human Pharmacology	3
PHM 431	Pharmacology of Drug Addition	3
PHM 450	Introduction to Chemical Toxicology	3
PHM 461	Tropical Medicine Pharmacology	2
PHM 483	Chemotherapy of Infectious Diseases	3
PHM 492	Pharmacotherapy of Human Viral Infections	2
PHM 813	Cardiovascular Pharmacology and Toxicology	3
PHM 817	Neurotoxicology	2
PHM 828	Concepts in Carcinogenesis	2
PHM 829	Neuropharmacology	2
PHM 831	Endocrine Pharmacology and Toxicology	2
PHM 833	Gastro-Intestinal and Liver Pharmacology and Toxicology	2
PHM 834	Respiratory Pharmacology	2
PHM 835	Biopharmaceuticals: From Development to Manufacturing	3
PHM 837	Autonomic Pharmacology	1
PHM 840	Safety Pharmacology	2
PHM 841	Cellular and Molecular Toxicology	3
VM 812	Food Safety Toxicology	3
3. Complete no more than 5 credits of professional electives:		
BLD 842	Managing Biomedical Laboratory Operations	2
PHM 851	Intellectual Property and Patent Law for Biomedical Sciences	2
PHM 854	Leadership and Team-Building for Biomedical Research	2
PHM 855	The Business of Biomedical Research Organizations	2
PHM 857	Project Management	2
PHM 858	Drug Development Process	3
4. Completion of a final examination or evaluation.		
Students who wish to complete a Pharmacology concentration must complete all core courses listed in item 1. above and the following:		
1. Complete 8 credits from the following:		
HM 833	Introduction to Pharmaceutical Counterfeiting and Public Health	3
PHM 430	Human Pharmacology	3
PHM 431	Pharmacology of Drug Addition	3
PHM 813	Cardiovascular Pharmacology and Toxicology	3
PHM 829	Neuropharmacology	2
PHM 834	Respiratory Pharmacology	2

PHM	835	Biopharmaceuticals: From Development to Manufacturing	3
PHM	837	Autonomic Pharmacology	1
2.	Other elective science courses:		
BLD	830	Concepts in Molecular Biology	2
HM	803	Epidemiology and Public Health	3
HM	806	Environmental Factors of Health	3
PHM	450	Introduction to Chemical Toxicology	3
PHM	461	Tropical Medicine Pharmacology	2
PHM	483	Chemotherapy of Infectious Diseases	3
PHM	817	Neurotoxicology	2
PHM	828	Concepts of Carcinogenesis	2
PHM	831	Endocrine Pharmacology and Toxicology	2
PHM	833	Gastro-Intestinal and Liver Pharmacology and Toxicology	2
PHM	840	Safety Pharmacology	2
PHM	841	Cellular and Molecular Toxicology	3
VM	812	Food Safety Toxicology	3
3.	Professional Elective Courses (not more than 5 credits):		
BLD	842	Managing Biomedical Laboratory Operations	2
PHM	851	Intellectual Property and Patent Law for Biomedical Sciences	2
PHM	854	Leadership and Team-Building for Biomedical Research	2
PHM	855	The Business of Biomedical Research Organizations	2
PHM	857	Project Management	2
PHM	858	Drug Development Process	3

Students who wish to complete a **Toxicology** concentration must complete all core courses listed in item 1. above and the following:

- Complete 8 credits from the following:

HM	806	Environmental Factors of Health	3
PHM	450	Introduction to Chemical Toxicology	3
PHM	817	Neurotoxicology	2
PHM	828	Concepts in Carcinogenesis	2
PHM	841	Cellular and Molecular Toxicology	3
VM	812	Food Safety Toxicology	3
- Other elective science courses:

BLD	830	Concepts in Molecular Biology	2
HM	803	Epidemiology and Public Health	3
HM	833	Introduction to Pharmaceutical Counterfeiting and Public Health	3
PHM	430	Human Pharmacology	3
PHM	431	Pharmacology of Drug Addiction	3
PHM	461	Tropical Medicine Pharmacology	2
PHM	483	Chemotherapy of Infectious Diseases	3
PHM	813	Cardiovascular Pharmacology and Toxicology	3
PHM	829	Neuropharmacology	2
PHM	831	Endocrine Pharmacology and Toxicology	2
PHM	833	Gastro-Intestinal and Liver Pharmacology and Toxicology	2
PHM	834	Respiratory Pharmacology	2
PHM	835	Biopharmaceuticals: Development to Manufacturing	3
PHM	837	Autonomic Pharmacology	1
PHM	840	Safety Pharmacology	2
- Professional Elective Courses (not more than 5 credits):

BLD	842	Managing Biomedical Lab Operations	2
PHM	851	Intellectual Property and Patent Law for Biomedical Sciences	2
PHM	854	Leadership and Team-Building for Biomedical Research	2
PHM	855	The Business of Biomedical Research Organizations	2
PHM	857	Project Management	2
PHM	858	Drug Development Process	3

Academic Standards

Students enrolled in the Master of Science degree in Pharmacology and Toxicology are expected to maintain a minimum cumulative grade-point average of 3.0. A student who does not maintain a 3.0 grade-point average will be placed on probation and given one year of enrollment to achieve a 3.0 cumulative grade-point average, or dismissal from the program may result.

Doctor of Philosophy

In addition to meeting the requirements of the university and of the colleges of Osteopathic Medicine, Human Medicine, or Veterinary Medicine, students must meet the requirements specified below.

Admission

Admission to the doctoral program is conducted by the BioMolecular Science Gateway. An applicant to the program must hold a bachelor's degree from an accredited four-year institution. Applicants who hold a master's degree may also apply.

Requirements for the Doctor of Philosophy Degree in Pharmacology and Toxicology

During the first two years of the program, the primary objective is to provide students with a firm foundation and a broad background from which they may specialize in a more sharply delineated aspect of the discipline. This objective is accomplished in two ways: (1) specific course requirements including biometry, physiology, biochemistry, and pharmacology and (2) laboratory rotations with two different faculty members during the first year.

The comprehensive preliminary examination is given by the end of the second year. It consists of a written examination and an oral presentation of the dissertation proposal to the student's dissertation committee.

The potential areas of specialization for dissertation research are limited to those areas which are afforded by the research interests of the faculty.

Approximately four and one-half calendar years of study beyond the bachelor's degree are needed to meet the requirements.

Students must complete the following required courses for the degree:

CREDITS

- All of the following courses (10 credits):

PHM	801	Fundamental Principles of Pharmacology and Toxicology	3
PHM	802	Cellular, Molecular and Integrated Systems Pharmacology	3
PHM	803	Chemical Disposition in Mammals	1
PHM	816	Integrative Toxicology: Mechanisms, Pathology and Regulation	3
- One of the following courses (3 or 4 credits):

PHM	827	Physiology and Pharmacology of Excitable Cells	4
PSL	828	Cellular and Integrative Physiology I	3
PSL	829	Cellular and Integrative Physiology II	3
- One of the following courses (3 credits):

BMB	801	Molecular Biology	3
BMB	802	Metabolic Regulation and Signal Transduction	3
- The following course (24 to 36 credits):

PHM	999	Doctoral Dissertation Research	24 to 36
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- Successfully defend the doctoral dissertation.

Academic Standards

A candidate must maintain at least a 3.0 grade in all required PHM courses.

BIOMOLECULAR SCIENCE GATEWAY - FIRST YEAR

Students are encouraged to apply for admission to the Ph.D. program through the BioMolecular Science Gateway – First Year, where students choose a doctoral major from any of six Ph.D. programs: biochemistry and molecular biology, cell and molecular biology, genetics and genome sciences, microbiology and molecular genetics, pharmacology and toxicology, or physiology. For additional information refer to the *College of Natural Science* section of this catalog.

PHARMACOLOGY AND TOXICOLOGY—ENVIRONMENTAL TOXICOLOGY

Doctor of Philosophy

For information about the Doctor of Philosophy degree program in pharmacology and toxicology—environmental toxicology, refer to the statement on *Doctoral Program in Environmental and Integrative Toxicological Sciences* in the *Graduate Education* section of this catalog.

DEPARTMENT of PHYSICAL MEDICINE and REHABILITATION

James R. Sylvain, Chairperson

Specialists in Physical Medicine and Rehabilitation (PM&R) are dedicated to the restoration of function for individuals who are impaired or disabled by trauma, disease or congenital disorder. The mission of PM&R physicians (physiatrists) is to restore hope and freedom in persons with disability by helping them achieve the highest level of function that can be realized for themselves, their families and for society-at-large.

The faculty, allied health professionals and staff in the Department of PM&R are involved in the education of medical students in the colleges of Osteopathic Medicine and Human Medicine. They provide local, statewide and national education and service programs for osteopathic physiatrists and related healthcare professionals including online courses and community education programs on disability and rehabilitation.

Services provided through the Department of PM&R include admissions and consults in both acute and sub-acute inpatient rehabilitation facilities and multiple subspecialty outpatient clinics including traumatic brain injury, spinal cord injury, stroke, electrodiagnostics, muscular dystrophy, menigomyelocele, medical acupuncture, spasticity and neurolysis, osteopathic manipulation and interventional pain management.

The Department of PM&R conducts research for the advancement of psychiatric techniques, knowledge and the development of diagnostic and treatment modalities for neuromusculoskeletal disorders. Current areas of research include peripheral nerve diagnosis, sports concussion, osteopathic manipulation and cervical spine biomechanics and hemiparetic arm movement following stroke.

The Department of PM&R conducts a graduate medical education residency program in physical medicine and rehabilitation which is accredited by the American Osteopathic Association (AOA) and the American Medical Association (AMA). The department also conducts post-residency fellowships in electrodiagnosis, interventional pain management and sports medicine.

DEPARTMENT of PHYSIOLOGY

Charles Leroy Cox, Chairperson

GRADUATE STUDY

The Department of Physiology is administered jointly by the colleges of Osteopathic Medicine, Human Medicine, Natural Science, and Veterinary Medicine. All four of these colleges offer a Master of Science degree program in physiology and Doctor of Philosophy degree program in molecular, cellular, and integrative physiology. In addition, the College of Natural Science offers a Doctor of Philosophy degree program with a major in physiology—environmental toxicology. For additional information about the department and its graduate degree programs, refer to the statement on the *Department of Physiology* in the *College of Natural Science* section of this catalog.

Division of Human Pathology

The Division of Human Pathology is administered by the Department of Physiology.

PHYSIOLOGY—ENVIRONMENTAL TOXICOLOGY

Doctor of Philosophy

For information about the Doctor of Philosophy degree program in physiology—environmental toxicology, refer to the statement on *Multidepartmental Doctoral Programs in Environmental Toxicology* in the *Graduate Education* section of this catalog.

BIOMOLECULAR SCIENCE GATEWAY - FIRST YEAR

Students are encouraged to apply for admission to the Ph.D. program through the BioMolecular Science Gateway – First Year, where students choose a doctoral major from any of six Ph.D. programs: biochemistry and molecular biology, cell and molecular biology, genetics and genome sciences, microbiology and molecular genetics, pharmacology and toxicology, or physiology. For additional information refer to the *College of Natural Science* section of this catalog.

DEPARTMENT of PSYCHIATRY

Jed Gary Magen, Chairperson

The Department of Psychiatry is administered jointly by the colleges of Human Medicine and Osteopathic Medicine. The College of Human Medicine is the primary administrative unit. The department plays a major role in integrating the behavioral sciences with the biological sciences and with clinical science elements of the professional programs of these colleges. The department's responsibilities include: preclinical and clinical medical student teaching, psychiatry residency training, professional continuing medical education (CME), collaborating in graduate medical and psychiatric education with affiliated institutions, developing programs on CME for physicians, contributing to CME programs for other mental health care disciplines, patient care, and research. Areas of research emphasis include: neurocognitive dysfunctions secondary to malaria and AIDS, trace minerals in HIV-infected individuals, and developing research programs including some in collaboration with other clinical departments. The department has extensive telepsychiatry services to multiple sites around the state of Michigan.

DEPARTMENT of RADIOLOGY

Kevin Robinson, Chairperson

The Department of Radiology is jointly administered by the Colleges of Osteopathic Medicine and Human Medicine. The Department provides basic and clinical education in anatomy and diagnostic imaging including radiology, ultrasound, magnetic resonance, CT, women's imaging and nuclear medicine. Department faculty have special skills and interests in management, health policy, and medical decision-making. In the College of Osteopathic Medicine, faculty participate in the Systems sequence, deliver RAD 610 as a required course, and provide radiology and

anatomy content for several Statewide Campus System residency courses. Other electives are offered in both colleges, including clerkships in radiology and nuclear medicine at affiliated hospitals. The department sponsors a visiting professor program for residents, interns, and medical students. The department directs an osteopathic residency program through a hospital in Garden City, Michigan. Research interests include molecular imaging, imaging physics bioengineering, fMRI, sports physiology and regenerative medicine. More information about the department can be found at www.rad.msu.edu.

Division of Human Anatomy

The Division of Human Anatomy is administered by the Department of Radiology.