



College of VETERINARY MEDICINE

Birgit Puschner, DEAN

In 1907, recognizing that animal agriculture was a significant part of a healthy state economy, the Michigan legislature authorized a course of study leading to the Doctor of Veterinary Medicine degree. This program, inaugurated in 1910, was the beginning of the College of Veterinary Medicine. Since that time, society has come to value animals in additional roles beyond their role in agriculture. Pets are a source of companionship and comfort for people of all ages. And the pleasure that the general public enjoys from zoos and from nature depends in large part on the well being of the animals that are found there.

The present-day College of Veterinary Medicine is the only veterinary college in the state of Michigan and one of 30 nationally. It is organized in six departments — Large Animal Clinical Sciences, Microbiology and Molecular Genetics, Pathobiology and Diagnostic Investigation, Pharmacology and Toxicology, Physiology, and Small Animal Clinical Sciences — and includes the Veterinary Medical Center and the Veterinary Diagnostic Laboratory.

The college offers the programs that are listed below:

- a preveterinary program
- a professional program leading to the Doctor of Veterinary Medicine degree
- a certificate program in veterinary technology
- a Bachelor of Science degree program in veterinary technology
- graduate programs leading to the Master of Science and Doctor of Philosophy degrees
- a graduate specialization in food safety
- a graduate certificate in food safety and toxicology
- intern and residency training programs in various clinical specialties

VETERINARY TECHNOLOGY

Taylor Epp, Director

Veterinary technicians and technologists are compassionate, highly motivated paraprofessionals dedicated to animal health care. As integral members of the veterinary health care team, they are entrusted with diverse medical responsibilities that include animal nursing care, laboratory specimen analysis, surgical assistance, anesthesia, radiographic imaging (x-ray), nutritional management, dental prophylaxis, physical therapy, and client education. These varied duties afford the veterinary paraprofessional a profound impact on every aspect of animal care. Their involvement enables veterinary hospitals and animal care and research facilities to offer expanded services efficiently and effectively.

The American Veterinary Medical Association (AVMA) recognizes two levels of training for the veterinary paraprofessional: veterinary technician and veterinary technologists. The Certificate of Completion at Michigan State University prepares veterinary technicians and the Bachelor of Science degree prepares veterinary technologists. The Certificate of Completion is two-year training program. After completion of the pre-clinical courses, students complete clinical clerkship training at the Michigan State University Veterinary Medical Center. Through the clinical clerkships, the students develop and apply their knowledge and problem-solving skills in a functional hospital setting. The level of training of the veterinary technician is most appropriate for individuals who seek employment in privately owned veterinary clinical practices.

VETERINARY MEDICINE
Veterinary Technology

Veterinary technologists require four years of academic training. In addition to the core curriculum of the Certificate of Completion, the students complete the general education requirements of Michigan State University and elective courses. The elective courses allow the students to focus on potential career paths within the veterinary profession such as production animal medicine, equine and companion animal medicine, pathology, biomedical research, and practice management. Their training offers exposure to clinical specialty areas such as emergency medicine, cardiology, ophthalmology, equine anesthesia, and necropsy. The level of training of the veterinary technologist is linked with employment in research facilities, vivaria, industry, educational institutions, pharmaceutical companies, and large-group or specialty practices.

The state of Michigan requires that any person practicing as a veterinary technician/technologist must be licensed and registered with the state. Regulation of veterinary technicians/technologists is the responsibility of the Veterinary Board of Examiners in the Michigan Department of Licensing and Regulation. The credentialing examination is *only* available to qualified graduates of accredited training programs. The Veterinary Technology Program is accredited by the American Veterinary Medical Association (AVMA) and graduates of the Certificate of Completion or Bachelor of Science in Veterinary Technology are eligible to take the National Board Examinations for licensure.

Enrollment in the Veterinary Technology Program's academic certificate and degree options is limited. Students are admitted for fall semester only. Applications for admission are accepted through early February of the year that admission is sought. For additional information, contact the Veterinary Technology Program, Veterinary Medical Center, 736 Wilson Road, Room A-22, Michigan State University, East Lansing, MI 48824-1316 or visit <http://cvm.msu.edu/vt>.

The Certificate of Completion articulates with an Associate in Applied Sciences degree from Lansing Community College. For specific degree requirements for the Associate in Applied Science, contact Lansing Community College at <http://www.lcc.edu>.

Bachelor of Science

Admission

The number of students who can be admitted to the Bachelor of Science degree program in veterinary technology is limited. All persons who are interested in applying for admission to the bachelor's degree program in veterinary technology must complete an application which can be found, along with the application process instructions, by visiting www.cvm.msu.edu/vt.

Applications for admission to the bachelor's degree program in veterinary technology are accepted through early February of the year that admission is sought.

Students who are enrolled in colleges and universities other than Michigan State University should contact Michigan State University's Office of Admissions and the College of Veterinary Medicine regarding admission to the bachelor's degree program in veterinary technology as transfer students.

To be considered for admission, an applicant must have a minimum cumulative grade-point average of 2.75 and a minimum of a 2.5 grade-point average of the last 12 credits completed and a minimum of a 2.0 grade in all math and science courses:

1. Completion of at least 28 credits of the University graduation requirements or transfer equivalents with a cumulative grade-point average of 2.5 or higher including:
 - a. One of the following: (Mathematics 101 and 103) or (Mathematics 103 and 114) or (Mathematics 116 or 124 or 132 or 152H).
 - b. Biological Science 161 and 171.

- c. Tier I writing course.
- d. Additional credits selected from an Integrative Studies in the Arts and Humanities course numbered below 211, an Integrative Studies in the Arts and Humanities course numbered 211 or higher, an Integrative Studies in the Social, Behavioral, and Economic Sciences 200-level course, and an Integrative Studies in the Social, Behavioral, and Economic Sciences 300-level course.

The final selection of students to be admitted to the baccalaureate degree program in veterinary technology is based on the cumulative grade-point average of all courses taken, the grade-point average calculated on all courses in mathematics and the physical and biological sciences, and the grade-point average of the last 12 credits. The selection process also includes submission of a personal statement, letters of recommendation and documentation of 80 hours of veterinary related experience.

Students who complete the requirements for the Bachelor of Science degree in Veterinary Technology will be qualified to take the National Board Examinations for licensure as veterinary-technicians.

Requirements for the Bachelor of Science Degree in Veterinary Technology

1. The requirements for a bachelor's degree as specified in the *Undergraduate Education* section of the University catalog; 120 credits, including general elective credits, are required for the Bachelor of Science degree in Veterinary Technology.

The completion of the Mathematics courses referenced in item 2. b. below may also be used to satisfy the University mathematics requirement.

The University's Tier II writing requirement for the Veterinary Technology major is met by completing the following courses: Veterinary Medicine 410 and 413. Those courses are referenced in items 2. a. below.

Students who are enrolled in the Bachelor of Science degree in Veterinary Technology may complete the alternative track in Integrative Studies in Biological and Physical Sciences that consists of the following courses: Biological Sciences 161, 162, 171, and 172; and Chemistry 141. The completion of Biological Science 171 satisfies the laboratory requirement. Biological Science 162 and 172 and Chemistry 141 may be counted toward both the alternative track and the requirements for the major referenced in item 2. below.

	CREDITS
2. The following requirements for the major:	103
a. All of the following courses (73 credits):	
BS 161 Cell and Molecular Biology	3
BS 162 Organismal and Population Biology	3
BS 171 Cell and Molecular Biology Laboratory	2
BS 172 Organismal and Population Biology Laboratory	2
CEM 141 General Chemistry	4
VM 110 Veterinary Medical Terminology	1
VM 120 Veterinary Comparative Nutrition	2
VM 130 Comparative Anatomy for Veterinary Technicians	2
VM 140 Pharmacology for Veterinary Technicians	2
VM 150 Hospital Procedures and Communication	2
VM 155 Veterinary Technology Careers and Professional Development	1
VM 160 Small Animal Nursing Skills	3
VM 165 Large Animal and Laboratory Animal Nursing Care Techniques	2
VM 170 Hematology and Immunology for Veterinary Technicians	2
VM 175 Clinical Pathology Laboratory I for Veterinary Technicians	1
VM 176 Clinical Pathology Laboratory II for Veterinary Technicians	1
VM 205 Preventive Animal Health Care for Veterinary Technicians	3
VM 210 Surgical Nursing for Veterinary Technicians	2
VM 215 Surgical Nursing and Anesthetic Management Laboratory	1
VM 245 Parasitology for Veterinary Technicians	2
VM 250 Veterinary Comparative Clinical Physiology	5
VM 255 Small Animal Diseases and Management	3
VM 265 Dentistry Techniques for Veterinary Technicians	1
VM 270 Advanced Skills Development for Veterinary Technicians	1
VM 275 Large Animal Diseases and Management	3
VM 295 Biomedical Research and Regulatory Issues for Veterinary Technicians	1
VM 303 Anesthesiology for Veterinary Technicians	2
VM 304 Radiology for Veterinary Technicians	2
VM 305 Hospital Practice Management for Veterinary Technicians	2

VM	410	Veterinary Technology Clerkship in Anesthesiology	3
VM	411	Veterinary Technology Clerkship in Radiology	3
VM	412	Veterinary Technology Clerkship in Companion Animal Medicine	3
VM	413	Veterinary Technology Clerkship in Companion Animal Surgery	3
b.	One of the following options (0 to 7 credits):		
(1)	MTH 116	College Algebra and Trigonometry	5
	MTH 124	Survey of Calculus I	3
	MTH 132	Calculus I	3
	MTH 152H	Honors Calculus I	3
(2)	MTH 103	College Algebra	3
	and		
	One of the following:		
	MTH 101	Quantitative Literacy I	3
	MTH 102	Quantitative Literacy II	3
	MTH 114	Trigonometry	3
	MTH 201	Elementary Mathematics for Teachers I	3
	STT 200	Statistical Methods	3
	STT 201	Statistical Methods	4
(3)	Successfully complete the proctored mathematics placement exam with a score of 19 or higher.		
c.	At least 7 credits from the following courses approved by the student's academic advisor:		
ABM	100	Decision-making in the Agri-Food System	3
ABM	225	Commodity Marketing I	3
ACC	230	Survey of Accounting Concepts	3
ANS	305	Applied Animal Behavior	3
ANS	313	Principles of Animal Feeding and Nutrition	4
ANS	314	Genetic Improvement of Domestic Animals	4
ANS	407	Food and Animal Toxicology	3
ANS	413	Non-Ruminant Nutrition	3
ANS	445	Equine Exercise Physiology	4
EPI	390	Disease in Society: An Introduction to Epidemiology and Public Health	4
PHM	350	Introductory Human Pharmacology	3
VM	285	Clinical Nutrition for Veterinary Technologists	1
IBIO	300	Neurobiology	3
IBIO	313	Animal Behavior	3
IBIO	341	Fundamentals of Genetics	4
IBIO	369	Introduction to Zoo and Aquarium Science	3
IBIO	408	Histology	4
IBIO	413	Laboratory in Behavioral Neuroscience (W)	4
IBIO	415	Ecological Aspects of Animal Behavior (W)	3
d.	At least 18 credits from the following courses or from the courses listed in item 2. c. All course selections must be approved by the student's academic advisor:		
VM	414	Veterinary Technology Clerkship in Equine Medicine and Surgery	3 to 6
VM	415	Veterinary Technician Clerkship in Food Animal and Equine Medicine and Surgery	3 to 6
VM	450	Veterinary Technology Clerkship in Emergency Medicine	3
VM	451	Veterinary Technology Clerkship in Cardiology	3
VM	452	Veterinary Technology Clerkship in Neurology	3
VM	453	Veterinary Technology Clerkship in Ophthalmology	3
VM	454	Veterinary Technology Clerkship in Critical Care	3
VM	466	Veterinary Technology Clerkship in Large Animal Anesthesia	3
VM	470	Veterinary Technology Clerkship in Food Animal Medicine	3 to 6
VM	480	Veterinary Technology Clerkship in Clinical Pathology	3
VM	482	Veterinary Technology Clerkship in Necropsy	3
VM	483	Veterinary Technology Clerkship in Biomedical Research	3 to 12
VM	484	Veterinary Technology Clerkship in Zoo and Wildlife	3 to 12
VM	486	Veterinary Technology Clerkship in Clinical Parasitology	3
VM	490	Veterinary Technology Clerkship in Special Problems	3 to 12

PREPROFESSIONAL PROGRAM for VETERINARY MEDICINE

Students who meet the requirements for admission to the university as freshmen and sophomores, as shown in the *Undergraduate Education* section of the catalog, may select the preveterinary program in the College of Veterinary Medicine as their major preference. A strong high school preparation in science, including chemistry, biology, and physics, is highly desirable. Students who are enrolled in the preveterinary program are enrolled in the

Neighborhood Student Success Collaborative, but receive academic advising in the College of Veterinary Medicine Preveterinary Advising Center.

The courses in mathematics and natural science required for admission to the Professional Program in Veterinary Medicine are included in the requirements for the preveterinary program. Students who are enrolled in the preveterinary program should complete the University requirements for bachelor's degrees. Courses that are used to satisfy university requirements may also be used to satisfy certain requirements for admission to the Professional Program in Veterinary Medicine.

University regulations require that a student who has arrived at junior standing must select a major leading to a baccalaureate degree. The College of Veterinary Medicine does *not* offer a bachelor's degree program for preveterinary students. Therefore, upon reaching junior standing, students who have been enrolled in the preveterinary program and who have not been admitted to the Professional Program in Veterinary Medicine must be admitted to a major in another college in order to complete the requirements for a bachelor's degree. Students interested in the Professional Program in Veterinary Medicine are not required to complete a baccalaureate degree to be considered for admission.

Enrollments in the preveterinary program are not limited. However, because of the limitation on the number of students admitted each year to the Professional Program in Veterinary Medicine, completion of the preveterinary program does not assure admission to the professional program.

Because admission to the Professional Program in Veterinary Medicine is competitive and the majority of successful applicants have completed at least three years of a bachelor's degree program, students who are enrolled in the preveterinary program are encouraged to plan toward a baccalaureate degree in a major consistent with their interests and alternative educational and career goals. Students in any major may apply for admission to the Professional Program. For additional information, refer to the **Professional Program in Veterinary Medicine** statement.

Requirements for the Preveterinary Program

	CREDITS
1. All of the following courses:	38
BMB 401 Comprehensive Biochemistry	4
BS 161 Cell and Molecular Biology	3
BS 162 Organismal and Population Biology	3
BS 171L Cell and Molecular Biology Laboratory	2
CEM 141 General Chemistry	4
CEM 161 Chemistry Laboratory I	1
CEM 251 Organic Chemistry I	3
CEM 252 Organic Chemistry II	3
CEM 255 Organic Chemistry Laboratory	2
MTH 116 College Algebra and Trigonometry	5
PHY 231 Introductory Physics I	3
PHY 232 Introductory Physics II	3
PHY 251 Introductory Physics Laboratory I	1
PHY 252 Introductory Physics Laboratory II	1
2. Upper-level Biology Elective (3-credit minimum):	
A course selected from cell biology, genetics, histology, immunology, neurobiology, or physiology.	
3. Students who are enrolled in the preveterinary program should complete the University requirements for bachelor's degrees as described in the <i>Undergraduate Education</i> section of the catalog.	

The completion of Mathematics 116 referenced in item 1. above may also satisfy the University mathematics requirement.

Students who are enrolled in the Preveterinary Program in the College of Veterinary Medicine may complete an alternative track to Integrative Studies in Biological and Physical Sciences that consists of the following courses: Biological Science 161, 162, and 171L and Chemistry 141. The completion of Biological Science 161 and 171L satisfies the laboratory requirement. Biological Science 161, 171, and 171L and Chemistry 141 may be counted toward both the alternative track and the requirements for the preveterinary program referenced in item 1. above.

Students who are enrolled in the preveterinary program will be required to meet the Tier II writing requirement approved for the student's major leading to the bachelor's degree.

PROFESSIONAL PROGRAM in VETERINARY MEDICINE

The professional veterinary medicine program is designed to provide basic and applied medical education with flexible, high-quality clinical training opportunities that prepare career-ready graduates. Graduates may become licensed as private veterinary practitioners in any state, and they are well positioned for successful pursuit of a wide variety of careers, including those in: (1) private practice, general or specialized by species or discipline; (2) government, including the U.S. Department of Agriculture, the U.S. Public Health Service, the U.S. Army and Air Force, and state, county, and local health agencies, for important work related to livestock disease control, meat and poultry inspection, development of biological products, prevention of the entry of foreign animal diseases, and public health; (3) biomedical research at colleges and universities, government agencies, biological and pharmaceutical companies, or private medical research institutions, for the benefit of animals and people; and (4) education, typically at colleges of veterinary medicine.

The professional program leading to the Doctor of Veterinary Medicine degree is accredited by the American Veterinary Medical Association.

Admission to the Professional Program in Veterinary Medicine

The College of Veterinary Medicine strives to select individuals with the academic ability, motivation, emotional intelligence, and social competence to succeed as veterinary students and future veterinarians. Student diversity is promoted to help meet the needs of a diverse society. A wide variety of experiences are represented in each entering class, with academic backgrounds including the sciences, the arts and humanities, and various advanced degrees.

A new class of students begins the four-year professional program each fall semester. Applications for admission and related materials must be received by the deadline as specified by the Veterinary Medical College Application Service (VMCAS).

Factors considered by the Admissions Committee in determining an applicant's relative competitive position are:

1. Academic performance: A minimum last-3-semester grade-point average (GPA) in combination with a minimum prerequisite GPA of 3.0 is required for an application to receive review.
2. File review of nonacademic experiences and attributes fitting to the values of the College.
3. Multiple Mini Interviews (MMIs) by faculty, staff, alumni, and other vested individuals trained to assess for the qualities considered important for positive professional outcomes (by invitation).

Applications, regular or transfer, are reviewed by the Committee on Student Admissions. Final selection of applicants is based on a combination of academic performance, evidence of significant accomplishments in nonacademic areas, and performance in MMIs.

Applicants are considered for admission in the following order of priority:

1. Residents of the state of Michigan, as defined by Michigan State University. (Since Michigan State University is a public, tax-assisted institution, admission priority is granted to residents of Michigan.)
2. Residents of states other than Michigan, including U.S. Territories and Trust Possessions.
3. All others.

Requirements to be completed by students prior to enrollment:

All prerequisite courses must be completed by the spring semester of the year of matriculation with a minimum grade of 2.0 in each course. Fifty percent of the science prerequisite courses must be complete at the time of application, with a minimum grade of 2.0 in each course.

Science Prerequisite Courses

College Algebra and Trigonometry (or precalculus or calculus)
Physics I and II with laboratories
Chemistry I with laboratory
Introductory Biology I and II with laboratories
Organic Chemistry I and II with laboratory
Biochemistry
Advanced Biology Elective (3 credit minimum),
such as Cell Biology, Physiology, Neurobiology,
Immunology, Genetics, Microbiology, or Histology
Advanced Placement (AP) credits are accepted for College Algebra and Trigonometry, Physics I and II, Chemistry I, and Introductory Biology I and II.

General Education Requirements

Arts and Humanities - two courses that must include two of the following subject areas: history, literature, art/music/theatre history or appreciation, philosophy, and religion.

Social Science - two courses that must include two of the following subject areas: cultural anthropology, economics, human geography, political science, psychology, and sociology.

English - one course (3 semester credits) of English composition.

Advanced Placement (AP) credits are accepted to fulfill any of these requirements.

VETERINARY SCHOLARS ADMISSION PATHWAY

This pathway has been established by the College of Veterinary Medicine in cooperation with the Honors College at Michigan State University in order to provide an admission avenue for students who wish to complete a bachelor's degree consisting of advanced, scholarly studies in concert with their entry to the four-year professional veterinary medical degree program. All Michigan State University preveterinary students who are members of the Honors College may choose to participate in this program. Up to ten Michigan State University students may be chosen each year to be granted admission to the veterinary medical program contingent upon completion of a bachelor's degree in a major of the students choice.

The following components will be considered in selecting candidates for this admission pathway:

1. Completion of at least 50 percent of the required preveterinary science courses.
2. Minimum 3.5 cumulative and preveterinary science grade-point averages.
3. Bachelor's degree program proposal planned in consultation with the Honors College advising staff and a departmental honors advisor demonstrating enriched, advanced, and scholarly work in a major of the student's choice.
4. Evidence of quality veterinary and animal exposure.
5. Completion of at least three Honors College experiences beyond the minimum preveterinary requirements.
6. Performance in the regular veterinary admission criteria including grade-point averages, and file review.
7. Personal statement describing the scholarly content of the proposed bachelor's degree program and its relevance to the individual's career and personal goals.
8. Evaluations from the advisor in the student's degree program, a veterinarian, and an individual of the applicant's choice.

Students who wish to enter the professional veterinary medical program before earning a bachelor's degree may apply through the regular veterinary admission process.

The College of Veterinary Medicine's Committee on Student Admissions selects the candidates for this pathway and reserves the right to modify the criteria and process. Applications not meeting the above criteria will be dismissed.

Academic Standards

Once admitted to the Veterinary Scholars Pathway, students must maintain a 3.5 cumulative and preveterinary science grade-point average during completion of the Honors College degree.

Additional Information

For additional information concerning admission to the professional program, contact the Admissions Office, College of Veterinary Medicine, Veterinary Medical Center-South Building, 784 Wilson Road, Room F-104 Michigan State University, East Lansing, Michigan 48824-1314. **Note:** Prospective applicants should maintain contact with the College's Admissions Office for current information.

Statement on Advanced Status

Rarely will students be considered for admission to the program with advanced standing.

Requirements for the Bachelor of Science Degree

1. The University requirements for the bachelor's degree as described in the *Undergraduate Education* section of this catalog.
2. Preveterinary program requirements.
3. At least 56 credits of the professional program in Veterinary Medicine.

Health Requirements for Students in the Professional Program in Veterinary Medicine

1. The student must be covered by a personal health insurance policy throughout enrollment in the program.
2. The student's tetanus vaccination must be current throughout enrollment in the program.
3. The student must have a rabies vaccination prior to participation in senior clerkships. Rabies vaccination is recommended for entering students.
4. The student must participate in TB monitoring which consists of two TB tests, one in the first semester and one at graduation.

Requirements for the Doctor of Veterinary Medicine Degree in Veterinary Medicine

Completion of the following 157-credit, four-year professional program with a grade-point average of at least 2.0. Completion of the college's core competencies during the four-year professional program. Students must successfully complete all pre-clinical core competencies before matriculating to the clinical phase of the curriculum.

VETERINARY MEDICINE (YEAR 1)

SEMESTER 1 (Fall) (19 credits)

VM	500	Veterinary Science I	2
VM	501	One Health I	1
VM	502	Veterinary Doctoring I	1
VM	503	Veterinary Career and Practice Management I	1
VM	515	Animals in Society	2
VM	516	Musculoskeletal System I	3
VM	517	Nervous System I	3
VM	518	Cardiovascular System I	3
VM	519	Cutaneous System I	3

SEMESTER 2 (Spring) (19 credits)

VM	504	One Health II	1
VM	505	Veterinary Doctoring II	1
VM	506	Veterinary Career and Practice Management II	1
VM	520	Respiratory System I	3
VM	523	Immunologic and Hematologic Systems I	3
VM	525	Digestive System I	3
VM	527	Endocrine System I	3
VM	528	Reproductive System I	2
VM	529	Urinary System I	2

VETERINARY MEDICINE (YEAR 2)

SEMESTER 3 (Fall) (19 credits)

VM	507	One Health III	1
VM	508	Veterinary Doctoring III	1
VM	509	Veterinary Career and Practice Management III	1
VM	530	Veterinary Science II	4
VM	531	Immunologic and Hematologic Systems II	3
VM	534	Cutaneous System II	3
VM	535	Reproductive System II	3
VM	536	Respiratory System II	3

SEMESTER 4 (Spring) (19 credits)

VM	510	One Health IV	1
VM	512	Veterinary Doctoring IV	1
VM	537	Veterinary Career and Practice Management IV	1
VM	565	Cardiovascular System II	2
VM	568	Urinary System II	3
VM	569	Musculoskeletal System II	2
VM	571	Nervous System II	3
VM	575	Digestive System II	3
VM	577	Endocrine System II	3

VETERINARY MEDICINE (YEAR 3)

SEMESTER 5 (Fall) (19 credits)

VM	539	Veterinary Career and Practice Management V	1
VM	578	Clinical Reasoning I	8
VM	579	Clinical Reasoning II	7
VM	580	Surgical and Anesthetic Skills	3

SEMESTER 6 (Spring) (17 credits)

VM	581	Clinical Reasoning III	5
VM	582	Veterinary Clinical Experience	3

Complete 9 credits in required or elective clerkships.

VETERINARY MEDICINE (YEAR 4)

SEMESTERS 7 (Summer), 8 (Fall), 9 (Spring)

Students will be required to complete 30 required clerkship credits and an additional 15 credits of elective clerkship credits. Students complete their 9-credits of Preceptorship during Year 4 through enrollment in VM 611. The 9 credits in VM 611 must be completed in three consecutive, separate enrollments in consultation with the student's advisor. Satisfactory completion of semesters one through six of the professional curriculum is required for enrollment in any of the listed clerkships.

VETERINARY MEDICINE
Professional Program in Veterinary Medicine

REQUIRED CLERKSHIPS

LCS	616	Large Animal Medicine and Surgery	6
PDI	630	Diagnostic Pathology Clerkship	3
SCS	611	Diagnostic Imaging Clerkship	3
SCS	625	Small Animal Primary Care Clerkship	3
SCS	626	Small Animal Soft Tissue Surgery Clerkship	3
SCS	646	Small Animal Orthopedic Surgery Clerkship	3
SCS	647	Small Animal Internal Medicine Clerkship	3
SCS	648	Anesthesia Clerkship	3
SCS	695	Emergency and Critical Care Medicine Clerkship	3

30

ELECTIVE CLERKSHIPS

LCS	610	Clinical Problems in Large Animal Clinical Sciences	3
LCS	611	Research Problems in Large Animal Clinical Sciences	3
LCS	613	Special Problems in Large Animal Clinical Sciences at Off-Campus Sites	3
LCS	614	Equine Clinical Proficiency Clerkship	3
LCS	615	Equine Emergency and Critical Care Clerkship	3
LCS	621	Practice-Based Ambulatory Clerkship	3
LCS	622	Advanced Equine Clinical Clerkship	3
LCS	623	Equine Musculoskeletal Diseases Clerkship	3
LCS	624	Equine Theriogenology Clerkship	3
LCS	625	Equine Herd Health Clerkship	3
LCS	626	Advanced Equine Surgery Clerkship	3
LCS	627	Advanced Equine Medicine Clerkship	3
LCS	628	Techniques in Equine Anesthesia and Surgery	3
LCS	632	Advanced Food Animal Medicine and Surgery	3
LCS	640	Large Animal Anesthesia Clerkship	3
LCS	646	Equine Neonatal Medicine Clerkship	3
LCS	647	Concepts of Agricultural Practice Clerkship	3
LCS	660	Wildlife Disease Ecology and Management	3
LCS	677	Veterinary Preceptorship	3
LCS	678	Government and Corporate Veterinary Practice	3
LCS	679	Food Animal Production Medicine I	3
LCS	682	Food Animal Production Medicine II	3
LCS	685	Ruminant Health Problem Solving Clerkship	3
LCS	690	Veterinary Public Health Field Experience Clerkship	3
LCS	691	Veterinary Public Health Research Clerkship	3
MMG	690	Veterinary Microbiology Clerkship	3
PDI	610	Veterinary Gross Anatomy Dissection	3
PDI	611	Research Problems in Veterinary Anatomy	3
PDI	631	Necropsy Clerkship	3
PDI	632	Problems in Veterinary Pathology	3
PDI	633	Special Problems in Veterinary Pathology	3
PDI	634	Endocrinology Clerkship	3
PDI	635	Special Problems in Histopathology and Cytology Clerkship	3
PDI	636	Aquatic Animal Medicine Clerkship	3
PHM	658	Research Problems in Pharmacology or Toxicology	3
SCS	613	Diagnostic Ultrasound Clerkship	3
SCS	630	Spay/Neuter Clerkship	3
SCS	640	Cardiology Clerkship	3
SCS	641	Comparative Ophthalmology Clerkship	3
SCS	642	Zoo and Wildlife Clerkship	3
SCS	644	Dermatology Clerkship	3
SCS	651	Advanced Comparative Ophthalmology Clerkship	3
SCS	654	Clinical Medical Oncology Clerkship	3
SCS	670	Clinical Nutrition for Small Animals	3
SCS	690	Veterinary Molecular Biology Clerkship	3
SCS	693	Problems in Small Animal Clinical Sciences Clerkship	3
SCS	694	Small Animal Specialty Practice Clerkship	3
VM	611	Veterinary Externship	3
VM	690	Special Problems in Veterinary Medicine	3
VM	692	Career Development and Business Skills	3

Student Performance

The Committee on Student Performance monitors student performance in accordance with established College standards and offers assistance to students experiencing difficulties in the professional curriculum. An important function of this committee is to determine the reasons for student difficulties and recommend study schedules, counseling, and other means of helping the student perform in a satisfactory manner. The Committee on Student Performance may take appropriate academic disciplinary action consistent with the academic standards of the College and the **Medical Student Rights and Responsibilities** document.

Student Rights and Responsibilities

Refer to the statement on *Student Rights and Responsibilities* in the *General Information, Policies, Procedures and Regulations* section of this catalog.

GRADUATE STUDY

The College of Veterinary Medicine offers graduate programs in each of six departments: Large Animal Clinical Sciences, Microbiology and Molecular Genetics, Pathobiology and Diagnostic Investigation, Pharmacology and Toxicology, Physiology, and Small Animal Clinical Sciences. These departments participate in the training of the master's degree programs. Doctor of Philosophy degree programs are offered in all departments except Small Animal Clinical Sciences. In addition, there are two college-based graduate programs: Comparative Medicine and Integrative Biology (CMIB) (Master of Science and Doctor of Philosophy) and Food Safety (Master of Science). Trainees in the CMIB program work on a diverse diseases and biological processes with foci ranging from the molecular, cellular, and organismal and population level. CMIB Ph.D. students also have the option of participating in the Environmental and Integrative Toxicological Sciences (EITS) Doctoral Program. CMIB alumni are employed in academia, industry and government positions. In addition, the college is home to the online Food Safety Professional Master of Science program, highly valued by the food industry.

Post-D.V.M. training in various recognized clinical specialties are available including those in Anatomic Pathology, Clinical Pathology, Ophthalmology, Small Animal Internal Medicine, Small Animal Soft Tissue Surgery, Small Animal Orthopedic Surgery, Large Animal Surgery, and Large Animal Internal Medicine.

Several colleges and departments offer Ph.D. programs with admission through The BioMolecular Science Gateway. These include graduate programs in: Biochemistry and Molecular Biology, Cell and Molecular Biology, Genetics, Microbiology and Molecular Genetics, Pharmacology and Toxicology, and Physiology. The BioMolecular Science Gateway is administered through the College of Natural Science. For additional information, refer to the statement on the doctoral programs in the *College of Natural Science* section of this catalog.

The College of Agriculture and Natural Resources, the College of Communication Arts and Sciences, the College of Engineering, the College of Human Medicine, the College of Natural Science, the College of Social Science, and the College of Veterinary Medicine participate in the graduate specialization in food safety. The College of Veterinary Medicine is the primary administrative unit. For more information, refer to the *Graduate Specialization in Food Safety* statement.

The College of Veterinary Medicine, the College of Agriculture and Natural Resources, the College of Engineering, and the College of Natural Science administer the graduate specialization in environmental toxicology. The College of Agriculture and Natural Resources is the primary administrative unit. For additional information, refer to the *Graduate Specialization in Environmental Toxicology* statement in the *College of Agriculture and Natural Resources* section of this catalog.

Several colleges and departments within Michigan State University cooperate in offering interdepartmental Doctor of Philosophy degree programs with majors in cell and molecular biology, genetics, and neuroscience, which are administered by the College of Natural Science. For additional information, refer to the statement on the doctoral programs in the *College of Natural Science* section of this catalog.

Students who are enrolled in master's and doctoral degree programs in the College of Agriculture and Natural Resources, the College of Natural Science, and the College of Veterinary Medi-

vine may elect the Graduate Specialization in Fish and Wildlife Disease Ecology and Conservation Medicine. For additional information, refer to the statement on *Graduate Specialization in Fish and Wildlife Disease Ecology and Conservation Medicine* in the *College of Agriculture and Natural Resources* section of this catalog.

GRADUATE CERTIFICATE IN FOOD SAFETY

The Graduate Certificate in Food Safety embodies the principles of prevention of foodborne illness. The certificate is a fully online program that addresses the needs of the food industry, government, and public health for their employees to be educated in many of the aspects of safeguarding food supply. The certificate is not open to students pursuing the Master of Science degree in Food Safety.

Requirements for the Graduate Certificate in Food Safety

Students must complete 12 credits from the following:

	CREDITS
1. All of the following courses (9 credits):	
VM 811 Evolution and Ecology of Foodborne Pathogens	3
VM 812 Food Safety Toxicology	3
VM 831 Foodborne Disease Epidemiology for the Professional	3
2. One of the following courses (3 credits):	
FSC 810 International Food Laws and Regulations	3
FSC 811 U.S. Food Laws and Regulations	3
VM 814 Packaging for Food Safety	3
VM 817 Livestock Pre-Harvest Food Safety	3
VM 821 Food Protection and Defense	3
VM 824 Global Food Safety	3
VM 825 Quantifying Food Risk	3
VM 834 Current Issues in Food Safety	3
VM 835 Food Safety for Produce	3
VM 840 Anti-Counterfeit Strategy and Product Production	3
Other 800-level courses may be used to fulfill this requirement with program advisor approval.	

GRADUATE SPECIALIZATION IN FOOD SAFETY

The College of Agriculture and Natural Resources, the College of Communication Arts and Sciences, the College of Engineering, the College of Human Medicine, the College of Natural Science, the College of Social Science, and the College of Veterinary Medicine participate in the graduate specialization in food safety. The College of Veterinary Medicine is the primary administrative unit.

The specialization is available as an elective to students who are enrolled in a master's degree program in the departments of Agricultural Economics, Agricultural Engineering, Animal Science, Communication, Entomology, Epidemiology, Food Science and Human Nutrition, Horticulture, Large Animal Clinical Sciences, Microbiology and Molecular Genetics, Packaging, Pathobiology and Diagnostic Investigation, Pharmacology and Toxicology, Plant Pathology, and Sociology.

The specialization is designed for students who are interested in enhancing the focus of their study on food safety so they can apply their knowledge from basic disciplines to solve problems in the area of food safety.

A faculty member who is in the department that administers the student's degree program will serve as the student's academic advisor for the specialization. The academic advisor will assist the student in planning a program of study that is related to the student's interests, capabilities, and professional goals. With the approval of the department and college that administer the student's degree program, the courses that are used to satisfy the requirements for the specialization may also be used to satisfy the requirements for the master's degree.

Requirements for the Graduate Specialization in Food Safety

The student's program of study must be approved by the student's academic advisor for the specialization. To qualify for this graduate specialization, the student must meet the requirements specified below:

	CREDITS
1. Maintain a grade-point average of at least 3.0 in the courses that are used to satisfy the requirements for the specialization.	
2. Complete both of the following seminar courses (2 credits):	
VM 828 Food Safety Seminar Series	1
VM 829 Problems in Food Safety	1
3. Complete one course from each of the following topic areas in food safety (9 credits):	
Risk/Public Health	
EPI 813 Investigation of Disease Outbreaks	3
LCS 830 Epidemiology, Risk Assessment and Public Health Impact of Food-borne Diseases	3
VM 831 Foodborne Disease Epidemiology for the Professional	3
VM 832 Food Safety Disease Control	3
Human Dimensions	
FSC 421 Food Laws and Regulations	3
PKG 480 Packaging Laws and Regulations	3
SOC 950 Topics in Rural and Environmental Studies	3
Food	
FSC 440 Food Microbiology	3
FSC 840 Advanced Food Microbiology	3
FSC 842 Foodborne Disease	3

A list of supporting electives for the graduate specialization in food safety, depending on the student's individual focus of study in food safety is available from the student's academic advisor.

Master of Science

For the master's degree, departments of the College of Veterinary Medicine recommend Plan A with thesis unless otherwise specified.

In addition to meeting the requirements of the university as described in the *Graduate Education* section of this catalog, students must meet the requirements specified below.

Admission

A bachelor's degree is required of all applicants for graduate study. Admission must be approved by the department in which the applicant proposes to do the major work. Scholastic record, experience, personal qualifications, and area of subject-matter interest are considered by the department in determining the applicant's acceptability.

Upon admission, the master's student is classified in one of two categories:

- Regular status:** for those who have an undergraduate grade-point average of 3.00 or above and are otherwise qualified to undertake a master's program.
- Provisional status:** for those who have some remediable inadequacy of qualifications or subject-matter preparation.

Requirements for the Master of Science Degree

Up to 10 credits may be allowed for thesis research (course number 899). The distribution of credits among major and minor areas is determined by the student's major department.

Residence

A minimum of 9 credits must be earned in residence on campus unless a department specifies more than 9 credits.

VETERINARY MEDICINE

Graduate Study

Time Limit

For the master's degree, the student must complete all requirements within six calendar years from the beginning of the first semester in which credit was earned toward the degree.

Doctor of Philosophy

Doctor of Philosophy degree programs are offered in anatomy, large animal clinical sciences, microbiology, pathology, pharmacology, and physiology.

In addition to meeting the requirements of the University as described in the *Graduate Education* section of this catalog, students must meet the requirements specified below.

Admission

Admission to a doctoral program requires the approval of the department in which the applicant's major work is to be done.

The doctoral student is classified in one of two categories:

1. **Regular status:** for those who have a grade-point average in prior graduate work of 3.00 or above and who are otherwise qualified to undertake a doctoral program.
2. **Provisional status:** for those who have some remediable inadequacy of qualifications.

Dual Degree Programs in the College of Veterinary Medicine

Students who are enrolled in the Doctor of Veterinary Medicine degree program may be granted approval to pursue simultaneously either a research-focused Master of Science degree or a Doctor of Philosophy degree. For additional information, interested students should refer to the *Requirements for a Joint Master's Degree and Medical Degree* or *Special Programs* statements in the *Graduate Education* section of this catalog. They should also contact the Associate Dean for Academic Programs and the Associate Dean for Research and Graduate Studies in the College.

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 veterinary doctoral degree (Doctor of Veterinary Medicine) and a graduate research doctoral degree (Doctor of Philosophy). The program seeks to meet a national need for veterinarians who are proficient in research as well as in veterinary medicine, and who will pursue careers as faculty members in veterinary medical school and research institutions.

The program is designed to select, educate, and train highly motivated students having outstanding research and academic qualifications. Trainees pursue veterinary medical and graduate studies in parallel, meet regularly with peers in seminars, and engage in veterinary medical-level 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 Graduate Studies in the College of Veterinary Medicine.

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

Post-D.V.M. Clinical Education Programs

Internships. The Department of Small Animal Clinical Sciences offers 13-month rotating internships designed to provide general

clinical training for the post-D.V.M. student and a basis for further education in a specialty area.

Residencies. Residencies designed to meet the training requirement for board certification are offered in a variety of clinical specialties by the departments of Small Animal Clinical Sciences, Large Animal Clinical Sciences, and Pathology. Concurrent work toward an advanced degree is possible.

COMPARATIVE MEDICINE AND INTEGRATIVE BIOLOGY

Nationwide, there is a need for scientists who understand modern molecular biology in the context of integrated systems and can apply this understanding to human and animal health. Addressing this national need with an interdepartmental graduate program in Comparative Medicine and Integrative Biology will offer graduates the understanding of how molecular and cellular events integrate into whole-animal systems, knowledge of how appropriate animal models can be used to study human and animal disease, and understanding of how species differences and similarities can be used to investigate basic biology and disease.

Graduates of the master's and/or the doctoral program in comparative medicine and integrative biology will find employment in academia, governmental research and regulatory agencies, and in pharmaceutical industry research. They will become leaders in discovery and problem-solving research in medical science and will play an instrumental role in the translation of new knowledge to address current issues in human and animal health and well-being. The overall program is designed to develop an integrative approach to research in clinical, cellular, and molecular problems in comparative medicine and integrative biology. It emphasizes development of a firm scientific background in clinical and basic biomedical sciences and the conduct of original research.

Admission

To be considered for admission, applicants must hold a bachelor's or higher degree in life sciences or related fields and have achieved a grade-point average of at least 3.0. As biological sciences interface more and more with disciplines such as bioinformatics, mathematics, and engineering, it is possible that students holding degrees in fields other than life sciences may contribute to and benefit from training in comparative medicine and integrative biology. The admissions committee may recommend that degree holders in other fields be admitted if their background is deemed appropriate to a particular research area in the college. The committee is chaired by the associate dean for research and graduate studies of the College of Veterinary Medicine and has representatives from each department, as appointed by the chair of each department. An applicant's acceptance will be based on the academic record including grade-point average, quality of previous training, performance on standard tests such as the GRE, and proficiency in English as demonstrated by standard tests such as the TOEFL or equivalents; statement of professional goals, three letters of reference, and availability of appropriate mentors.

Upon admission to the program, the admissions committee will appoint a temporary advisor. Within six months after entrance into the program, a major advisor will be selected by mutual agreement between the student and the proposed major advisor, after consultation with the associate dean for research and graduate studies and the department chair from the home department of the proposed major advisor.

The major advisor will be required to submit a student's progress report to the admissions committee by December 30 of each year. The committee will conduct an individual interview with each

graduate student annually to assess progress in the program. Assessment of the student's progress will be reported to the major advisor, chairperson of the advisor's department, and the Associate Dean of Research and Graduate Studies.

Master of Science

The College of Veterinary Medicine offers a master of science program in comparative medicine and integrative biology to develop an understanding of major concepts in comparative medicine and integrative biology as well as to acquire comprehensive knowledge of a major field and related subjects. **Plan A** consists of prescribed course work, original research of an important problem in human and animal health or biology, a thesis, and a final oral examination. **Plan B** consists of prescribed course work and a final research paper.

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

Requirements for the Master of Science Degree in Comparative Medicine and Integrative Biology

The student must complete a total of 30 credits for the degree under Plan A (with thesis) or Plan B (without thesis), with at least 12 of those non-research credits in courses at the 800-900 level. Student's who lack sufficient background in certain areas may be asked to take collateral courses at the 400-500 level. These collateral courses are not counted toward degree requirements. The student's program of study must be approved by the student's major advisor and must meet the requirements specified below:

CREDITS
30

Requirements for Both Plan A and Plan B:

- Both of the following courses:

EPI 827	The Nature and Practice of Scientific Integrity	3
VM 820	Current Topics in Comparative Medicine and Integrative Biology	2
- One of the following courses:

STT 421	Statistics I	3
STT 422	Statistics II	3
PHM 980	Problems	3

Additional Requirements for Plan A:

- One course from two of the following three major areas: Molecular Life Sciences, Integrative Biology, and Pathology. A list of approved courses is available from your academic advisor.
- Complete 10 credits of 899 Master's Thesis Research from one of the following departments: Large Animal Clinical Sciences, Microbiology and Molecular Genetics, Pathology, Pharmacology and Toxicology, Physiology and Small Animal Clinical Sciences.
- Elective credits including non-research and seminar courses as determined by the academic advisor.
- Pass an oral examination in defense of the thesis.

Additional Requirements for Plan B:

- One course from each of the following three major areas: Molecular Life Sciences, Integrative Biology, and Pathology. A list of approved courses is available from your academic advisor.
- Elective credits including non-research and seminar courses as determined by the academic advisor.
- Submit a satisfactory research paper.

Doctor of Philosophy

The College also offers the Doctor of Philosophy degree focused on depth of understanding across disciplines, acquisition of research skills and the conducting of original research.

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

Requirements for the Doctor of Philosophy Degree in Comparative Medicine and Integrative Biology

The student must complete a minimum of 18 credits of non-research courses, with at least 12 credits in courses at the 800 level

and above. All students are required to take the following courses, with at least two enrollments in Veterinary Medicine 820:

EPI 827	The Nature and Practice of Scientific Integrity	3
VM 820	Current Topics in Comparative Medicine and Integrative Biology	2

All students are required to take at least one course from each of four major areas: molecular life sciences, integrative biology, pathology, and statistics and epidemiology. A list of approved courses is available from the major advisor. In rare cases, a student may lack sufficient background in certain areas and may be asked to complete collateral courses at the 400 or 500 level. Credits earned in such collateral courses are not counted towards the degree.

The doctor of philosophy degree program in comparative medicine and integrative biology is conducted in two phases:

Phase I consists of acquiring and/or documenting a high degree of competence in fundamental and basic biomedical sciences and developing research skills. Phase I culminates with a comprehensive examination, submission of a research proposal, and presentation of a research seminar outlining the research proposal including preliminary data. Students may elect to take their comprehensive exam after completion of at least 12 credit hours of course work.

Phase II consists of conducting research, continuing to expand knowledge by taking additional courses and seminars as necessary, and completing 24 credits in and successfully defending the Ph.D. Dissertation.

FOOD SAFETY

Master of Science

The Master of Science in Food Safety is an online program designed for students who want to enhance their study of food safety.

The Master of Science is offered by the College of Veterinary Medicine. This integrated multidisciplinary program is designed for students with various disciplinary interests and experiences. It is particularly relevant for students whose professional careers are at the interface of research, regulatory affairs, production, marketing, finance, and management.

Admission

Applicants will be accepted after review by an admissions committee of faculty. An academic specialist will serve as the student's academic advisor and will assist the student in planning a program of study that is related to the student's interests and professional goals and that fulfills college and university requirements.

Applicants must have completed a bachelor's degree from an accredited and recognized college or university with a cumulative grade-point average of 3.0 on a 4.0 scale. The applicant must have completed at least 6 credits of college-level course work in biological sciences, including 3 credits in microbiology. A 300-level course or higher is recommended. The applicant must prove or demonstrate proficiency in written and spoken English and submit a personal statement and three letters of recommendation. Experience in the workplace is weighed heavily in meeting requirements for admission.

Applicants who do not meet all of the requirements listed above may be admitted provisionally and permitted to enroll for collateral course work, not to count toward the degree. This course work must be approved beforehand by the program director.

VETERINARY MEDICINE
Graduate Study

Requirements for the Master of Science Degree in Food Safety

The student must complete 30 credits under Plan B (without thesis). The specific program of study must be approved by the student's academic advisor.

				CREDITS
1.	One of the following courses (3 credits):			
	FSC	810	International Food Laws and Regulations	3
	FSC	811	U.S. Food Laws and Regulations	3
2.	All of the following courses (18 credits):			
	VM	810	Food Safety Introduction and Professional Management	3
	VM	811	Evolution and Ecology of Foodborne Pathogens	3
	VM	812	Food Safety Toxicology	3
	VM	815	Applied Project in Food Safety	3
	VM	830	Food Safety Research Methods	3
	VM	831	Foodborne Disease Epidemiology for the Professional	3
3.	Nine additional credits in electives approved by the student's academic advisor.			
4.	Pass a final applied project.			

FOOD SAFETY AND TOXICOLOGY

Graduate Certificate

The Graduate Certificate in Food Safety and Toxicology embodies the principles of prevention in public health and addresses the needs of the food industry, government and public health for their employees to be educated in the many aspects of safeguarding food supply. Education of public health professionals in food safety and toxicology provides society with public health professionals who can contribute to the prevention and control of foodborne diseases. The Graduate Certificate in Food Safety and Toxicology is available only online.

Requirements for the Graduate Certificate in Food Safety and Toxicology

				CREDITS
Students must complete the following courses (18 credits):				
1.	All of the following courses (15 credits):			
	HM	852	Outbreak Investigations in Public Health	3
	VM	811	Evolution and Ecology of Foodborne Pathogens	3
	VM	812	Food Safety Toxicology	3
	VM	821	Food Protection and Defense	3
	VM	832	Food Safety Disease Control	3
2.	One of the following courses (3 credits):			
	FSC	810	International Food Laws and Regulations	3
	FSC	811	U.S. Food Laws and Regulations	3

**DEPARTMENT of
 LARGE ANIMAL
 CLINICAL SCIENCES**

Melinda J. Wilkins, Chairperson

The Department of Large Animal Clinical Sciences offers courses designed to meet the needs of the professional program in veterinary medicine and post-D.V.M. clinical training programs that provide the basis for specialty board certification in large animal medicine and surgery.

Many members of the faculty participate in graduate training at the master's and doctoral level through the interdepartmental program in Comparative Medicine and Integrative Biology.

Several colleges and departments within Michigan State University cooperate in offering interdepartmental Doctor of Philosophy degree programs with majors in cell and molecular biology, genetics, and neuroscience, which are administered by the College of Natural Science. For additional information, refer to the statement on the doctoral programs in the *College of Natural Science* section of this catalog.

Students who are enrolled in Master of Science degree programs in the Department of Large Animal Clinical Sciences may elect a specialization in food safety. For additional information, refer to the statement on the specialization in the *College of Veterinary Medicine* section of this catalog.

GRADUATE STUDY

Master of Science

The principal objectives of the Master of Science program are to introduce candidates to research and to prepare them for positions requiring advanced education. Opportunities are available in veterinary and medical colleges, animal and veterinary science departments, industrial research and development, U. S. Public Health Service, U. S. Food and Drug Administration, U. S. Department of Agriculture, and private business organizations or practices.

The master's degree student is usually required to develop a course of study which requires writing a thesis based upon original research (Plan A). In rare instances, a student may be permitted to elect a non-thesis (Plan B) course of study upon recommendation of the guidance committee and the approval of the department's faculty.

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

Admission

The candidate must possess a Doctor of Veterinary Medicine degree or an equivalent degree and be accepted by the graduate faculty of the department.

Requirements for the Master of Science Degree in Large Animal Clinical Sciences

The student must complete 30 credits under either Plan A (with thesis) or Plan B (without thesis).

Students majoring in large animal clinical sciences may elect to support the major field with courses in two or three additional areas. Supporting and minor courses may be in anatomy, pathology, physiology, pharmacology, bacteriology, virology, immunology, mycology, parasitology, nutrition, animal science, statistics, chemistry, genetics, or education.

Academic Standards

A second semester of grades averaging below 3.00 constitutes cause for withdrawal from the program.

Doctor of Philosophy

The Doctor of Philosophy degree program is designed to provide veterinary medical graduates the experience and training necessary to develop an integrative approach to animal disease research. The program emphasizes the development of a firm scientific background in fundamental and basic biomedical sciences, in-depth knowledge in an area of veterinary science, and the conduct of in-depth original research.

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

Admission

Applicants for admission must hold a Doctor of Veterinary Medicine degree or another medical degree and have a grade–point average of at least 3.00 in two previous years of graduate or professional study. At least one year of clinical experience is recommended. A Master of Science degree is not required.

Applicants must submit an autobiographical sketch, a statement of interest and objectives, and three letters of recommendation from individuals capable of judging their academic capabilities and accomplishments. The department's Graduate Postgraduate Training Committee reviews applications for admission and recommends persons for admission to the department chairperson. The admissions decision is based upon the applicant's academic record and professional goals, the letters of recommendation, and space and faculty availability.

Requirements for the Doctor of Philosophy Degree in Large Animal Clinical Sciences

The doctoral program is divided into three phases: Phase I culminating with a qualifying examination, Phase II culminating with a comprehensive examination, and Phase III culminating with the completion and defense of the dissertation. There is no foreign language requirement.

Phase I consists of fundamental and basic biomedical sciences courses in which the student must demonstrate a high degree of competence. The student must complete 15 credits of inorganic chemistry, organic chemistry, biochemistry, and physiologic chemistry. No fewer than 3 credits must be in biochemistry. The student must also complete no fewer than 3 credits of statistics and no fewer than 6 credits in courses emphasizing mechanisms of animal disease. In order to continue in the doctoral program, the student must pass a qualifying examination formulated and conducted by the qualifying examination committee.

Phase II consists of at least 13 credits in an area of veterinary science chosen by the student. The 13 credits must be in courses at the 400 level or above. At least 8 of the 13 credits must be in courses at the 800 level or above, and it is recommended that these credits be from one of the following departments: anatomy, physiology, pharmacology and toxicology, microbiology, pathology, statistics and probability, or community health science. With the agreement of the department that administers the courses, the 8 credits may contribute to a minor from that department, but a minor is not required for the program.

The comprehensive examination is given by the student's guidance committee toward the end of Phase II when the student has completed most of the required courses. The examination consists of two parts: an oral examination and the presentation of a dissertation proposal. The oral examination is designed to evaluate the student's depth of knowledge in his or her chosen area of veterinary science and includes, but is not limited to, material from the required courses. The student must pass the oral examination before he or she may present the dissertation proposal. The proposal must be presented no earlier than 15 days, and no later than 45 days, after the student has passed the oral examination.

Phase III consists of conducting animal disease research, completing the dissertation, and defending the dissertation.

Academic Standards

A candidate may not receive more than three grades below 3.0 in courses required for the degree.

DEPARTMENT of MICROBIOLOGY and MOLECULAR GENETICS

Victor J. DiRita, Chairperson

GRADUATE STUDY

The Department of Microbiology and Molecular Genetics is administered jointly by the colleges of Veterinary Medicine, Human Medicine, Natural Science, and Osteopathic 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.

Students who are enrolled in Master of Science degree programs in the Department of Microbiology and Molecular Genetics may elect a specialization in food safety. For additional information, refer to the statement on the specialization in the *College of Veterinary Medicine* 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 PATHOBIOLOGY and DIAGNOSTIC INVESTIGATION

Srinand Sreevatsan, Chairperson

The Department of Pathobiology and Diagnostic Investigation offers courses for students in the professional program in Veterinary Medicine. The department offers Master of Science and Doctor of Philosophy degree programs. Residency training in diagnostic veterinary anatomic or clinical pathology is also available.

GRADUATE STUDY

Students who are enrolled in Master of Science degree programs in the Department of Pathobiology and Diagnostic Investigation may elect a specialization in food safety. For additional information, refer to the statement on the specialization in the *College of Veterinary Medicine* section of this catalog.

Many members of the faculty participate in graduate training at the master's and doctoral level through the interdepartmental program in Comparative Medicine and Integrative Biology.

Several colleges and departments within Michigan State University cooperate in offering interdepartmental Doctor of Philosophy degree programs with majors in cell and molecular biology, genetics, and neuroscience, which are administered by the College of Natural Science. For additional information, refer to the statement on the doctoral programs in the *College of Natural Science* section of this catalog.

Residency Training in Veterinary Pathology

The veterinary residency program is designed to provide post-D.V.M. advanced training for proficiency in the practice of pathology. Scheduled rotational assignments are available in the areas of necropsy, clinical pathology, and surgical pathology. Residents also receive experience in teaching and are exposed to the research activities of the department. Residents must identify their area of interest in either clinical pathology or anatomic pathology. Appointments are for a 2 to 4 year period depending on the background and career objectives of the individual resident. Annual evaluations are conducted, and reappointments are contingent on the student's performance.

Pathology for Graduate Students in Related Fields

Students majoring in related fields may elect to take supportive courses in pathology. Such students are expected to have an adequate background in biochemistry, microbiology, physiology, gross anatomy, and histology. Also, due to limited facilities, permission must be obtained from the department chairperson prior to enrollment.

PATHOBIOLOGY

Graduate education and research may be directed to either human or animal pathology. Major areas of research in pathology provide the basis for advanced degree programs. These areas include toxicologic pathology, oncology, neuropathology, hematology in a broad sense, immunopathology, pathology of infectious diseases, reproductive and cardiovascular pathology, and pathology of animal models for human disease. Comparative aspects of disease processes may encompass a variety of species, including humans and domestic or wild mammals and birds, and may emphasize anthroponoses dealing with diseases transmissible across species lines. An interdisciplinary approach to problem solving will be applied in all instances where indicated.

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

Admission

With few exceptions, the graduate student majoring in pathobiology will have a professional degree in some branch of medicine. Students holding a bachelor's degree and seeking graduate training in pathology are advised to inquire about possible openings before going through the process of formal application. The doctoral candidate will usually have, in addition, a master's degree in

a medical or paramedical science; however, possession of a master's degree does not guarantee admission to a doctoral program.

Academic Standards

In all graduate study programs in pathobiology, the student is expected to assume much responsibility. In research, particularly, the qualified student must demonstrate ability to independently plan, initiate, and carry to completion the project which the student undertakes.

Master of Science

Requirements for the Master of Science Degree in Pathobiology

The student must complete 30 credits under Plan A (with thesis). The student is required to prepare a manuscript judged by the academic advisor and the director of thesis research as suitable to submit for publication in an appropriate scientific journal.

Residence

A minimum of 10 semester credits must be acquired in residence.

Doctor of Philosophy

Requirements for the Doctor of Philosophy Degree in Pathobiology

The student is required to prepare a manuscript judged by the academic advisor and director of dissertation research as suitable to submit for publication in an appropriate scientific journal.

The minimum number of credits required for the degree depends principally upon the student's educational background and level of scholarly attainment. Those students who are well advanced in training or who have had considerable professional experience in pathology and can submit bona fide evidence of scholarship and attainment may not be required to take as many as the usual 40 credits of course work beyond the master's degree.

PATHOBIOLOGY—ENVIRONMENTAL TOXICOLOGY

Doctor of Philosophy

For information about the Doctor of Philosophy degree program in pathobiology—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 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 Master of Science and Doctor of Philosophy degree program in Pharmacology and Toxicology, and a Graduate Certificate in Safety Pharmacology. A Master of Science degree in Integrative Pharmacology is also available for professional laboratory personnel. In addition, the College of Veterinary Medicine offers a Doctor of Philosophy degree program with a major in pharmacology and toxicology—environmental toxicology. For additional information about the department and its graduate degree programs, refer to the statement on the *Department of Pharmacology and Toxicology* in the *College of Osteopathic Medicine* section of this catalog.

Students who are enrolled in Master of Science degree programs in the Department of Pharmacology and Toxicology may elect a specialization in food safety. For additional information, refer to the statement on the specialization.

MINOR IN PHARMACOLOGY AND TOXICOLOGY

The Minor in Pharmacology and Toxicology is designed to introduce science-oriented students to the field of pharmacology and toxicology. It provides student an opportunity to enhance their career and better position students for entry into professional programs including medical, veterinary, pharmacy schools, and to graduate programs in biomedical disciplines and careers within research.

The minor is available as an elective to students who are enrolled in bachelor's degree programs at Michigan State University. With the approval of the department and college that administers the student's degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.

Students who plan to complete the requirements for the minor should consult an undergraduate advisor in the department.

Requirements for the Minor in Pharmacology and Toxicology

CREDITS

Students must complete a minimum of 18 credits from the following:

1. One of the following courses (3 credits):
 - PHM 350 Introductory Human Pharmacology 3
 - PHM 430 Human Pharmacology 3
2. The following course (3 credits):
 - PHM 450 Introduction to Chemical Toxicology 3
3. Complete at least 2 or 3 credits from the following Pharmacology and Toxicology in Context courses:
 - PHM 211 Pharmacology and Toxicology in Society 2
 - PHM 454 Leadership and Team Management 3
4. Complete 9 or 10 credits from the following Science courses:
 - CEM 419 Independent Study 2
 - PHM 321 Pharmacology of Common Drugs 3
 - PHM 351 Fundamentals of Drug Safety 2
 - PHM 421 Clinical Toxicology 3
 - PHM 422 Fundamentals of Neuropharmacology 2
 - PHM 431 Pharmacology of Drug Addiction 3
 - PHM 480 Special Problems 3 to 6
 - PHM 487 Current Topics in Pharmacology and Toxicology 2
 - STT 464 Statistics for Biologists 3
 - ZOL 450 Cancer Biology (W) 3

Students should consult their academic advisor for section specific information for enrollment in CEM 419 and PHM 480.

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 PHYSIOLOGY

Charles Leroy Cox, Chairperson

The Department of Physiology is administered jointly by the colleges of Veterinary Medicine, Human Medicine, Natural Science, and Osteopathic Medicine. All four of these colleges offer Master of Science and Doctor of Philosophy degree programs with majors in 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.

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 SMALL ANIMAL CLINICAL SCIENCES

Nicholas Olivier, Chairperson

The Department of Small Animal Clinical Sciences offers courses designed to meet the needs of the professional program in veterinary medicine and post-D.V.M. clinical training programs that provide the basis for specialty board certification in various areas such as dermatology, diagnostic imaging, emergency and critical care, ophthalmology, internal medicine, cardiology, anesthesiology and surgery.

Many members of the faculty participate in graduate training at the master's and doctoral level through the interdepartmental program in Comparative Medicine and Integrative Biology.

Several colleges and departments within Michigan State University cooperate in offering interdepartmental Doctor of Philosophy degree programs with majors in cell and molecular biology, genetics, and neuroscience, which are administered by the College of Natural Science. For additional information, refer to the statement on the doctoral programs in the *College of Natural Science* section of this catalog.

GRADUATE STUDY

Master of Science

The department offers advanced studies leading to the Master of Science degree. The program is designed primarily for graduate veterinarians in the residency training program in the department.

Emphasis in the program is placed on clinically oriented research which is well supported by the facilities available and the clinical case volume. Graduates of this program will find opportunities in all areas of practice, teaching, and research.

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

Admission

The candidate must possess a Doctor of Veterinary Medicine degree or its equivalent and have the potential qualifications for graduate study. Licensure to practice veterinary medicine in the State of Michigan is usually required.

Requirements for the Master of Science Degree in Small Animal Clinical Sciences

The student must complete 30 credits under Plan A (with thesis).

Supporting courses may be taken in such areas as anatomy, pathology, physiology, pharmacology, microbiology, immunology, nutrition, parasitology, statistics, virology, chemistry, and animal genetics.

Academic Standards

Three grades below a 3.0 in graduate courses will remove a student from degree candidacy.

Transfer Credits

As many as 9 semester credits of graduate work (excluding research and thesis credits) may be transferred from other institutions, upon approval of the department chairperson, the Associate Dean for Research and Graduate Studies, and the student's guidance committee.

Post-D.V.M. Clinical Training Programs

These programs are supported by the clinical service activities of a highly specialized faculty utilizing the facilities and support staff of The Veterinary Teaching Hospital.

Internships

The department offers thirteen-month rotating internships designed to provide general clinical training for the post-D.V.M. student as well as to provide a basis for further specialty training. Selection of trainees is normally made through the National Internship-Residency Matching Program.

Residencies

Residencies designed to meet the training requirements for specialty board certification are currently offered in dermatology, internal medicine, and surgery. The dermatology residency is two years in length and the others are three years in length with yearly evaluation of progress and continuance based on trainee performance. Concurrent work toward the Master of Science degree is encouraged. Selection of trainees is normally accomplished through the National Internship Residency Matching Program.

INSTITUTE FOR INTEGRATIVE TOXICOLOGY

Norbert E. Kaminski, Director

The Institute for Integrative Toxicology was established to facilitate and coordinate the varied programs in departments and colleges across the Michigan State University campus related to toxic substances which include multidisciplinary research, education, and training in toxicology. These programs address almost all aspects of environmental toxicology with particular focus on adverse effects of chemical contaminants on living organisms. Research spans a broad range from studies of biochemical and molecular mechanisms of toxicity to studies on the distribution and fate of chemicals in various environmental media.

The Institute for Integrative Toxicology administers the doctoral Program in Environmental and Integrative Toxicological Sciences providing students with excellent training in a basic science discipline and training and credentials in environmental and integrative toxicological sciences. Students who complete this multidisciplinary course of study earn the Ph.D. degree in a basic science discipline with a dual major in environmental toxicology. In this way and through its colleges, Michigan State University makes study in the area of environmental toxicology available to graduate students.

VETERINARY DIAGNOSTIC LABORATORY, MICHIGAN STATE UNIVERSITY

Rachel Reams, Director

In the more than 30 years since its inception, the Veterinary Diagnostic Laboratory at Michigan State University has become one of the country's premier veterinary diagnostic laboratories whose mandate is to protect the public by ensuring the health of animals in Michigan and around the nation.

The Veterinary Diagnostic Laboratory is a full-service laboratory with expertise provided in anatomic pathology, bacteriology, clinical pathology, endocrinology, immunodiagnosics/parasitology, nutrition, toxicology, and virology.

Faculty are appointed in academic departments and participate in teaching, research, diagnostic, and service programs.

It is fully accredited for all species by the American Association of Veterinary Laboratory Diagnosticians.

VETERINARY MEDICAL CENTER

Chris Gray, Director

The MSU Veterinary Medical Center provides specialty referral services for animals from across the state of Michigan as well as nationwide, and also offers primary care small animal services to the community. The Center, which treats more than 28,000 patients each year, provides the environment for teaching veterinary and veterinary technology students, as well as interns and residents. It maintains facilities for clinical research activities for graduate and postdoctoral students, residents, and faculty. Board-certified specialists deliver world-class care in anesthesiology, cardiology, dermatology, diagnostic imaging, emergency and critical care, internal medicine, oncology, ophthalmology, orthopedics, neurology, and surgery across all species. The Center is accredited by the American Animal Hospital Association.