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 Diagnostic Center for Population and Animal Health.

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
- intern and residency training programs in various clinical specialties

VETERINARY TECHNOLOGY

Helene E. Pazak, 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 a two-year training program. After completion of the pre-clinical courses, students complete clinical clerkship training at the Michigan State University Veterinary Teaching Hospital. 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.
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 and State 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 Mathematics 110 or 116 that is 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, 411, 412, 413, and 415. Those courses are referenced in items 2. a. and 2. d. 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. b. below.

2. The following requirements for the major:

   a. All of the following courses (73 credits):
   
      | Course Title                                                                 | 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 Career                                           |         |
      | 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 for Veterinary Technicians              | 1       |
      | VM 176 Clinical Pathology Laboratory for Veterinary Technicians              | 2       |
      | VM 205 Preventive Animal Health Care for Veterinary Technicians              | 1       |
      | VM 210 Surgical Nursing for Veterinary Technicians                           | 2       |
      | VM 215 Surgical Nursing and Anesthetic Management Laboratory                  | 2       |
      | VM 245 Parasitology for Veterinary Technicians                               | 3       |
      | VM 250 Veterinary Comparative Clinical Physiology                            | 3       |
      | VM 255 Small Animal Diseases and Management                                 | 2       |
      | 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       |

   b. Biological Science 161 and 171.
   
   c. Tier I writing course.

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 request a special application form and detailed information regarding admission requirements and procedures from the Veterinary Technology Program, Veterinary Medical Center-South Building, 784 Wilson Road, Room F-101, Michigan State University, East Lansing, MI 48824-1316.

Applications for admission to the bachelor's degree program in veterinary technology are accepted through January 15th 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.

Minimal criteria for admission to the Bachelor of Science degree program in Veterinary Technology are:

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. Mathematics 103 or 110 or 116 or 124 or 132 or 152H.
   
   b. Biological Science 161 and 171.
   
   c. Tier I writing course.
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 pre-veterinary program are enrolled in the Neighborhood Student Success Collaborative, but receive academic advising in the College of Veterinary Medicine Pre-veterinary Advising Center.

The courses in mathematics and natural science that are required for admission to the Professional Program in Veterinary Medicine are included in the requirements for the pre-veterinary program. Students who are enrolled in the pre-veterinary program should complete the University requirements for bachelor's degree. 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 pre-veterinary students. Therefore, upon reaching junior standing, students who have been enrolled in the pre-veterinary 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.

Enrollments in the pre-veterinary 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 pre-veterinary 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 pre-veterinary 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 Pre-veterinary Program**

1. All of the following courses: .................................. 50
   
   CREDITS
   
   ANS 313 Principles of Animal Feeding and Nutrition .............. 4
   BMB 401 Basic Biochemistry .................................. 4
   BS 110 Organisms and Populations .................................. 4
   BS 111 Cells and Molecules .................................. 3
   BS 111L 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 .................................. 2
   CEM 255 Organic Chemistry Laboratory .................................. 2
   MMG 301 Introductory Microbiology .................................. 3
   MMG 302 Introductory Microbiology Laboratory .............. 1
   MMG 409 Eukaryotic Cell Biology .................................. 3
   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. One of the following courses:
   
   CREDITS
   
   ANS 314 Genetic Improvement of Domestic Animals .............. 4
   ZOL 341 Fundamentals of Genetics .................................. 4
   
   3. Students who are enrolled in the pre-veterinary program should complete the University requirements for bachelor's degrees as described in the Undergraduate Education 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 Pre-veterinary 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 110, 111, and 111L and Chemistry 141. The completion of Biological Science 110 and 111L satisfies the laboratory requirement. Biological Science 110, 111, and 111L and Chemistry 141 may be counted toward both the alternative track and the requirements for the pre-veterinary program referenced in item 1. above.

   Students who are enrolled in the pre-veterinary 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 an excellent basic medical education as well as clinical training in the diagnosis, treatment, and prevention of animal diseases and injuries. Graduates may pursue a variety of careers in salaried positions or become licensed as private practitioners in any state.

About three-fourths of the veterinarians in the United States are engaged in private practice. These veterinarians may be in general practices that care for the needs of all of the species of domestic animals or in practices limited to companion animals, farm animals, horses, poultry, or some other specific aspect of veterinary medicine.

Many veterinarians are employed by the U.S. Department of Agriculture for important work in livestock disease control, meat and poultry inspection, development of biological products, and prevention of the entry of foreign animal diseases. Veterinarians also find rewarding positions in public health work for the U.S. Public Health Service, the U.S. Army and Air Force, and for state, county, and local health agencies.

Some of the most exciting opportunities for veterinarians are in biomedical research for the benefit of both animals and people. Excellent research opportunities are available with colleges and universities, government agencies, biological and pharmaceutical companies, and private medical research institutions.

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

Admission to the Professional Program in Veterinary Medicine

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 October deadline as specified by the Veterinary Medicine College Application Service (VMCAS).

Factors considered by the Admissions Committee in determining an applicant’s relative competitive position are: (1) prerequisite science grade-point average; (2) last three semester’s grade-point average; (3) quantitative reasoning score of Graduate Record Examination (GRE); (4) verbal reasoning score of Graduate Record Examination (GRE); (5) bachelor’s degree; (6) breadth and depth of animal and veterinary experiences through time of application; (7) agricultural background and food animal experience; (8) diverse background gained from cultural, career, or community service experiences; (9) research experience; and (10) socio-economic (family/financial/cultural) challenges or hardships that you have overcome while obtaining your education and how you overcame these.

Final selection is based on a combination of the above listed academic criteria (1-5) and evidence of significant accomplishments in one or more of the above listed non-academic criteria (6-10).

Applications, regular or transfer, are reviewed by the Admissions Committee. 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. Students should complete the following requirements 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
- 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
- Genetics
- Eukaryotic Cell Biology
- Microbiology with laboratory
- Animal Nutrition (General or Human Nutrition)
- 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/theater 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.

PRODUCTION MEDICINE SCHOLARS ADMISSION PATHWAY

This pathway has been established by the College of Veterinary Medicine in cooperation with the Department of Animal Science at Michigan State University. It provides an admission pathway for Michigan State University animal science students who wish to complete, in addition to the minimum preveterinary requirements, a Bachelor of Science degree in Animal Science with a concentration in Production Animal Scholars. See the Department of Animal Science section of this catalog. The concentration is designed to prepare students for a herd-based, agricultural veterinary practice career. Completion of the production animal scholars concentration, combined with completion of specific electives in the professional Doctor of Veterinary Medicine program, will lead to a certificate of emphasis in production medicine to accompany the DVM degree.

Up to ten Michigan State University students may be admitted to the professional program in veterinary medicine via this pathway each year. Admission to the professional program is contingent upon completion of a Bachelor of Science degree in Animal Science with a concentration in Production Animal Scholars.

Candidates for this admission pathway must meet the following requirements:

1. Enrollment in the Bachelor of Science degree in Animal Science with a concentration in Production Animal Scholars.
2. Completion of at least 50 percent of the pre-veterinary courses required and 10 credits from the courses required for the production animal scholars concentration. For pre-veterinary requirements see the Requirements for the Preveterinary Program section of this catalog.
3. Minimum cumulative grade point average of 3.2. For preveterinary science courses, grades must average 3.2.
4. Demonstrate, either by past or current activities, a commitment to livestock agriculture through youth activities, family experiences, employment, college extracurricular activities, and other participation in the livestock industry. For production animal scholars candidates, horses are not considered to be livestock.
5. Demonstrate evidence of quality exposure to veterinary practice.
6. Establish a primary academic advisor in the Department of Animal Science.
7. Meet with an admissions counselor in the College of Veterinary Medicine at least one year prior to application.

When the above eligibility requirements are met, candidates may apply to the professional program in veterinary medicine through this pathway during the next regular admissions cycle. Regardless of previous degrees earned students accepted into the College of Veterinary Medicine via the Production Medicine Scholars Admission Pathway must matriculate within two years.

Evaluation for admission criteria to this pathway include:
1. Performance in the regular veterinary admission criteria, including grade-point averages, GRE scores, and file review.
2. An evaluation of the candidate’s experience in and commitment to livestock agriculture as demonstrated by a review of his or her application file and possibly an interview.
3. One letter of recommendation from the applicant’s primary academic advisor in animal science.
4. One letter of recommendation from an animal science faculty member or other agriculture professional who has had direct instructional involvement with the candidate. This person may not be the primary academic advisor.
5. One letter of recommendation from a veterinarian who has had direct involvement with the candidate.
6. Completion of at least 50 percent of the required preveterinary science courses.
7. Meet with an admissions counselor in the College of Veterinary Medicine.
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.
**Curriculum**

The curriculum leading to the D.V.M. degree is primarily the responsibility of the faculty of the College. Student input to curriculum matters is through student representation on the Curriculum Committee. Continuing development of new information in health-related fields and changes within the profession demand ongoing curricular evaluation and modification. Development of the knowledge, skills, and attitudes required of a veterinarian remains the major goal of this curriculum. Efficiency in obtaining this goal requires a dynamic program that can respond through instituting newly developed concepts and techniques. For these reasons, particulars of the curriculum described herein may change in subsequent years in accordance with established college and university policies and procedures.

**Requirements for the Doctor of Veterinary Medicine Degree in Veterinary Medicine**

Completion of the following 161-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**

**Phase I - Normality (Year 1)**

**Semester 1 (Fall)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANS 511</td>
<td>Animal Science for Veterinarians</td>
<td>2</td>
</tr>
<tr>
<td>MMG 559</td>
<td>Veterinary Microbiology and Immunology</td>
<td>4</td>
</tr>
<tr>
<td>PDI 514</td>
<td>Veterinary Neurosciences</td>
<td>2</td>
</tr>
<tr>
<td>PDI 516</td>
<td>Comparative Veterinary Gross Anatomy I</td>
<td>4</td>
</tr>
<tr>
<td>PDI 520</td>
<td>Veterinary Tissue Structure and Function</td>
<td>4</td>
</tr>
<tr>
<td>VM 511</td>
<td>Clinical Competencies I</td>
<td>2</td>
</tr>
<tr>
<td>VM 513</td>
<td>Ethical and Animal Welfare Issues in the Veterinary Profession</td>
<td>2</td>
</tr>
</tbody>
</table>

**Semester 2 (Spring)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMG 571</td>
<td>Veterinary Pathogenic Microbiology: Parasites</td>
<td>3</td>
</tr>
<tr>
<td>PDI 519</td>
<td>Comparative Veterinary Gross Anatomy II</td>
<td>4</td>
</tr>
<tr>
<td>PDI 521</td>
<td>Veterinary Organ Micronatomy</td>
<td>2</td>
</tr>
<tr>
<td>PHM 552</td>
<td>Veterinary Pharmacology I: Principles and Neuropharmacology</td>
<td>2</td>
</tr>
<tr>
<td>PSL 513</td>
<td>Animal Physiology for Veterinarians</td>
<td>4</td>
</tr>
<tr>
<td>VM 514</td>
<td>Comparative Life-stage Nutrition</td>
<td>1</td>
</tr>
<tr>
<td>VM 524</td>
<td>Basic Science in Clinical Medicine</td>
<td>1</td>
</tr>
<tr>
<td>VM 541</td>
<td>Veterinary Career Development and Practice Management</td>
<td>2</td>
</tr>
<tr>
<td>VM 546</td>
<td>Principals of Diagnostic Imaging</td>
<td>2</td>
</tr>
</tbody>
</table>

**Semester 3 (Fall)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMG 563</td>
<td>Veterinary Pathogenic Microbiology: Bacteria and Fungi</td>
<td>3</td>
</tr>
<tr>
<td>PDI 551</td>
<td>General Pathology</td>
<td>2</td>
</tr>
<tr>
<td>PHM 555</td>
<td>Veterinary Pharmacology II: Systems and Infectious Diseases</td>
<td>3</td>
</tr>
<tr>
<td>PDI 557</td>
<td>Veterinary Toxicology</td>
<td>2</td>
</tr>
<tr>
<td>VM 532</td>
<td>Veterinary Integrative Problem Solving</td>
<td>2</td>
</tr>
<tr>
<td>VM 533</td>
<td>Veterinary Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>VM 544</td>
<td>Veterinary Public Health</td>
<td>2</td>
</tr>
<tr>
<td>VM 547</td>
<td>Respiratory Diseases</td>
<td>2</td>
</tr>
</tbody>
</table>

**Phase II - Abnormality (Year 2)**

**Semester 4 (Spring)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCS 560</td>
<td>Clinical Competencies II</td>
<td>1</td>
</tr>
<tr>
<td>MMG 565</td>
<td>Veterinary Pathogenic Microbiology: Viruses</td>
<td>2</td>
</tr>
<tr>
<td>PDI 553</td>
<td>Systemic Pathology</td>
<td>4</td>
</tr>
<tr>
<td>PDI 554</td>
<td>Veterinary Clinical Pathology</td>
<td>3</td>
</tr>
<tr>
<td>VM 543</td>
<td>Cardiovascular Diseases</td>
<td>2</td>
</tr>
<tr>
<td>VM 545</td>
<td>Principles of Anesthesia and Surgery</td>
<td>4</td>
</tr>
<tr>
<td>VM 546</td>
<td>Musculoskeletal Diseases</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Selective – one credit selective course chosen from a list maintained in the College of Veterinary Medicine Academic Programs Office</td>
<td>1</td>
</tr>
</tbody>
</table>

**Phase III - Intervention and Prevention (Year 3)**

**Semester 5 (Fall)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>SCS 561</td>
<td>Clinical Competencies III</td>
<td>1</td>
</tr>
<tr>
<td>PDI 549</td>
<td>Applied Diagnostic Imaging</td>
<td>1</td>
</tr>
<tr>
<td>VM 553</td>
<td>Theriogenology and Urinary Diseases</td>
<td>5</td>
</tr>
<tr>
<td>VM 554</td>
<td>Hematological, Oncological and Dermatological Diseases</td>
<td>3</td>
</tr>
<tr>
<td>VM 555</td>
<td>Neurological and Ophthalmological Diseases</td>
<td>3</td>
</tr>
<tr>
<td>VM 557</td>
<td>Operative Surgery</td>
<td>2</td>
</tr>
<tr>
<td>VM 558</td>
<td>Digestive Diseases of Domestic Animals</td>
<td>3</td>
</tr>
<tr>
<td>VM 559</td>
<td>Metabolic and Endocrinological Diseases</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Selective – one credit selective course chosen from a list maintained in the College of Veterinary Medicine Academic Programs Office</td>
<td>1</td>
</tr>
</tbody>
</table>

**Clinical and Applied Veterinary Medical Science (Years 3 and 4)**

**Semesters 6 (Spring), 7 (Summer), 8 (Fall), 9 (Spring)**

Students will be required to complete 60 clerkship credits. Satisfactory completion of semesters one through five of the professional curriculum is required for enrollment in any of the listed clerkships.

**Required Clerkships**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>LCS 616</td>
<td>Large Animal Medicine and Surgery</td>
<td>6</td>
</tr>
<tr>
<td>LCS 630</td>
<td>Diagnostic Pathology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 611</td>
<td>Diagnostic Imaging Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 625</td>
<td>Small Animal General Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 626</td>
<td>Small Animal Soft Tissue Surgery Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 646</td>
<td>Small Animal Orthopedic Surgery Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 647</td>
<td>Small Animal Internal Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 648</td>
<td>Anesthesia Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 695</td>
<td>Emergency and Critical Care Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Students must also select one experience from the following Clerkships:</td>
<td></td>
</tr>
<tr>
<td>LCS 621</td>
<td>Equine Practice Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 631</td>
<td>Food Animal Practice Clerkship</td>
<td>3</td>
</tr>
</tbody>
</table>

**Elective Clerkships**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>LCS 610</td>
<td>Clinical Problems in Large Animal Clinical Sciences</td>
<td>3</td>
</tr>
<tr>
<td>LCS 611</td>
<td>Research Problems in Large Animal Clinical Sciences</td>
<td>3</td>
</tr>
<tr>
<td>LCS 613</td>
<td>Special Problems in Large Animal Clinical Sciences at Off-Campus Sites</td>
<td>3</td>
</tr>
<tr>
<td>LCS 614</td>
<td>Equine Clinical Proficiency Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 615</td>
<td>Equine Emergency and Critical Care Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 622</td>
<td>Equine Clinical Clerkship II</td>
<td>3</td>
</tr>
<tr>
<td>LCS 623</td>
<td>Equine Musculoskeletal Diseases Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 624</td>
<td>Equine Theriogenology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 625</td>
<td>Equine Herd Health Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 626</td>
<td>Advanced Equine Surgery Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 627</td>
<td>Advanced Equine Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 628</td>
<td>Techniques in Equine Anesthesia and Surgery</td>
<td>3</td>
</tr>
<tr>
<td>LCS 632</td>
<td>Advanced Food Animal Medicine and Surgery Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 640</td>
<td>Large Animal Anesthesia Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 648</td>
<td>Equine Neonatal Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 647</td>
<td>Concepts of Agricultural Practice Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 660</td>
<td>Wildlife Disease Ecology and Management</td>
<td>3</td>
</tr>
<tr>
<td>LCS 677</td>
<td>Veterinary Preceptorship</td>
<td>3</td>
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<tr>
<td>LCS 678</td>
<td>Government and Corporate Veterinary Practice</td>
<td>3</td>
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<tr>
<td>LCS 679</td>
<td>Food Animal Production Medicine I</td>
<td>6</td>
</tr>
<tr>
<td>LCS 682</td>
<td>Food Animal Production Medicine II</td>
<td>3</td>
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</table>
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.

Students who are enrolled in master’s degree programs in the College of Veterinary Medicine may elect the master’s specialization in agribusiness. For additional information, refer to the Master’s Specialization in Agribusiness Management statement in the Department of Agricultural Economics 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 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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>LCS 685</td>
<td>Ruminant Health Problem Solving Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 690</td>
<td>Veterinary Public Health Field Experience Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>LCS 691</td>
<td>Veterinary Public Health Research Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>MMG 690</td>
<td>Veterinary Microbiology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>PDI 609</td>
<td>Veterinary Gross Anatomy Dissection</td>
<td>3</td>
</tr>
<tr>
<td>PDI 611</td>
<td>Research Problems in Veterinary Anatomy</td>
<td>3</td>
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<tr>
<td>PDI 631</td>
<td>Necropsy Clerkship</td>
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</tr>
<tr>
<td>PDI 632</td>
<td>Problems in Veterinary Pathology</td>
<td>3</td>
</tr>
<tr>
<td>PDI 633</td>
<td>Special Problems in Veterinary Pathology</td>
<td>3</td>
</tr>
<tr>
<td>PDI 634</td>
<td>Endocrinology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>PDI 635</td>
<td>Special Problems in Histopathology and Cytology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>PDI 636</td>
<td>Aquatic Animal Medicine Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>PHM 658</td>
<td>Research Problems in Pharmacology or Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>SCS 613</td>
<td>Diagnostic Ultrasound Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 630</td>
<td>Spay/Neuter Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 640</td>
<td>Cardiology Clerkship</td>
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<tr>
<td>SCS 641</td>
<td>Comparative Ophthalmology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 642</td>
<td>Zoo and Wildlife Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 644</td>
<td>Dermatology Clerkship</td>
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<tr>
<td>SCS 654</td>
<td>Advanced Comparative Ophthalmology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 655</td>
<td>Clinical Medical Oncology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 670</td>
<td>Clinical Nutrition for Small Animals</td>
<td>3</td>
</tr>
<tr>
<td>SCS 690</td>
<td>Veterinary Molecular Biology Clerkship</td>
<td>3</td>
</tr>
<tr>
<td>SCS 693</td>
<td>Problems in Small Animal Clinical Sciences Clerkship</td>
<td>3</td>
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<tr>
<td>SCS 694</td>
<td>Small Animal Specialty Practice Clerkship</td>
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<td>VM 611</td>
<td>Veterinary Externship</td>
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<tr>
<td>VM 690</td>
<td>Special Problems in Veterinary Medicine</td>
<td>3</td>
</tr>
<tr>
<td>VM 692</td>
<td>Career Development and Business Skills</td>
<td>3</td>
</tr>
</tbody>
</table>

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. All of these departments are authorized to offer 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 (Master of Science and Doctor of Philosophy) and Food Safety (Master of Science). These programs are designed primarily for those preparing themselves for positions in teaching or research. Other programs, including residencies for post-Doctoral training in recognized clinical specialties, are available.

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, 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.
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:

1. Maintain a grade-point average of at least 3.0 in the courses that are used to satisfy the requirements for the specialization.
   CREDITS
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
     - 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:

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 master’s program.
2. Provisional status: for those who have some remediable inadequacy of qualifications.

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:

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. 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.

Requirements for Both Plan A and Plan 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:

1. 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.
2. 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.
3. Elective credits including non-research and seminar courses as determined by the academic advisor.

Additional Requirements for Plan B:

1. 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.
2. Elective credits including non-research and seminar courses as determined by the academic advisor.
3. 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.

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

Students must complete the following courses (18 credits):

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

Daniel L. Grooms, 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, 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 physical 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 doctoral programs in the College of Veterinary Medicine 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, 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 anthropozoonoses 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

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

1. One of the following courses (3 credits):
   - PHM 350 Introduction to 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, 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 bi-
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.

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.

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, immunodiagnostics/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.