ANIMAL SCIENCES, M.S.

The department emphasizes in vivo and in vitro studies that probe relationships at a fundamental mechanistic level as well as addressing current practical issues in animal agriculture. Studies may often employ the use of livestock or laboratory animals, or both, as subjects. Development of an individual course of study is flexible in order to meet the needs of students with varied interests. Graduates find employment in academic teaching and research, in professional veterinary or medical degree programs, in industrial research in the food and feed industries, in laboratory research programs with governmental and international agencies, private corporations, and in industrial or institutional management positions requiring a high level of scientific training.

The department is based in the Animal Sciences Building, which contains facilities for teaching and research, including a Computing and Biometry Laboratory and the Biological and Biomaterials Preparation Imaging and Characterization Facility. Nearby are the Livestock Laboratory, a state-of-the-art facility, and the Muscle Biology Laboratory. Teaching, research, and project assistantships are available to qualified students. Fellowships, scholarships, and traineeship awards are available from federal training programs, research grants, gifts and trusts, and special program funds.

RESEARCH FOCUS AREAS

Students may choose to focus on the areas of: nutrition, rumen microbiology, aquaculture, reproductive physiology—endocrinology, genetics, animal breeding, muscle biology, meat science, cell biology, animal health, immunity and toxicology, or international agriculture. Considerable opportunity for study exists in joint programs with bacteriology, toxicology, biochemistry, the interdepartmental graduate program in nutritional sciences, genetics, endocrinology, reproductive physiology training program, food science, physiology, agricultural and applied economics, biometry, cellular and molecular biology, pharmaceutical sciences, chemical and biological engineering, bio engineering, comparative biosciences and anatomy.

The area of nutrition involves a joint degree with the Department of Animal Sciences and either the Department of Nutritional Sciences or the Department of Biochemistry. Usually, students work with professors from both departments so fundamental concepts complement practical applications. Ruminant nutrition candidates often minor or have a joint major in the Department of Bacteriology. Nutritional research ranges from field studies to laboratory biochemical studies.

The endocrinology–reproductive physiology area ranges from hormonal studies with livestock, primates, and laboratory animals to biochemical studies at the cellular level including stem cell biology. These studies include mechanism of gene action, physiological genetics, in vitro maturation, fertilization, embryo development, cloning and gene transfer, neuroendocrinology, and the environmental and genetic control of puberty and postpartum anestrus.

The genetics–animal breeding focus includes a variety of areas from immunogenetics and molecular genetics to quantitative and population genetics. The animal breeding program seeks to develop, evaluate, and apply classical, quantitative, biochemical, and physiological genetics toward improving animal breeding techniques. Studies range from theoretical considerations of quantitative genetics to laboratory experimentation on genetic controls of growth and reproduction, gene transfer and cloning to field experimentation on producer herds and flocks. Candidates may minor in several areas including genetics, statistics, physiology, or biochemistry.

Meat science and muscle biology studies probe the relationship of muscle structure, composition, and metabolism to growth, the contractile function, and meat quality. Similar studies related to adipose tissue are included. This fundamental research is applied to muscle efficiency and improved retail meat quality and composition.

The area of cellular biology, animal health, immunity, and toxicology includes basic research which seeks to develop an understanding of cellular/subcellular structure and function, cell regulation, and cell–cell interactions. Cell function, as it relates to mechanisms of immunity and the effects of natural and synthetic compounds, forms the basis for investigations using in vitro and in vivo, whole animal, model systems. Results of fundamental studies are directly applicable and coordinated with ongoing applied research programs in animal and human health.

ADMISSIONS

Students with satisfactory undergraduate training in any biological science including emphasis on basic science courses will have suitable backgrounds for graduate studies in animal science. Typically students admitted to the program have GPAs of 3.2 or higher; candidates with a lower GPA may be considered for admission under special circumstances. Admission decisions are based on academic record, GRE scores, three letters of recommendation, and Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS), if applicable.

Students are admitted to the department if a faculty member agrees to accept the candidate into his or her research group and to provide laboratory/desk space and research support, and upon the approval of the Animal Sciences Graduate Admissions Committee and the Graduate School. The faculty member also makes the decision of whether or not to offer a research assistantship to the candidate. International candidates in the master of science program rarely receive financial support.

GRADUATE SCHOOL ADMISSIONS

Graduate admissions is a two-step process between academic degree programs and the Graduate School. Applicants must meet requirements of both the program(s) and the Graduate School. Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/admissions).

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding) is available from the Graduate School. Be sure to check with your program for individual policies and processes related to funding.

PROGRAM RESOURCES

Financial assistance may be available to qualified individuals in the form of research assistantships, teaching assistantships, or fellowships. Funding does not come from the department, but from the faculty
REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

<table>
<thead>
<tr>
<th>Face to Face</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Mode of Instruction Definitions

**Evening/Weekend:** These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.

**Online:** These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

**Hybrid:** These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

**Accelerated:** These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

CURRICULAR REQUIREMENTS

<table>
<thead>
<tr>
<th>Minimum Credit Requirement</th>
<th>30 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Residence Credit Requirement</td>
<td>16 credits</td>
</tr>
<tr>
<td>Minimum Graduate Coursework Requirement</td>
<td>Half of degree coursework (15 credits out of 30 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university’s Course Guide (<a href="https://registrar.wisc.edu/course-guide/">https://registrar.wisc.edu/course-guide/</a>). Courses must be agreed upon by student’s graduate committee members and approved by department certification committee.</td>
</tr>
</tbody>
</table>

RECOMMENDED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT/F&amp;W ECOL/</td>
<td>Statistical Methods for Bioscience I</td>
<td></td>
</tr>
<tr>
<td>HORT 571</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAT/F&amp;W ECOL/</td>
<td>Statistical Methods for Bioscience II</td>
<td></td>
</tr>
<tr>
<td>HORT 572</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Animal Nutrition Track

1 Credits

Additional Information

- Students are admitted to this degree program by their major professor. Following matriculation, the student and major professor plan a graduate curriculum and research program. Within one year of matriculation, the student submits her/his planned curriculum to the departmental graduate program coordinator to obtain departmental approval. The student and major professor discuss membership for the thesis committee. The committee consists of a minimum of three faculty members, with two of these members from the animal sciences department. The thesis committee meets as needed but mainly serves to evaluate the M.S. thesis and relevant knowledge of the student in a final thesis defense exam. The final thesis exam involves an oral defense of the research topic and general knowledge of animal nutrition, endocrinology & reproductive physiology, genetics and animal breeding, or meat science and muscle biology. Consistent with Graduate School policies, the M.S. degree requires a minimum of 30 graduate-level credits, including seminar and research (990) credits.

- All degree candidates must complete a satisfactory thesis. Instructions on preparing a master’s thesis can be found on the UW Graduate School website, https://grad.wisc.edu/current-students/masters-guide/.

- At the completion of the degree program, the candidate will take a final examination administered by the mentoring committee. The examination will be oral, and includes questions relating to the candidate’s graduate course program. The candidate will also be expected to defend the thesis.
Animal Breeding & Genetics Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN SCI/DY SCI/GENETICS 951</td>
<td>Seminar in Animal Breeding (every semester)</td>
<td></td>
</tr>
<tr>
<td>GENETICS 466</td>
<td>Principles of Genetics (or equivalent)</td>
<td></td>
</tr>
<tr>
<td>STAT/F&amp;W ECOL/HORT 571</td>
<td>Statistical Methods for Bioscience I (or equivalent)</td>
<td></td>
</tr>
</tbody>
</table>

1 These tracks are internal to the program and represent different pathways a student can follow to earn this degree. Track names do not appear in the Graduate School admissions application, and they will not appear on the transcript.

Endocrinology & Reproductive Physiology Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT/F&amp;W ECOL/HORT 571</td>
<td>Statistical Methods for Bioscience I</td>
<td></td>
</tr>
<tr>
<td>AN SCI 875</td>
<td>Special Topics (Endocrine Physiology)</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/PHMCOL-M/ZOOLOGY 630</td>
<td>Cellular Signal Transduction Mechanisms</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 507 &amp; BIOCHEM 508</td>
<td>General Biochemistry I and General Biochemistry II</td>
<td></td>
</tr>
<tr>
<td>BMOLCHEM 503</td>
<td>Human Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BMOLCHEM 704</td>
<td>Comprehensive Human Biochemistry</td>
<td></td>
</tr>
</tbody>
</table>

D. Advanced Biochemistry

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN SCI/OBS&amp;GYN/ZOOLOGY 954</td>
<td>Seminar in Endocrinology-Reproductive Physiology</td>
<td>0-1</td>
</tr>
</tbody>
</table>

F. Technical Writing

G. Advanced Statistics

H. Advanced Endocrinology

I. Advanced Reproduction

J. Advanced Topic Course. Select one of the following:

- Gamete and Embryo Biology
- Reproductive Patterns
- Pregnancy, Parturition, and Lactation

Meat Science & Muscle Biology Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN SCI/FOOD SCI 305</td>
<td>Introduction to Meat Science and Technology</td>
<td></td>
</tr>
<tr>
<td>AN SCI 508</td>
<td>Poultry Products Technology</td>
<td></td>
</tr>
<tr>
<td>AN SCI/FOOD SCI 515</td>
<td>Commercial Meat Processing</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 501</td>
<td>Introduction to Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 507</td>
<td>General Biochemistry I</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 508</td>
<td>General Biochemistry II</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/PHMCOL-M/ZOOLOGY 630</td>
<td>Biochemical Principles of Human and Animal Nutrition</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 550</td>
<td>Topics in Medical Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 601</td>
<td>Protein and Enzyme Structure and Function</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/GENETICS/MD GENET 620</td>
<td>Eukaryotic Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 624</td>
<td>Mechanisms of Enzyme Action</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/PHMCOL-M/ZOOLOGY 630</td>
<td>Cellular Signal Transduction Mechanisms</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 636</td>
<td>Macromolecular Crystallography and Dynamics</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 660</td>
<td>Methods in Biochemistry</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 711</td>
<td>Sequence Analysis</td>
<td></td>
</tr>
<tr>
<td>BMOLCHEM/BIOCHEM 710</td>
<td>Exploring Biochemical Function of Macromolecules</td>
<td></td>
</tr>
<tr>
<td>CHEM 565</td>
<td>Biophysical Chemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 621</td>
<td>Instrumental Analysis</td>
<td></td>
</tr>
<tr>
<td>FOOD SCI 410</td>
<td>Food Chemistry</td>
<td></td>
</tr>
</tbody>
</table>
Animal Sciences, M.S.

FOOD SCI 412 Food Analysis
FOOD SCI 432 Principles of Food Preservation
FOOD SCI 440 Principles of Food Engineering
FOOD SCI 464 Statistics for Food Industry Quality Control
FOOD SCI 512 Principles of Food Chemistry-Lab
FOOD SCI 514 Integrated Food Functionality
FOOD SCI 532 Integrated Food Manufacturing
FOOD SCI/BSE 542 Food Engineering Operations
FOOD SCI 550 Fermented Foods and Beverages
FOOD SCI 600 Professional Practice in Food Science
FOOD SCI 610 Food Proteins
FOOD SCI/BSE 642 Food and Pharmaceutical Separations
FOOD SCI/MICROBIO 650 Advanced Microbiology of Foodborne Pathogens
FOOD SCI/AN SCI 710 Chemistry of the Food Lipids
FOOD SCI 718 Colloid Chemistry of Foods
MICROBIO/FOOD SCI 324 Food Microbiology Laboratory
MICROBIO/FOOD SCI 325 Food Microbiology
MICROBIO 526 Physiology of Microorganisms
MICROBIO 527 Advanced Laboratory Techniques in Microbiology
MICROBIO/M&M & I/PATH-BIO 528 Immunology
MICROBIO/GENETICS 607 Advanced Microbial Genetics
MICROBIO/FOOD SCI 650 Advanced Microbiology of Foodborne Pathogens
PATH-BIO/HORT 500 Molecular Biology Techniques
STAT/F&W ECOL/HORT 571 Statistical Methods for Bioscience I
STAT/F&W ECOL/HORT 572 Statistical Methods for Bioscience II
ZOOLOGY 430 Comparative Anatomy of Vertebrates
ZOOLOGY 470 Introduction to Animal Development
ZOOLOGY 570 Cell Biology
ZOOLOGY 611 Comparative and Evolutionary Physiology
ZOOLOGY 612 Comparative Physiology Laboratory

4 Required if an equivalent statistics course was not taken previously.

Policies

Graduate School Policies
The Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

Major-Specific Policies

Graduate Program Handbook
The Graduate Program Handbook (http://www.ansci.wisc.edu/docs/graduate/Animal%20Sciences%20Grad%20Handbook.docx) is the repository for all of the program's policies and requirements.

Prior Coursework

Graduate Work from Other Institutions
For well-prepared advanced students, the program may accept prior graduate coursework from other institutions toward the minimum graduate degree credit and minimum graduate coursework (50%) requirement. The minimum graduate residence credit requirement can be satisfied only with courses taken as a graduate student at UW–Madison.

UW–Madison Undergraduate
For well-prepared advanced students, the program may decide to accept up to 7 credits numbered 300 or above completed at UW–Madison toward fulfillment of minimum degree and minor credit requirements. This work would not be allowed to count toward the 50% graduate coursework minimum unless taken at the 700 level or above.

UW–Madison University Special
The program may decide to accept up to 15 University Special student credits as fulfillment of the minimum graduate residence, graduate degree, or minor credit requirements on occasion as an exception (on a case-by-case basis).

UW–Madison coursework taken as a University Special student would not be allowed to count toward the 50% graduate coursework minimum unless taken at the 700 level or above.

Probation

The Graduate School regularly reviews the record of any student who earned grades of BC, C, D, F, or Incomplete in a graduate course (300 or above), or grade of U in research credits. This review could result in academic probation with a hold on future enrollment or in being suspended from the Graduate School.

Advisor / Committee

Every graduate student is required to have an advisor. To ensure that students are making satisfactory progress toward a degree, the Graduate School expects them to meet with their advisor on a yearly basis.

1 These tracks are internal to the program and represent different pathways a student can follow to earn this degree. Track names do not appear in the Graduate School admissions application, and they will not appear on the transcript.

2 Only one course from this group can be counted toward the credit load required in this section.

3 Required of Ph.D. candidates.
Your committee members advise and evaluate satisfactory progress, administer your final oral examination, evaluate your thesis, and sign your degree warrant. Your advisor chairs the committee. The final warrant request which includes committee membership must be submitted to the Graduate School at least three weeks before the examination date. A committee often accomplishes advising for the students in the early stages of their studies.

Master’s thesis committees must have at least 3 members, 2 of whom must be animal sciences graduate faculty or former graduate faculty up to one year after resignation or retirement and the third member from outside the department.

**CREDITS PER TERM ALLOWED**

15 credits

**TIME CONSTRAINTS**

Master’s degree students who have been absent for five or more consecutive years lose all credits that they have earned before their absence. Individual programs may count the coursework students completed prior to their absence for meeting program requirements; that coursework may not count toward Graduate School credit requirements.

**OTHER**

RAs, the most common appointment in this department, are hired for 12-months with compensation set on a university-wide basis. The department has a few TAs who assist in instruction, preparing materials, directing labs, grading lab exercises and exams, etc. Special fellowships and scholarships are available for outstanding students. Application instructions may be obtained from the Graduate School website. A graduate student may be employed to assist professors not directly associated with their thesis.

**PROFESSIONAL DEVELOPMENT**

**GRADUATE SCHOOL RESOURCES**

Take advantage of the Graduate School’s professional development resources (https://grad.wisc.edu/pd) to build skills, thrive academically, and launch your career.

**PROGRAM RESOURCES**

The Animal Sciences Graduate programs encourage students to develop Individual Development Plans (https://grad.wisc.edu/pd/idp) in collaboration with their major advisor to facilitate professional development. Besides the extensive opportunities offered across the campus at large, students in the animal sciences program also benefit from activities and programs provided by the Animal Science Graduate Student Association, a student-led organization for graduate students at UW–Madison who are interested in animal and dairy science.

**LEARNING OUTCOMES**

1. Articulates, critiques, or elaborates the theories, research methods, and approaches to inquiry or schools of practice in the field of study.

2. Identifies sources and assembles evidence pertaining to questions or challenges in the field of study.

3. Demonstrates understanding of the primary field of study in a historical, social, and global context.

4. Selects and/or utilizes the most appropriate methodologies and practices.

5. Evaluates or synthesizes information pertaining to questions or challenges in the field of study.

6. Communicates clearly in ways appropriate to the field of study.

7. Recognizes and applies principles of ethical and professional conduct.

**PEOPLE**

**Faculty:** Professors Crenshaw (chair), Albrecht, Claus, Khatib, Kirkpatrick, Parrish, Reed, Richards, Rosa, Schaefer; Associate Professor Sindelar; Assistant Professor Shanmuganayagam