

## 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 nursing
- graduate programs leading to the Master of Science and Doctor of Philosophy degrees
- a graduate certificate in food safety
- intern and residency training programs in various clinical specialties

## VETERINARY NURSING

*Taylor Epp, Director*

Veterinary nurses 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: a two-year certification and a four-year bachelor's degree. The Certificate of Completion at Michigan State University is a 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 two-year

level of training is most appropriate for individuals who seek employment in privately owned veterinary clinical practices.

The Bachelor of Science degree in Veterinary Nursing requires 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 four-year bachelor's degree level of training 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 professional must be licensed and registered with the state. Regulation of veterinary professionals 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 Nursing Program is accredited by the American Veterinary Medical Association (AVMA) and graduates of the Certificate of Completion or Bachelor of Science in Veterinary Nursing are eligible to take the National Board Examinations for licensure.

Enrollment in the Veterinary Nursing 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 Nursing 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 nursing is limited. All persons who are interested in applying for admission to the bachelor's degree program in veterinary nursing must complete an application which can be found, along with the application process instructions, by visiting [www.cvm.msu.edu/vt](http://www.cvm.msu.edu/vt).

Applications for admission to the bachelor's degree program in veterinary nursing 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

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Medicine regarding admission to the bachelor's degree program in veterinary nursing 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 nursing 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 Nursing will be qualified to take the National Board Examinations for licensure as veterinary-technicians.

### Requirements for the Bachelor of Science Degree in Veterinary Nursing

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 Nursing.

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 Nursing 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 Nursing 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 (102 credits):
  - a. All of the following courses (72 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 Nurses	2
VM 140	Pharmacology for Veterinary Nurses	2
VM 150	Hospital Procedures and Communication	2
VM 155	Veterinary Nursing 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 Nurses	2
VM 175	Clinical Pathology Laboratory I for Veterinary Nurses	1
VM 176	Clinical Pathology Laboratory II for Veterinary Nurses	1
VM 205	Preventive Animal Health Care for Veterinary Nurses	3
VM 210	Surgical Nursing for Veterinary Nurses	2
VM 215	Surgical Nursing and Anesthetic Management Laboratory	1
VM 245	Parasitology for Veterinary Nurses	2
VM 250	Veterinary Comparative Clinical Physiology	4
VM 255	Small Animal Diseases and Management	3
VM 265	Dentistry Techniques for Veterinary Nurses	1
VM 270	Advanced Skills Development for Veterinary Nurses	1
VM 275	Large Animal Diseases and Management	3
VM 295	Biomedical Research and Regulatory Issues for Veterinary Nurses	1
VM 303	Anesthesiology for Veterinary Nurses	2
VM 304	Radiology for Veterinary Nurses	2
VM 305	Hospital Practice Management for Veterinary Nurses	2
VM 410	Veterinary Nursing Clerkship in Anesthesiology	3
VM 411	Veterinary Nursing Clerkship in Radiology	3
VM 412	Veterinary Nursing Clerkship in Companion Animal Medicine	3
VM 413	Veterinary Nursing Clerkship in Companion Animal Surgery	3
b.	One of the following options (0 to 7 credits):	
(1)	One of the following courses:	
	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 and	3
	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 (W)	4
	ANS 314 Genetic Improvement of Domestic Animals (W)	4
	ANS 407 Food and Animal Toxicology	3
	ANS 413 Non-Ruminant Nutrition	4
	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 Nurses	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 Nursing Clerkship in Equine Medicine and Surgery	3 to 6

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VM 415	Veterinary Nursing Clerkship in Food Animal and Equine Medicine and Surgery	3 to 6
VM 450	Veterinary Nursing Clerkship in Emergency Medicine	3
VM 451	Veterinary Nursing Clerkship in Cardiology	3
VM 452	Veterinary Nursing Clerkship in Neurology	3
VM 453	Veterinary Nursing Clerkship in Ophthalmology	3
VM 454	Veterinary Nursing Clerkship in Critical Care	3
VM 466	Veterinary Nursing Clerkship in Large Animal Anesthesia	3
VM 470	Veterinary Nursing Clerkship in Food Animal Medicine	3 to 6
VM 480	Veterinary Nursing Clerkship in Clinical Pathology	3
VM 482	Veterinary Nursing Clerkship in Necropsy	3
VM 483	Veterinary Nursing Clerkship in Biomedical Research	3 to 12
VM 484	Veterinary Nursing Clerkship in Zoo and Wildlife	3 to 12
VM 486	Veterinary Nursing Clerkship in Clinical Parasitology	3
VM 490	Veterinary Nursing 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 credits):	
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

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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 student's 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.

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- Personal statement describing the scholarly content of the proposed bachelor's degree program and its relevance to the individual's career and personal goals.
- 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

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

### Health Requirements for Students in the Professional Program in Veterinary Medicine

- The student must be covered by a personal health insurance policy throughout enrollment in the program.
- The student's tetanus vaccination must be current throughout enrollment in the program.
- The student must have a rabies vaccination prior to participation in senior clerkships. Rabies vaccination is recommended for entering students.
- 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.

	CREDITS
<b>VETERINARY MEDICINE (YEAR 1)</b>	
<b>SEMESTER 1 (Fall) (19 credits)</b>	
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
<b>SEMESTER 2 (Spring) (19 credits)</b>	
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
<b>VETERINARY MEDICINE (YEAR 2)</b>	
<b>SEMESTER 3 (Fall) (19 credits)</b>	
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
<b>SEMESTER 4 (Spring) (19 credits)</b>	
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
<b>VETERINARY MEDICINE (YEAR 3)</b>	
<b>SEMESTER 5 (Fall) (19 credits)</b>	
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
<b>SEMESTER 6 (Spring) (17 credits)</b>	
VM 581 Clinical Reasoning III	5
VM 582 Veterinary Clinical Experience	3
Complete 9 credits in required or elective clerkships.	

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### 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.

#### 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
MMG690	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
LCS 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 Veterinary Medicine, the College of Agriculture and Natural Resources, the College of

## COLLEGE OF VETERINARY MEDICINE

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 Medicine 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

CREDITS

Students must complete 12 credits from the following:

- 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
  - 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.

### 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.

### 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:

- 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.
- Provisional status:** for those who have some remediable inadequacy of qualifications.

## COLLEGE OF VETERINARY MEDICINE

### **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.



## COLLEGE OF VETERINARY MEDICINE

### 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. Students 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
<b>Requirements for Both Plan A and Plan B:</b>	
1. 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
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:

	CREDITS
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

## COLLEGE OF VETERINARY MEDICINE

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.

### 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.

## DEPARTMENT of LARGE ANIMAL CLINICAL SCIENCES

### *Annette O'Connor, 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.

## 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.

## COLLEGE OF VETERINARY MEDICINE

### 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.

### 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

*Dalen W. Agnew, 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.

## COLLEGE OF VETERINARY MEDICINE

Residency training in diagnostic veterinary anatomic or clinical pathology is also available.

### GRADUATE STUDY

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 anthrozooses 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

## COLLEGE OF VETERINARY MEDICINE

the statement on *Doctoral Program in Environmental and Integrative Toxicological Sciences* in the *Graduate Education* section of this catalog.

# DEPARTMENT of PHARMACOLOGY and TOXICOLOGY

**Anne McLaren Dorrane, 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. 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.

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. The principal objective of the departmental Doctor of Philosophy (PhD) program is to prepare students for pharmacology- and toxicology-related careers.

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

### **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. One of the following Pharmacology and Toxicology in Context courses:	
PHM 211 Pharmacology and Toxicology in Society	2
PHM 454 Leadership and Teams for Scientists and Health Professionals	3
4. Complete 9 or 10 credits from the following Science courses:	
IBIO 450 Cancer Biology (W)	3
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 461 Tropical Medicine Pharmacology	2
PHM 480 Special Problems	3 to 6
PHM 483 Chemotherapy of Infectious Diseases	3
PHM 487 Current Topics in Pharmacology and Toxicology	2
STT 464 Statistics for Biologists	3
Students should consult their academic advisor for section specific information for enrollment in PHM 480.	
Students who complete PHM 211 in item 3. must complete 10 credits to fulfill item 4.	
Students who complete PHM 454 in item 3. must complete 9 credits to fulfill item 4.	

### **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 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.

## COLLEGE OF VETERINARY MEDICINE

### **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

#### **Robert Charles Fowkes-Gajan, 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

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## 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.