

ANIMAL SCIENCES, M.S.

The department emphasizes *in vivo* and *in vitro* studies that probe relationships at a fundamental mechanistic level as well as address 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 program 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 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

Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website.

Graduate admissions is a two-step process between academic programs and the Graduate School. **Applicants must meet** the minimum requirements (<https://grad.wisc.edu/apply/requirements/>) **of the Graduate School as well as the program(s).**

Once you have researched the graduate program(s) you are interested in, apply online (<https://grad.wisc.edu/apply/>).

Requirements	Detail
Fall Deadline	August 1
Spring Deadline	December 1
Summer Deadline	May 1
GRE (Graduate Record Examinations)	Required.
English Proficiency Test	Every applicant whose native language is not English or whose undergraduate instruction was not in English must provide an English proficiency test score and meet the Graduate School minimum requirements (https://grad.wisc.edu/apply/requirements/#english-proficiency).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

Students with satisfactory undergraduate training in any biological science including emphasis on basic science courses will have suitable backgrounds for graduate studies in Animal Sciences. 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 program 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.

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 restrictions 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 member agreeing to advise the new student; therefore students join labs directly instead of doing rotations. Funding is awarded on a competitive basis and may be renewed annually pending satisfactory progress. Terms of these appointments are initially defined in the letter of offer to the student.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

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

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students are able to complete a program with minimal disruptions to careers and other commitments.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirements Detail	
Minimum Credit Requirement	30 credits
Minimum Residence Credit Requirement	16 credits
Minimum Graduate Coursework Requirement	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 (https://registrar.wisc.edu/course-guide (https://registrar.wisc.edu/course-guide/)). Courses must be agreed upon by student's graduate committee members and approved by department certification committee.
Overall Graduate GPA Requirement	3.00 GPA required.
Other Grade Requirements	The Graduate School requires an average grade of B or better in all coursework (300 or above, not including research credits) taken as a graduate student unless conditions for probationary status require higher grades. Grades of Incomplete are considered to be unsatisfactory if they are not removed during the next enrolled semester.
Assessments and Examinations	Contact the program for information on required assessments and examinations.
Language Requirements	Language requirements are determined on an individual basis with the major professor and will depend on the area of concentration within the department.

REQUIRED COURSES

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 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 faculty. 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.

Seminar Requirement

The Animal Sciences Graduate seminar features outside speakers, UW Faculty, and Animal Sciences graduate students presenting their research or defending their thesis. This course is held on Tuesday mornings during the fall semester from 11 a.m. to noon. Attendance is required at

this seminar series by all animal sciences graduate students. Master's degree students are required to register for the AN SCI 875 Special Topics Animal Science Seminar for credit once. Although attendance is required, registering for the seminar for credit is done the semester a student presents.

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 Nutrition Track ¹

Code	Title	Credits
Recommended Courses		
STAT/F&W ECOL/ HORT 571	Statistical Methods for Bioscience I	
STAT/F&W ECOL/ HORT 572	Statistical Methods for Bioscience II	
AN SCI/ DY SCI 931	Seminar in Animal Nutrition	
AN SCI/ DY SCI 414	Ruminant Nutrition & Metabolism	
AN SCI 415	Application of Monogastric Nutrition Principles	
AN SCI/ NUTR SCI 626	Experimental Diet Design	
NUTR SCI/ BIOCHEM 510	Nutritional Biochemistry and Metabolism	
PATH-BIO/ HORT 500	Molecular Biology Techniques	

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.

Animal Breeding & Genetics Track ¹

Code	Title	Credits
Required Courses		
AN SCI/DY SCI/ GENETICS 951	Seminar in Animal Breeding (every semester)	
GENETICS 466	Principles of Genetics (or equivalent)	
STAT/F&W ECOL/ HORT 571	Statistical Methods for Bioscience I (or equivalent)	

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Endocrinology & Reproductive Physiology Track ¹

Code	Title	Credits
Select one course from each section A, B and C:		
A.		

STAT/F&W ECOL/ Statistical Methods for Bioscience I
HORT 571

B.		
AN SCI 875	Special Topics (Endocrine Physiology)	
BIOCHEM/ PHMCOL-M/ ZOOLOGY 630	Cellular Signal Transduction Mechanisms	

C.		
BIOCHEM 507 & BIOCHEM 508	General Biochemistry I and General Biochemistry II	
BMOLCHEM 503	Human Biochemistry	

D. Advanced Biochemistry

E.		
AN SCI/OBS&GYN/ ZOOLOGY 954	Seminar in Endocrinology-Reproductive Physiology	0-1

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

Selected Topics in Endocrinology-Reproductive Physiology

Pregnancy, Parturition, and Lactation

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Meat Science & Muscle Biology Track ¹

Code	Title	Credits
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Discipline Requirements: Courses to be taken as a graduate student at UW–Madison (maximum 12 credits for M.S. and 15 credits for the Ph.D. per semester).

Students should choose courses from the following list in consultation with their advisor:

AN SCI/ FOOD SCI 305	Introduction to Meat Science and Technology ²	
AN SCI 508	Poultry Products Technology ²	
AN SCI/ FOOD SCI 515	Commercial Meat Processing ²	
BIOCHEM 501	Introduction to Biochemistry	
BIOCHEM 507	General Biochemistry I	
BIOCHEM 508	General Biochemistry II	
BIOCHEM/ NUTR SCI 510	Nutritional Biochemistry and Metabolism	
BIOCHEM 550	Topics in Medical Biochemistry	
BIOCHEM 601	Protein and Enzyme Structure and Function	
BIOCHEM/ GENETICS/ MD GENET 620	Eukaryotic Molecular Biology	
BIOCHEM 624	Mechanisms of Enzyme Action	

BIOCHEM/ PHMCOL-M/ ZOOLOGY 630	Cellular Signal Transduction Mechanisms
BIOCHEM 636	Macromolecular Crystallography and Dynamics
CHEM 565	Biophysical Chemistry
CHEM 621	Instrumental Analysis
FOOD SCI 410	Food Chemistry
FOOD SCI 412	Food Analysis
FOOD SCI 432	Principles of Food Preservation
FOOD SCI 440	Principles of Food Engineering
FOOD SCI 514	Integrated Food Functionality
FOOD SCI 532	Integrated Food Manufacturing
FOOD SCI 550	Fermented Foods and Beverages
FOOD SCI 610	Food Proteins
FOOD SCI/ BSE 642	Food and Pharmaceutical Separations
FOOD SCI/ AN SCI 710	Chemistry of the Food Lipids ³
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 607	Advanced Microbial Genetics
M M & I/PATH- BIO 528	Immunology
PATH-BIO/ HORT 500	Molecular Biology Techniques
STAT/F&W ECOL/ HORT 571	Statistical Methods for Bioscience I ⁴
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

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.

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

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.

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.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (<https://doso.students.wisc.edu/bias-or-hate-reporting/>)
- Graduate Assistantship Policies and Procedures (<https://hr.wisc.edu/policies/gapp/#grievance-procedure>)
- Hostile and Intimidating Behavior Policies and Procedures (<https://hr.wisc.edu/hib/>)
 - Office of the Provost for Faculty and Staff Affairs (<https://facstaff.provost.wisc.edu/>)
- Dean of Students Office (<https://doso.students.wisc.edu/>) (for all students to seek grievance assistance and support)
- Employee Assistance (<http://www.eao.wisc.edu/>) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (<https://employeeabilities.wisc.edu/>) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (<https://grad.wisc.edu/>) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (<https://compliance.wisc.edu/>) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office of Student Conduct and Community Standards (<https://conduct.students.wisc.edu/>) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (<http://www.ombuds.wisc.edu/>) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (<https://compliance.wisc.edu/titleix/>) (for concerns about discrimination)

College of Agricultural and Life Sciences: Grievance Policy

In the College of Agricultural and Life Sciences (CALs), any student who feels unfairly treated by a member of the CALs faculty or staff has the right to complain about the treatment and to receive a prompt hearing. Some complaints may arise from misunderstandings or communication breakdowns and be easily resolved; others may require formal action. Complaints may concern any matter of perceived unfairness.

To ensure a prompt and fair hearing of any complaint, and to protect the rights of both the person complaining and the person at whom the complaint is directed, the following procedures are used in the College of Agricultural and Life Sciences. Any student, undergraduate or graduate,

may use these procedures, except employees whose complaints are covered under other campus policies.

1. The student should first talk with the person at whom the complaint is directed. Most issues can be settled at this level. Others may be resolved by established departmental procedures.
2. If the student is unsatisfied, and the complaint involves any unit outside CALs, the student should seek the advice of the dean or director of that unit to determine how to proceed.
 - a. If the complaint involves an academic department in CALs the student should proceed in accordance with item 3 below.
 - b. If the grievance involves a unit in CALs that is not an academic department, the student should proceed in accordance with item 4 below.
3. The student should contact the department's grievance advisor within 120 calendar days of the alleged unfair treatment. The departmental administrator can provide this person's name. The grievance advisor will attempt to resolve the problem informally within 10 working days of receiving the complaint, in discussions with the student and the person at whom the complaint is directed.
 - a. If informal mediation fails, the student can submit the grievance in writing to the grievance advisor within 10 working days of the date the student is informed of the failure of the mediation attempt by the grievance advisor. The grievance advisor will provide a copy to the person at whom the grievance is directed.
 - b. The grievance advisor will refer the complaint to a department committee that will obtain a written response from the person at whom the complaint is directed, providing a copy to the student. Either party may request a hearing before the committee. The grievance advisor will provide both parties a written decision within 20 working days from the date of receipt of the written complaint.
 - c. If the grievance involves the department chairperson, the grievance advisor or a member of the grievance committee, these persons may not participate in the review.
 - d. If not satisfied with departmental action, either party has 10 working days from the date of notification of the departmental committee action to file a written appeal to the CALs Equity and Diversity Committee. A subcommittee of this committee will make a preliminary judgement as to whether the case merits further investigation and review. If the subcommittee unanimously determines that the case does not merit further investigation and review, its decision is final. If one or more members of the subcommittee determine that the case does merit further investigation and review, the subcommittee will investigate and seek to resolve the dispute through mediation. If this mediation attempt fails, the subcommittee will bring the case to the full committee. The committee may seek additional information from the parties or hold a hearing. The committee will present a written recommendation to the dean who will provide a final decision within 20 working days of receipt of the committee recommendation.
4. If the alleged unfair treatment occurs in a CALs unit that is not an academic department, the student should, within 120 calendar days of the alleged incident, take his/her grievance directly to the Associate Dean of Academic Affairs. The dean will attempt to resolve the problem informally within 10 working days of receiving the complaint. If this mediation attempt does not succeed the student may file a written complaint with the dean who will refer it to the CALs Equity and Diversity Committee. The committee will seek a

written response from the person at whom the complaint is directed, subsequently following other steps delineated in item 3d above.

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

ANIMAL AND DAIRY SCIENCES DEPARTMENT

Professors

Weigel (Chair), Khatib (Associate Chair), Cabrera, Claus, Crenshaw, Fricke, Kirkpatrick, Parrish, Reed, Richards, Rosa, Sindelar, Wattiaux, Wiltbank

Associate Professors

Hernandez, White

Assistant Professors

Adcock, Arriola Apelo, Dorea, Ferraretto, Guo, Laporta, Leone, Peñagaricano, Shanmuganayagam, Van Os

Instructors/Lecturers

Halbach, Kean, O'Rourke, Ronk, Williams

Student Services Coordinator

Liv Sandberg

Graduate Coordinator

Theresa Pillar