In addition to a core group of faculty members the Department of Animal Biosciences works closely with professionals from the Ontario Ministry of Agriculture and Food (OMAF), Agriculture and Agri-Food Canada (AAFC), and other affiliated organizations. The graduate program encompasses MSc by course work, MSc by thesis, and PhD options in four main fields:

- **Animal Breeding and Genetics** (quantitative or molecular)
- **Animal Nutrition** (monogastric or ruminant)
- **Animal Physiology** (environmental and reproductive)
- **Animal Behaviour and Welfare**

### Administrative Staff

**Chair**
James Squires (223 ANNU, Ext. 53928)
squires@uoguelph.ca

**Graduate Program Coordinator**
Wendy Pearson (227 ANNU, Ext. 53652)
wpearson@uoguelph.ca (nkarrow@uoguelph.ca)

**Graduate Program Assistant**
Jacob Harwood (144 ANNU, Ext. 56215)
harwood@uoguelph.ca (wmcgratt@uoguelph.ca)

### Graduate Faculty

*This list may include Regular Graduate Faculty, Associated Graduate Faculty and/or Graduate Faculty from other universities.*

- **Christine Baes**
  B.Sc. Guelph, M.Sc. Hohenheim, PhD Christian-Albrechts - Associate Professor
  Graduate Faculty

- **Renée Bergeron**
  B.Sc., M.Sc. Laval, PhD Illinois - Professor

- **Dominique P. Bureau**
  B.Sc., M.Sc. Laval, PhD Guelph - Professor
  Graduate Faculty

- **Grégory Bédécarrats**
  Licence de Biochimie, M.Sc., Dipl. Rennes (France), PhD McGill - Professor
  Graduate Faculty

- **John P. Cant**
  B.Sc. Nova Scotia, MS, PhD California - Professor
  Graduate Faculty

- **Angela Cánovas**
  B.Sc. Lleida, M.Sc. Valencia, PhD Lleida - Associate Professor
  Graduate Faculty

- **Trevor Devries**
  B.Sc., PhD British Columbia - Professor
  Graduate Faculty

- **Jennifer Ellis**
  B.Sc., M.Sc., PhD Guelph - Assistant Professor
  Graduate Faculty

- **Ming Z. Fan**
  BS Xinjiang, MS Harbin, PhD Alberta - Professor
  Graduate Faculty

- **Alexandra Harlander**
  DVM, D.V.Sc. Vienna, PhD Germany - Associate Professor
  Graduate Faculty

- **Lee-Anne Huber**
  B.Sc., M.Sc., PhD Guelph - Assistant Professor
  Graduate Faculty

- **David Huyben**
  B.Sc., M.Sc. Guelph, PhD Sweden - Assistant Professor
  Graduate Faculty

- **Niel A. Karrow**
  B.Sc. Guelph, M.Sc., PhD Waterloo - Professor
  Graduate Faculty

- **Elijah Kiarie**
  B.Sc., M.Sc. Nairobi, PhD Manitoba - Associate Professor
  Graduate Faculty

- **Julang Li**
  M.Sc. Changchun Veterinary College (China), PhD Ottawa - Professor
  Graduate Faculty

- **Ira B. Mandell**
  BS, MS Ohio State, PhD Saskatchewan - Professor
  Graduate Faculty

- **Katrina Merkies**
  B.Sc., PhD Guelph - Associate Professor
  Graduate Faculty

- **Vern R. Osborne**
  B.Sc., M.Sc., PhD Guelph - Professor
  Graduate Faculty

- **Wendy Pearson**
  B.Sc., M.Sc., PhD Guelph - Associate Professor
  Graduate Faculty

- **Eduardo Ribeiro**
  DVM Santa Catarina State, M.Sc., PhD Florida - Associate Professor
  Graduate Faculty

- **J. Andrew B. Robinson**
  B.Sc., M.Sc. Guelph, PhD Cornell - Associate Professor
  Graduate Faculty

- **Flavio S. Schenkel**
  BBA, B.Sc., M.Sc. Brazil, PhD Guelph - Professor
  Graduate Faculty

- **E. James Squires**
  B.Sc., M.Sc., PhD Memorial - Professor and Chair
  Graduate Faculty

- **Michael Steele**
  B.Sc., M.Sc., PhD Guelph - Associate Professor
  Graduate Faculty

- **Dan Tulpan**
  B.Sc. Burcharest, PhD British Columbia - Assistant Professor
MSc Program

The MSc program involves advanced courses and the completion of a research project. These are means of developing the skills and intellectual curiosity that may further qualify the student for a leadership role within animal organizations and industries or serve as a prerequisite for doctoral studies. The MSc degree may be completed via two routes: by thesis or by course work and major paper. The MSc by coursework and major paper is offered in four areas of specialization:

1. Animal Breeding and Genetics,
2. Animal Nutrition,
3. Animal Behaviour and Welfare, and

Admission Requirements

An honours baccalaureate, with a minimum average grade of ‘B’ during the last 2 years of full-time equivalent study. For Canadian degrees, we interpret this as the last 20 semester courses, however we do not split a semester and we will not consider any fewer than 16 courses.

Program Requirements

Students enrol in one of two study options:

1. thesis, or
2. course work and major research paper.

Thesis

Candidates for the thesis-based MSc degree must successfully complete a prescribed series of courses, prepare and submit a thesis proposal to their advisory committee, conduct a research project, prepare a thesis based on their results and defend this in a final examination. The number of course credits required in this option will be decided by the student’s advisory committee in consultation with the student, and may exceed the minimum 1.5 credits required by the Faculty of Graduate Studies. Generally, 4 or 5 courses (1.5-2.0 credits) will be taken, including the mandatory ANSC*6610 Scientific Communication, Knowledge Dissemination and Professional Development (0.50 credits)

Course Work and Major Research Paper (MRP)

Candidates for the MSc degree by course work and major paper option must complete a minimum of 4.0 credits (7 courses). Of these courses, one will be ANSC*6900 Major Paper in Animal Biosciences and another must be the mandatory ANSC*6610 Scientific Communication, Knowledge Dissemination and Professional Development (0.50 credits). The major paper will be a detailed, critical review of an area of study related to the specialization chosen by the student and should include analyses and interpretations of relevant data.

At the beginning of the program, the student and student’s advisory committee will design the coursework program according to the program guidelines and the aspirations and background of the student.

Students will normally choose a minimum of 4 courses in the area of specialization, and a minimum of two courses outside the area of specialization. These latter courses can be offered by departments other than Animal Biosciences.

A maximum of one approved senior-level undergraduate course can be included in the list of prescribed courses. Recommended graduate courses in the three areas of specialization are as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ANSC*6900</td>
<td>Major Paper in Animal Biosciences</td>
<td>1.00</td>
</tr>
<tr>
<td>ANSC*6210</td>
<td>Principles of Selection in Animal Breeding</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6370</td>
<td>Quantitative Genetics and Animal Models</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6390</td>
<td>QTL and Genetic Markers</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6450</td>
<td>Topics in Animal Biotechnology</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6900</td>
<td>Major Paper in Animal Biosciences</td>
<td>1.00</td>
</tr>
<tr>
<td>ANSC*6510</td>
<td>Topics in Comparative Animal Nutrition</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6030</td>
<td>Modelling Metabolic Processes</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6360</td>
<td>Techniques in Animal Nutrition Research</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6450</td>
<td>Topics in Animal Biotechnology</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6460</td>
<td>Lactation Biology</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6470</td>
<td>Advanced Animal Nutrition and Metabolism I</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6480</td>
<td>Advanced Animal Nutrition and Metabolism II</td>
<td>0.50</td>
</tr>
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<td>ANSC*6900</td>
<td>Major Paper in Animal Biosciences</td>
<td>1.00</td>
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<td>ANSC*6440</td>
<td>Advanced Critical Analysis in Applied Ethology</td>
<td>0.50</td>
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<tr>
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<td>Animals in Society: Historical and Global Perspectives on Animal Welfare</td>
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<td>0.50</td>
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<td>ANSC*6730</td>
<td>Applied Environmental Physiology and Animal Housing</td>
<td>0.50</td>
</tr>
<tr>
<td>ANSC*6740</td>
<td>Special Topics in Applied Animal Welfare Science</td>
<td>0.50</td>
</tr>
<tr>
<td>UNIV*6030</td>
<td>Seminars and Analysis in Animal Behaviour and Welfare</td>
<td>0.50</td>
</tr>
</tbody>
</table>

The MSc by course work and major paper degree will require a minimum of three semesters of full-time study (or the equivalent).

PhD Program

The PhD program is research oriented and provides instruction and experiences that develop the student’s ability to independently formulate hypotheses and design and execute experiments or conduct observational studies to reach definitive conclusions.

Admission Requirements

Students entering a PhD program should show potential for independent, productive, and original research. A PhD program can be entered by three routes: following completion of an MSc program; following transfer prior to completion of an MSc program; and directly from a bachelor degree.
In general, a minimum average grade of ‘B’ for a completed MSc program plus strong letters of reference are required. Students wishing to be considered for transfer to a PhD program prior to completion of the MSc program must request the transfer before the end of the fourth semester and have an excellent academic record as well as a strong aptitude for research.

Direct admission to the PhD program may be permitted for applicants who hold a bachelor's degree and have an excellent academic history and strong indications of research potential.

Program Requirements
Satisfactory completion of a PhD program requires a comprehensive knowledge of the area of emphasis and the ability to conduct original research in this area, plus a sound general background in two related areas of study. This competence is demonstrated in a qualifying examination and through the preparation and submission of a thesis proposal to their advisory committee that outlines the design and plans to execute a substantial and original research project. Based on this research, a thesis is prepared and defended in a final examination.

The number of courses required for a PhD program will be decided by the student's advisory committee in consultation with the student. All PhD students are required to complete the mandatory ANSC*6610 Scientific Communication, Knowledge Dissemination and Professional Development (0.50 credits). Students taking this course as an MSc student are not required to take it as a PhD student.

Collaborative Specializations
Neuroscience
The Department of Animal Biosciences participates in the MA/MSc/PhD collaborative specialization in neuroscience. Please consult the Neuroscience (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/neuroscience/) listing for a detailed description of the MA/MSc/PhD collaborative specialization.

One Health
The Department of Animal Biosciences participates in the collaborative specialization in One Health. Master's and Doctoral students wishing to undertake thesis research or their major research paper/project with an emphasis on one health are eligible to apply to register concurrently in Animal Biosciences and the collaborative specialization. Students should consult the One Health (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/one-health/) listing for more information.

Toxicology
The Department of Animal Biosciences participates in the masters/doctoral collaborative specialization in toxicology. The research and teaching expertise of these faculty include aspects of toxicology; they may serve as advisors for masters and doctoral students in Toxicology. Students choosing this option must meet the requirements of the Toxicology collaborative specialization, as well as those of their home department. Please consult the Toxicology (calendar.uoguelph.ca/graduate-calendar/collaborative-specializations/toxicology/) listing for a detailed description of the masters/doctoral collaborative specialization.

Courses
Some courses are only offered when there is a certain minimum enrolment.
ANSC*6250 Growth and Metabolism Winter Only [0.50]
Animal growth and metabolism are considered at the cellular level in a manner that extends beyond the basic disciplines of biometrics and biochemistry with attention focused on the main carcass components - muscle, fat and bone.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6330 Topics in Computational Biology and Bioinformatics Fall and Winter [0.50]
Major topics and methods in bioinformatics and computational biology for animal sciences will be covered. Topics include alignments, phylogenetics, genomics, data mining, databases, DNA, RNA and protein structures, DNA sequence analysis, data curation, pipeline construction and data visualization.
Offering(s): Offered annually
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6360 Techniques in Animal Nutrition Research Winter Only [0.50]
Theory and/or practices of techniques to evaluate feedstuffs and determine nutrient utilization in poultry, swine and ruminants is covered through lectures, short laboratories and a major project.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6370 Quantitative Genetics and Animal Models Fall Only [0.50]
The course covers quantitative genetics theory associated with animal models, linear models applied to genetic evaluation of animals; estimation of genetic parameters for animal models; and computing algorithms for large datasets.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6390 QTL and Genetic Markers Winter Only [0.50]
Advanced training in QTL mapping and selection assisted by genetic markers.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6400 Mammalian Reproduction Winter Only [0.50]
Discussions and applications of methodology for collection and examination of gametes and embryos and for measurements of hormones in biological fluids.
Offering(s): Offered in odd-numbered years.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6440 Advanced Critical Analysis in Applied Ethology Fall Only [0.50]
Students explore the process of scientific inquiry and experimental design within the context of applied ethology research. Discussions include the peer review process, critical analyses and applications of methods for applied animal behaviour research.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6450 Topics in Animal Biotechnology Fall Only [0.50]
The course will explore current methods and recent advances of biotechnology, innovation, and emerging translational products of significance to animal production and human health.
Prerequisite(s): MCB*2050 or MBG*2040 or ANSC*4050
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6460 Lactation Biology Fall Only [0.50]
An in-depth systems analysis of lactation, comparing the cow, pig, rat, human and seal. Mammary development from conception through to lactogenesis, lactation and involution will be covered. Hypotheses of regulation of the biochemical pathways of milk synthesis will be tested in relation to experimental observations.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6470 Advanced Animal Nutrition and Metabolism I Fall Only [0.50]
A systematic review of key aspects of energy, protein, amino acid and carbohydrate utilization and metabolism in farm animals.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6480 Advanced Animal Nutrition and Metabolism II Winter Only [0.50]
A systematic review of key aspects of lipid, vitamin and mineral utilization and metabolism in farm animals.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6490 Advanced Dairy Management Winter Only [0.50]
A comprehensive systems science and integrative capstone course that encompasses the "closing of the loop" education of dairy production systems. Students will be exposed to real-time issues relating to dairy production from, environment, economics, nutrition, housing, health, welfare, society and agrology. This course will allow the student to practice their training from the courses they have been exposed to as undergraduates into many case study evaluations on farms provincially, nationally and internationally.
Restriction(s): Instructor consent required.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6550 Systematic Review and Meta-Analysis for Animal Biosciences Winter Only [0.50]
Major topics and methods in the systematic review of the scientific literature, meta-analysis, and empirical modeling for animal sciences will be covered. Students learn via hands-on "doing" with reflection on their work via the execution of a meta-analysis in their topic area and preparation of a meta-analysis manuscript.
Restriction(s): Instructor consent required.
Department(s): Department of Animal Biosciences
Location(s): Guelph

ANSC*6610 Scientific Communication, Knowledge Dissemination and Professional Development Unspecified [0.50]
This course helps to foster graduate student career success in academia, government or industry by enhancing student skills in scientific communication and knowledge dissemination and by providing opportunities for personal growth in a chosen area of professional development.
Restriction(s): Restricted to Animal Biosciences students.
Department(s): Department of Animal Biosciences
Location(s): Guelph
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<td>ANSC*6740</td>
<td>Special Topics in Applied Animal Welfare Science</td>
<td>Summer Only [0.50]</td>
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<tr>
<td>ANSC*6900</td>
<td>Major Paper in Animal Biosciences</td>
<td>Summer, Fall, and Winter [1.00]</td>
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