

GRADUATE PROGRAM POLICY

**DEPARTMENT OF ANIMAL AND FOOD SCIENCES (ANFS)
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES (CANR)
UNIVERSITY OF DELAWARE**

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Graduate Program Policy
Department of Animal and Food Sciences
College of Agriculture and Natural Resources
University of Delaware

The Department of Animal and Food Sciences has five graduate degree offerings:

- (1.) The Master of Science (M.S.) Degree in Animal Science,
- (2.) The M.S. Degree in Food Science,
- (3.) The Non-thesis M.S. Degree in Animal and Food Sciences:
 - a. Business and Entrepreneurial Leadership Concentration
 - b. Veterinary Biosciences, Biotechnology and One Health Concentration
- (4.) The Doctor of Philosophy (Ph.D.) Degree in Animal Science and Food Sciences.

The M.S. and Ph.D. degrees are earned through an academic research program requiring the completion of an approved thesis or dissertation, respectively. The Non-thesis M.S. Degree is primarily a graduate-level course-based degree coupled with an Independent research study, but does not require a research thesis. Programs of study followed by thesis-requiring graduate degree candidates in the Department of Animal and Food Sciences will be determined by the candidate's background and interests. For the Thesis/Dissertation-requiring degrees, the academic program will be developed jointly by the student and the advisor, with approval of the student's graduate committee. Other than the core course requirements (see below), there are no specifically-required graduate courses for either of the thesis/dissertation-requiring M.S. or Ph.D. degrees. The Non-thesis Master's requires specific course requirements, as detailed in section B, below.

I. Admission Requirements for Thesis-Requiring Degrees

A. All Applicants: An applicant for graduate study in Animal and Food Sciences must have appropriate academic training. Preparation for most areas of study should include general and organic chemistry, general biology, microbiology, biochemistry, physics, and calculus. Applicants lacking preparatory course work will be required to complete the appropriate courses(s) prior to admission. A minimum cumulative grade point average of 2.75 (4 point scale), and a 3.00 average in the major is required of applicants holding the bachelor's degree. A Graduate Record Examination (GRE) combined score (quantitative + verbal sections) of 300 on the general exam is desirable. Applicants must provide three letters of recommendation from former professors or supervisors, a completed Graduate Studies Application form, and a completed assistantship form (if applying for financial aid).

B. International Applicants: Foreign students must demonstrate competence in the use of the English language by a TOEFL score of 575 (paper-based), 90 (internet-based), 230 (computer-based) or greater and provide evidence of sufficient financial support for the course of the degree program. Foreign students applying for a teaching assistantship must have a TOEFL score of 600 (paper-based), 100 (internet-based), 250 (computer-based) or greater. Applicants may be requested to visit the department for a personal interview, or participate in a remote interview (Skype, Zoom or some other online platform), before a final decision concerning admission is made.

In addition to the above conditions, admission to the graduate program is dependent upon availability of appropriate faculty expertise in the student's area of interest, adequate advisor funding, as well as space in the laboratory of interest.

Admission to the Graduate Program is performed by the Chair of the Graduate Committee in consultation with the Graduate Advisory Committee and the chosen advisor. Following admission to the University, a letter of offer is generated by the Department Chair detailing the admission status, advisor, and terms of the graduate contract. The Graduate Advisory Committee will consist of faculty representing the various research disciplines in the department.

II. General Degree Requirements

A. M.S. Degree in Animal Science and M.S. Degree in Food Science.

In the M.S. program in Animal Science, a student may specialize in animal nutrition, pathology, physiology, immunology, molecular biology, genomics, systems biology, management, or a combination of these disciplines (i.e., nutritional immunology, etc.). In the M.S. program in Food Science, a student may specialize in food science, safety, microbiology or engineering.

1. Time Limitation. The programs are normally completed in 2 to 2 ½ years of full-time study. All requirements for the Master's degrees must be met within a maximum of ten consecutive semesters.

2. Credits. A minimum of 30 graduate credit hours is required, of which six credits must be six hours of thesis (ANFS 869) or six hours of research (ANFS 668/868) or a combination of both. The student must have a minimum cumulative grade point average of 3.00 (4 point scale) in order to receive the M.S. degree.

3. **Core Courses.** All students pursuing the M.S. degree will complete the following core courses: ANFS 865 Seminar (1 cr.), and CHEM 527 Introductory Biochemistry (3 cr.) or CHEM 641 Biochemistry (3 cr.) or ANFS 670 Principles of Molecular Genetics (3 cr.) or ANFS 675 Veterinary Biochemistry (3 cr.) or an appropriate equivalent Biochemistry course, and a statistics course (STAT 608 Research Methods (3 cr.), STAT 615 Design and Analysis of Experiments (3 cr.), or an equivalent statistics course.

Commented [GT1]: I couldn't find a course with this title, so I picked 615 as an alternative

4. **Elective Courses.** The remaining courses, totaling not less than 17 credit hours, will be determined by the student, faculty advisor and the Graduate Committee. These courses will vary among students depending on their specific needs to carry out their research and complete the program. Elective courses taken by students pursuing the M.S. in Animal Science include, but are not limited to, those with the ANFS, BISC, CHEM, and APEC/STAT designations. Elective courses taken by students pursuing the M.S. in Food Science include, but are not limited to, those with the ANFS, BISC, CHEM, APEC/STAT, CHEG, MATH, MEEG, PLSC, PHYS, and NDTD designations (see Graduate Course Offerings).

5. **Graduate Committee.** Each student will have a Graduate Committee consisting of at least three faculty or professional members nominated by the faculty advisor and approved by the Department Chairperson. The advisor, who serves as the chair of the committee, must be a department faculty member. The Graduate Committee's responsibility is the evaluation of the student's program, thesis and examination. Participation from individuals from industry, government, or other academic departments on Graduate Committees may be required depending on the student's area of research and the availability of faculty expertise within the department. However, the number of "non-University of Delaware" committee members must not exceed 50% of the total number on the committee. Departmental Adjunct Faculty shall be considered as "non-University of Delaware" members in their participation on Graduate Committees. The Department Chairperson is considered an *ex officio* member of all Graduate Committees.

6. **Research Proposal.** A research topic shall be determined in conference between the faculty advisor and the student. The student will prepare a research proposal containing pertinent background material including a literature review, specific objectives of the

research project, and methods to be used in the planned studies. The proposal shall be submitted to the student's Graduate Committee for review and approval of the research project. A proposal review meeting shall be held prior to the completion of the first year following matriculation. The proposal shall be submitted to the committee members at least ten working days prior to the scheduled meeting. The student will give an oral presentation summarizing the proposal. The committee members will question the student to verify that the student understands the research problem and the experimental approaches needed to address it. The Committee will also ensure that the student has the proper training and resources to do the research. As a result of the proposal review meeting, the student may be required to revise the proposal and/or take additional relevant course work.

7. Thesis. A thesis reporting the objectives, procedures, results, and a discussion of the student's research shall be prepared according to the most recent edition of the *Thesis Manual* prepared by the Office of Graduate Studies. Copies of the thesis shall be submitted to the student's Graduate Committee at least ten working days prior to the final examination. It is highly recommended that the student present his/her results at an appropriate scientific meeting and prepare a manuscript(s) based on his/her research results in a form suitable for publication. Published thesis research is acceptable as part of the thesis. At the discretion of the advisor, students may be required to provide a draft manuscript at the time of the defense.

8. Thesis Defense. Upon completion of the thesis, the student is required to give an oral presentation (seminar) summarizing the thesis research. Following questions from the public, the committee members will question the student about the thesis and related subject areas to verify that the student fully understands the research findings and their implications. A favorable vote of at least two-thirds of the committee members is required for passing.

B. Department of Animal and Food Sciences: Non-Thesis M.S. Degree in Animal Science or Food Science: Business and Entrepreneurial Leadership Concentration

1. Rationale For and Purpose of Program

The Department of Animal & Food Sciences offers B.S. degrees in Animal Science, Pre-veterinary Medicine and Animal Biosciences, and Food Science. We anticipate that a Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership in Animal Science and Food Science will serve the needs of multiple groups of individuals.

First, we have a successful program that in 2017, placed approximately 35 of 45 students of our graduates that applied to Veterinary Schools. Almost all students who are not accepted to Veterinary School on their first attempt, continue to apply a second, or even third time. Thus, gaining more educational experience and showing an ability to excel in graduate level courses readily assists these students during their subsequent applications.

Second, graduates that major in animal science and who are interested in pursuing careers in the animal industries may see that a Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership can provide them with tools and skills for pursuing a science-related career in cooperative extension, industry, government, service, non-profit, or other fields related to the animal and/or food sciences.

Third, there are individuals in the workplace that seek additional training that can be used to enhance their core competencies in an ever rapidly evolving job market. The Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership in Animal Science and Food Science is not automatically a terminal degree. However, it should be clear that obtaining this degree usually will not provide adequate preparation of pursuing a Ph.D. degree that would normally be obtained by completing a research-based M.S. plan of study.

Students completing the Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership will:

1. Expand knowledge and skills in the animal and food sciences
2. Acquire knowledge and skills in areas of leadership, organization, project management, organizations and entrepreneurship
3. Apply knowledge through design and completion of a problem-solving project

2. Date of Permanent Status

The Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership began in Fall, 2019.

3. Admission Requirements

Applicants must submit all materials directly to the University Office of Graduate and Professional Education using the online admission process before admission can be considered. Admission applications are available at: <https://grad-admission.udel.edu/apply/>

On a 4.0 system, a G.P.A. of at least 3.0 is preferred. Applications will be evaluated based on a combination of record of academic or professional achievement, 3 letters of recommendations, and a personal statement describing how the completion of the Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership will contribute to their professional goals. Applicants must take the GRE Aptitude Test and should have a minimum of 300 combined on verbal and quantitative reasoning. Students for whom English is not their first language the recommended minimum scores are 100 on the TOEFL examination and/or IELTS of 6.5.

Admission to the Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership in Animal or Food Science is based on selections made by the department graduate committee in compliance with University policies and procedures. Admission is selective and competitive and based on the number of well-qualified applicants, the number of available faculty to serve as mentors, and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission, if they offer other appropriate strengths and/or experience.

4. Academic Preparation Requirements

A Bachelor's degree from an accredited program and preferably from a curriculum based on biological sciences (e.g., but not limited to, Animal Science, Food Science, Biology, Nutrition, Physiology, Genetics, Microbiology, Chemistry, Biochemistry, or another appropriate discipline) is required for admission.

5. Application Deadlines

Applications will be taken on a continuing basis to allow for admittance in either the Fall, Spring, or Summer Semesters. The deadlines for each semester are given below. Note:

International applicant deadlines precede Domestic, US citizen applicants, due to additional timing requirements for obtaining an appropriate student VISA.

- Fall:** June 1 (International applicants)
August 1 (Domestic applicants, US citizens)
- Spring:** December 1
- Summer:** April 1 (International applicants)
May 1 (Domestic applicants, US citizens)

6. Types of Admission

Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

A. Regular Admission: Regular status is offered to students who meet all of the established entrance requirements.

A. Conditional Admission: Successful applicants are typically admitted conditionally because stated information is self-reported and uploaded documents are unofficial. Fulfilling the conditions stated on an offer of conditional admission by the first date of graduate coursework is critical, so the instructions stated on the letter must be followed carefully. Failure to clear all stated conditions by the start of graduate coursework may result in revocation of admission to the graduate program.

7. Degree Requirements

The Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership is intended for applicants who want to further their academic training in animal or food science, but who are not research-oriented, but may be seeking a management position in an animal or food science career. This degree requires satisfactory completion of 30 hours of graduate-level coursework, including 16 credits of graduate-level coursework, 5 credits of an in-depth project, an 3 credit ethics course, and 6 credits of PLUS coursework (see below). The 16 credits of coursework must include 12 graduate credits in Animal and Food Sciences (ANFS) courses. The degree candidate will prepare and submit a problem-solving project report under the supervision of their faculty advisor. Upon completion of the paper, the student shall be required to present a

public seminar on the work and to pass an oral examination given by the candidate's committee. This examination shall cover both course-work and the paper.

8. Course Requirements

a. Animal or Food Science Core (16 cr. hrs.)

A total of 16 credit hours of graduate-level courses, of which 12 credit hours must be ANFS (or ANFS-approved) courses with a focus on animal science OR food science including Seminar ANFS 865 - Seminar (1 cr.)

ANFS 602 - Forage Resource Management (3 cr.)

ANFS 609 - Food Processing (4 cr.)

ANFS 611 - Food Science Capstone (4 cr.)

ANFS 615 - Developmental Biology (3 cr.)

ANFS 628 - Food Chemistry (4 cr.)

ANFS 629 - Food Analysis (4 cr.)

ANFS 635 - Animal Virology (3 cr.)

ANFS 636 - Immunology of Domestic Animals (3 cr.)

ANFS 639 - Food Microbiology (4 cr.)

ANFS 640 - Comparative Histopathology (4 cr.)

ANFS 642 - Lactational Physiology (3 cr.)

ANFS 643 - Food Engineering Technology (4 cr.)

ANFS 644 - Bioinformatics (3 cr.)

ANFS 649 - Food Biotechnology (4 cr.)

ANFS 650 - Applied Biomedical Communication (3 cr.)

ANFS 654 - Advanced Ruminant Nutrition (3 cr.)

ANFS 655 - The Gut Microbiome: Microbial and Host Perspectives (4 cr.)

ANFS 667 - Special Topics (1 to 12 cr.)

ANFS 670 - Principles of Molecular Genetics (3 cr.)

ANFS 671 - Paradigms in Cell Signaling (3 cr.)

ANFS 865 - ANFS Graduate Seminar (1 cr.)

b. Ethics Course (3 cr.) Select one course.

UAPP 650 - Values and Ethics of Leadership (3 cr.)

BUAD 640 - Ethical Issues in Domestic and Global Business Environments (3 cr.)

c. Problem Solving Project (5 cr.)

ANFS 666 (5 cr.) - The degree candidate will prepare and submit a problem-solving project report under the supervision of their faculty advisor. This project may be an action program, the development of a plan to address a pertinent problem, the development of materials or methodology suited to the student's situation, or the development and execution of research appropriate to the profession. A formal project report must be submitted to and approved by the candidate's faculty advisor and the ANFS graduate committee. The student and faculty advisor are responsible for the content and length of the paper and the paper will follow established formatting guidelines. The candidate will be allowed to submit a draft of the project paper to the faculty advisor and committee and to make recommended revisions. A maximum of five-credit hours are awarded for satisfactory completion of this project paper. Upon completion of the paper, the student shall be required to present a public seminar on the work and to pass an oral examination given by the candidate's committee. This examination shall cover both course-work and the paper. If a student does not receive a grad or a B or higher on the project, he/she will be recommended for dismissal from the program.

d. PLUS courses (6 cr.) Select two courses.

1. Leadership and Organization

BUAD 670 - Managing People, Teams, and Organizations (3 cr.)

BUAD 678 - Leading Across Boundaries (3 cr.)

UAPP 604 - Leadership in Organizations (3 cr.)

UAPP 697 - Leading Organizations in Public & NP Sectors (3 cr.)

2. Project Management, Operations, or Entrepreneurship

BUAD 671 - Managing for Creativity and Innovation (3 cr.)

ENTR 616 – Applied Creativity (3 cr.)

ENTR 658 – Application Development for New Technology (3 cr.)

ENTR 660 - High Technology Entrepreneurship (3 cr.)

Commented [GT2]: This course does not exist. This was the closest I could find

MISY 640 - Project Management and Costing (3 cr.)

UAPP 689 - Information Technology & Management of Public & NP Orgs (3 cr.)

UAPP 684 Performance Management and Program Evaluation (3 cr.)

3. Statistics (3 cr.)

STAT 608 - Surveys and Economic Experiments (3 cr.)

BISC 643 - Biological data analysis (3 cr.)

STAT 656 - Biostatistics (3 cr.)

4. Electives (16 cr.)

Of the elective course credits, 12 will be graduate-level courses in ANFS (or in ANFS-approved, graduate-level courses). The other 4 credit hours should be selected with advice from the student's faculty advisor.

9. Advisory Committee

Students accepted into the Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership will be assigned an advisor and committee of 2 additional faculty. The student has the responsibility to meet with their advisor and committee members to plan their course of study and project in the program. Advice will be given concerning course selection based on interests and undergraduate/graduate background. Our program is sufficiently small that we are able to give individualized attention to graduate students.

10. Transfer Credits

With approval of the Chair who renders a decision after consultation with the Graduate Committee and relevant faculty, and if necessary, in consultation with the department that offers the (potentially) equivalent course, up to six credits may be recommended to the Office of Graduate and Professional Education to be transferred to apply to the degree provided that the credits have not been applied to obtain a different degree.

Transfer of Graduate Credit Earned at another University (Official Transcript Required)

- Credits used to complete other degrees may not be transferred into a degree at UD.
- Maximum of 6 credits earned at another U.S. institution may be applied to a graduate degree if not used to complete a previous degree.

- Grade must be “B” or better to be acceptable for transfer. Course completion date must be no older than 5 years.
- Credits but no grades or quality points will transfer.
- Credits from institutions outside the United States are not transferable to the University of Delaware unless permission to transfer is given by Office of Graduate and Professional Education.

11. Degree Progress

A. Academic load and progress

The Non-Thesis MS degree with a Concentration in Business and Entrepreneurial Leadership program will follow the University of Delaware, Office of Graduate and Professional Education recommended policy for determining students’ failure to make satisfactory progress towards degree requirements and time limits for completion. Students may be enrolled on a full-time (9 credits per term) or part-time (fewer than 9 credits per term) basis.

B. Grade and GPA requirements

Students must have a minimum overall cumulative grade point average of 3.0 to be eligible for the degree. In addition, the grades in courses specifically required for the degree program must average at least 3.0. All graduate-numbered courses taken with graduate student classification at the University of Delaware are applied to the cumulative index. *Credit hours and courses for which the grade is below "C-" do not count toward the degree, even though the grade is applied to the index. Students with GPAs falling below a 3.0 will be dismissed from the program.*

C. Academic Probation

The Office of Graduate Studies monitors the academic progress of all graduate students and notifies students in writing of all academic deficiencies. The cumulative GPA after each 9-hour increment determines academic standing. In addition to the University policy regarding minimum grade point averages, some departments require graduate students to maintain certain performance minima in their programs of study in all or in particular courses. Failure to meet the stated minima may lead to academic dismissal from the program.

12. Financial aid

There are no financial awards for this degree, this is a tuition-financed program.

C. Department of Animal and Food Sciences: Non-thesis Master's Degree Concentration: Veterinary Biosciences, Biotechnology, and One Health (VBBOH)

1. Rationale and Purpose of Program

Many students that finish a pre-Veterinary, -Medical or -Graduate course of study at the University of Delaware, do so without rigorous technical training in pathogen-host interactions, metabolic disorders, or the connection of nutrition to host immunity and health. For those who are not directly competitive for direct matriculation into professional programs, industrial research positions, or graduate school, we plan a two-year, non-thesis Master's in a concentration of Veterinary Biosciences, Biotechnology, and One Health (VBBOH). We broadly define One Health as the interactions of hosts, pathogens, their nutrition and their environment. This program is designed to provide hands-on technical training, as well as extensive theoretical training in host-pathogen, -nutrition, and –metabolic interactions.

The Department of Animal & Food Sciences offers B.S. degrees in Animal Biosciences, Animal Science, Food Science and Pre-veterinary Medicine. We anticipate that a new, hands-on, more technically-focused non-thesis Master's with a concentration in Veterinary Biosciences, Biotechnology, and One Health will serve the needs of multiple groups of individuals.

First, we have a successful pre-veterinary and animal biosciences (PV, AB) program that consistently places 85%+ of our undergraduates that apply for admission into Veterinary Schools. Almost all students who are not accepted to Veterinary School on their first attempt, continue to apply a second, or even third time. Thus, gaining more educational experience and showing an ability to excel in graduate level courses readily assists these students during their subsequent applications.

Second, graduates that major in animal science and who are interested in pursuing careers in animal health and pharmaceutical research may see that a non-thesis concentration can provide them with tools and skills for pursuing this career path.

Third, there are individuals in the workplace regionally that seek additional training that can be used to enhance their core competencies in a rapidly-evolving job market. The non-thesis Master's degree concentration in Veterinary Biosciences, Biotechnology, and One Health (VBBOH) can contribute to the marketability of these individuals and is not automatically a terminal degree.

Students completing the VBBOH non-thesis concentration will:

1. Expand their knowledge and skills in fundamental host-pathogen interactions, nutrition, and immunology.
2. Acquire hands-on technical training in cell and molecular biology techniques as they relate to basic research, diagnostic, and clinical applications.
3. Acquire training in experimental design and data analysis.

2. Date of Permanent Status

The non-thesis Master's concentration is scheduled to start in Fall 2019, upon approval by the Faculty Senate.

3. Admission Requirements

Applicants must submit all materials directly to the University Office of Graduate and Professional Education using the online admission process before admission can be considered. Admission applications are available at: <https://grad-admission.udel.edu/apply/>

On a 4.0 system, a G.P.A. of at least 3.0 is preferred. Applications will be evaluated based on a combination of record of academic or professional achievement, 3 letters of recommendations, and a personal statement describing how the completion of the Master's in Veterinary Biosciences, Biotechnology, and One Health concentration will contribute to their professional goals. Applicants must take the GRE Aptitude Test and should have a minimum of 300 combined on verbal and quantitative reasoning. Students for whom English is not their first language, an official TOEFL score of at least 100 is required (on the iBT), with a minimum speaking score of 18. TOEFL scores greater than two years old cannot be considered to be official.

Admission to the Master's concentration in Veterinary Biosciences, Biotechnology, and One Health (VBBOH) is based on selections made by the department graduate committee in compliance with University policies and procedures. Admission is selective and competitive and is dependent on the number of well-qualified applicants, the number of available faculty to serve as mentors, and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission, if they offer other appropriate strengths and/or experience.

4. Academic Preparation Requirements

A Bachelor's degree from an accredited program, preferably from a curriculum based on biological sciences (e.g., but not limited to, Animal Science, Food Science, Biology, Nutrition, Physiology, Genetics, Microbiology, Chemistry, Biochemistry, or another appropriate discipline) is required for admission.

5. Application Deadlines

Applications will be taken on a continuing basis to allow for admittance in either the Fall, Spring, or Summer Semesters. The suggested deadlines for each semester are given below.

Note: International applicant deadlines precede Domestic US citizen applicants, due to additional timing requirements for obtaining an appropriate student VISA.

- Fall:** June 1 (International applicants)
August 1 (Domestic applicants, US citizens)
- Spring:** December 15 (International applicants)
January 15 (Domestic applicants, US citizens)
- Summer:** April 15 (International applicants)
May 15 (Domestic applicants, US citizens)

6. Types of Admission

Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

- A. Regular Admission:** Regular status is offered to students who meet all of the established entrance requirements.
- B. Conditional Admission:** Successful applicants are typically admitted conditionally because stated information is self-reported and uploaded documents are unofficial. Fulfilling the conditions stated on an offer of conditional admission by the first date of graduate coursework is critical, so the instructions stated on the letter must be followed carefully. Failure to clear all stated conditions by the start of graduate coursework may result in revocation of admission to the graduate program.

7. Degree Requirements

The Veterinary Biosciences, Biotechnology, and One Health non-thesis M.S. concentration is intended for applicants who want to further their academic training in host-pathogen interactions, are research-oriented, but may lack hands-on training. Alternatively, they may come from an industry background and want to increase their skills and understanding, while not being able to commit to a full-time, thesis-requiring graduate program. This non-thesis degree requires satisfactory completion of a minimum of 30 hours of graduate-level coursework composed of:

- A. Host-Pathogen Core: 9 credit hours (cr hrs) minimum, 3 cr. Hrs. being taken within ANFS
- B. Nutrition/Immunology Core: 6 cr. hrs., 3 cr. Hrs. being taken within ANFS
- C. Technical and Practical Training: (9 cr. hrs., 3 cr hrs being taken within ANFS)
- D. Research Training and Data Analysis: 3 cr. hrs.
- E. Individual Research Experience: 3 cr. hrs. of ANFS 668

8. Course Requirements

A. Host-Pathogen Core (9 cr. hrs.)

Essential to an understanding of the concept of One Health is knowledge of host-pathogen interactions in the context of their environment. The Host-Pathogen Interactions Core is a total of 9 credit hours of graduate-level courses, of which 3 credit hours must be from an ANFS course. Courses meeting these requirements are given, below:

| College | Department | Course # | Course Title |
|---------|------------|----------|----------------------------|
| CANR | ANFS | 635 | Animal Virology |
| CANR | ANFS | 640 | Comparative Histopathology |
| CANR | ENWC | 611 | Insect Pest Management |
| CAS | BISC | 625 | Cancer Biology |
| CAS | BISC | 682 | Bacterial Pathogenesis |

B. Nutrition and Immunology Core (6 cr. hrs.)

Essential for an understanding of the concept of One Health is knowledge of how nutrition informs and shapes host immune processes. This core is composed of 6 cr hrs of graduate-level courses, 3 cr hrs of which must be from ANFS. Courses meeting these requirements are given, below:

| College | Department | Course # | Course Title |
|---------|------------|----------|--------------------------------|
| CANR | ANFS | 636 | Immunology of Domestic Animals |
| CANR | ANFS | 654 | Advanced Ruminant Nutrition |

| | | | |
|------|------|-----|------------------------------|
| CANR | ANFS | 655 | The Gut Microbiome |
| CAS | NSCI | 640 | The Immune System & Behavior |

Additional courses may meet this requirement and be included as they are developed by new faculty.

C. Technical and Practical Training (9 cr. hrs.)

This core requires the acquiring of real-world, hands-on skills for accomplishing research tasks. The Technical and Practical Training Core is a total of a minimum of 9 credit hours of graduate-level courses, of which 3 credit hours must be from an ANFS course. Courses providing these skills are given in the table, below:

| College | Department | Course # | Course Title |
|---------|------------|----------|---|
| CANR | ANFS | 644 | Bioinformatics |
| CANR | ANFS | 650 | Applied Biomedical Communications |
| CANR | ANFS | 671 | Paradigms in Cell Signaling |
| CANR | APEC | 603 | Simulation Model. & Analysis |
| CAS | BISC | 816 | Systems Biology of Cells... |
| COE | BINF | 644 | Bioinformatics |
| COE | BINF | 650 | Protein Modifications |
| COE | BINF | 694 | Systems Biology I |
| CAS | CHEM | 624 | Principles of Mass Spectrometry |
| CAS | CHEM | 645 | Protein Structure and Function |
| CAS | CHEM | 646 | DNA-Protein Interactions |
| CENG | BMEG | 679 | Introduction to Medical Imaging Systems |
| HESC | MMSC | 603 | Research Design |
| HESC | MMSC | 608 | Molecular Prep. Techniques |
| HESC | MMSC | 625 | Basic Molecular Techniques |
| HESC | MMSC | 626 | Protein Purification and Characterization |
| HESC | MMSC | 627 | Flow Cytometry |
| HESC | MMSC | 635 | Practical Genomics, Proteomics & Bioinformatics |
| HESC | MMSC | 640 | Adv. Nanomedicine |
| HESC | MMSC | 651 | Cell and Tissue Culture Techniques |
| HESC | MMSC | 660 | Adv. Tech. in Nanomedicine |
| HESC | MMSC | 691 | Molecular Diagnostics |
| HESC | MMSC | 692 | Applications of Molecular Diagnostic Techniques |

D. Research Training and Data Analysis (3 cr hrs)

This core requires the learning of approaches to statistical analysis of biologically-derived data. Courses providing these skills are given in the table, below, but are subject to additions should appropriate courses become available:

| College | Department | Course # | Course Title |
|---------|------------|----------|------------------|
| CANR | STAT | 608 | Research Methods |

| | | | |
|-----|------|-----|--------------------------|
| CAS | BISC | 643 | Biological data analysis |
| CAS | STAT | 656 | Biostatistics |

* - requires a prior statistics course

E. Individual Research Experience (3 cr hrs, in ANFS)

During the final semester of study, students must participate in a laboratory research experience at the ANFS 668 level. This experience is designed to provide a real-world application of the techniques and concepts developed during the course work. This course will be developed in conjunction with a participating faculty member and will require both written and practical evaluation.

9. Advising

Students accepted into the Master's in Veterinary Biosciences, Biotechnology and One Health concentration will be assigned an advisor. The student has the responsibility to meet with their advisor to plan their course of study and schedule their research experience in the program.

Advice will be given concerning course selection based on interests and undergraduate/graduate background. Our program is sufficiently small that we are able to give individualized attention to graduate students.

10. Transfer Credits

With approval of the Chair who renders a decision after consultation with the Graduate Committee and relevant faculty, and if necessary, in consultation with the department that offers the (potentially) equivalent course, up to 9 credits may be recommended to the Office of Graduate and Professional Education to be transferred to apply to the degree provided that the credits have not been applied to obtain a different degree (i.e., bachelor's degree or completed graduate degree elsewhere).

Transfer of Graduate Credit Earned at another University (Official Transcript Required)

- Credits used to complete other degrees may not be transferred into a degree at UD.
- Maximum of 9 credits earned at another U.S. institution may be applied to a graduate degree if not used to complete a previous degree.
- Grade must be "B" or better to be acceptable for transfer. Course completion date must be no older than 5 years.
- Credits but no grades or quality points will transfer.

- Credits from institutions outside the United States are not transferable to the University of Delaware unless permission to transfer is given by Office of Graduate and Professional Education.

11. Degree Progress

A. Academic load and progress

The Master's in Veterinary Biosciences, Biotechnology, and One Health concentration will follow the University of Delaware, Office of Graduate and Professional Education recommended policy for determining students' failure to make satisfactory progress towards degree requirements and time limits for completion. Students may be enrolled on a full-time (9 credits per term) or part-time (minimum of 6 credits) basis.

B. Grade and GPA requirements

Students must have a minimum overall cumulative grade point average of 3.0 to be eligible for the degree. In addition, the grades in courses specifically required for the degree program must average at least 3.0. All graduate-numbered courses taken with graduate student classification at the University of Delaware are applied to the cumulative index. *Credit hours and courses for which the grade is below "C-" or below do not count toward the degree, even though the grade is applied to the index. Students with GPAs falling below a 3.0 will be dismissed from the program.*

C. Academic Probation

The Office of Graduate Studies (or Graduate College) monitors the academic progress of all graduate students and notifies students in writing of all academic deficiencies. The cumulative GPA after each 9-hour increment determines academic standing. In addition to the University policy regarding minimum grade point averages, some departments require graduate students to maintain certain performance minima in their programs of study in all or in particular courses. Failure to meet the stated minima may lead to academic dismissal from the program.

12. Financial aid

There are no financial awards for this degree, this is a tuition-financed program.

D. Department of Animal and Food Sciences: The Doctor of Philosophy (Ph.D.) Degree in Animal and Food Sciences.

The Doctor of Philosophy Degree has become the highest mark of achievement awarded for the demonstrated ability to investigate problems independently. Doctoral study devotes itself to developing the student's capacity to make significant contributions to knowledge through the development of a critical, disciplined mind. This training is best accomplished under the full-time student status in order to maximize the interaction of the student with a scientific group.

1. Admission.

Students may enter the Ph.D. program after having previously earned a bachelor's degree (B.A. or B.S.), an M.S. degree, or a Doctorate in Veterinary Medicine (DVM), or equivalent. A student who has been admitted to the Ph.D. program in Animal Science may begin working toward the degree. However, he/she has no official status as a doctoral candidate until he/she has passed the comprehensive examination.

2. Areas of Specialization.

The Ph.D. degree in Animal and Food Sciences will be granted in the following major areas of specialization: animal nutrition, pathology, physiology, immunology, molecular biology, genomics, systems biology, management, food science, safety, microbiology or engineering, or a combination of these disciplines (i.e., nutritional immunology, etc.).

In addition to the major area of specialization, the student's advisor, in consultation with the Doctoral Committee, will determine whether the student should pursue a minor field of specialization. If a minor field of specialization is selected, the committee will judge the suitability of the field, relevance to the major area of specialization, and requirements for the minor.

3. Time Limitation.

A maximum of 14 consecutive semesters beyond the bachelor's degree, or 10 consecutive semesters beyond the master's degree, is allowed to complete the requirements for the Ph.D. degree.

4. Core Courses and General Requirements.

All students pursuing the Ph.D. will complete the following core courses:

- ANFS 865 Seminar (1 cr.),
- ANFS 969 Doctoral Dissertation (9 cr.),

- CHEM 641 Biochemistry (3 cr.) or ANFS 675 Veterinary Biochemistry (3 cr.) or an equivalent metabolism-focused biochemistry course,
 - CHEM 642 Biochemistry (3 cr.) or ANFS 670 Principles of Molecular Genetics (3 cr.) or an equivalent nucleic acid-focused biochemistry course,
- Statistics course: STAT 608 Research Methods (3 cr.), STAT 615 Design and Analysis of Experiments (3 cr.) cr.), or an equivalent statistics course. Beyond the core courses, no specific number of courses completed, or credits earned are uniformly required. The student and advisor, in concert with the Doctoral Committee, will select appropriate course work based on the student's background and major and minor (if applicable) area(s) of specialization for the Ph.D. Consideration will be given to the student's prior training and experience at the undergraduate (B.A. or B.S.) and M.S. and/or D.V.M. (if applicable) level(s). Students with more advanced training and experience will need fewer courses to complete their Ph.D. program. General requirements for the Ph.D. are based on a period of residency, writing of a satisfactory research proposal and dissertation, and passing the comprehensive examination and the final dissertation defense. The candidate's doctoral program will consist of a combination of Doctoral Committee approved formal courses, seminars, individual study, and research credits as needed by the student.

5. Residency Requirements.

At least one continuous academic year (two semesters) must be devoted to full-time study as a registered student in the major field at the University of Delaware. Full-time study consists of a minimum load of nine credit hours per semester.

6. Advisor and Doctoral Committee.

Most applicants to the Ph.D. program identify a potential faculty advisor at the time of application. If that faculty member is unable (due to lack of space, funding, etc.) to advise the student, then another advisor who is acceptable to the student is sought. If an advisor cannot be identified, then the student is not admitted to the Ph.D. program. As a condition of admission into the program, a faculty member must agree to serve as the student's graduate advisor for the balance of the student's program. A student may change advisors but this is very rare (see Section VI, Evaluation of Graduate Student Progress). A Doctoral Committee will be appointed within six months following matriculation. The committee shall consist of not less than four and

no more than six faculty or professional members nominated by the graduate advisor and approved by the Department Chairperson. Participation from industry, government or other academic departments on the Doctoral Committee may be required, depending on the student's area of research. At least one member of the committee shall be from outside the Department of Animal and Food Sciences. However, not more than half of the Faculty shall be considered as "outside" members in their participation on Doctoral Committees. The committee is responsible for approving the student's course work and research program. The committee will prepare, administer, and evaluate the student's comprehensive and final examinations and will supervise and approve the dissertation. The student's faculty advisor serves as chair of the Doctoral Committee. A faculty member may serve as the graduate advisor for a student in both his/her M.S. and Ph.D. programs, although this is not common. Students who have completed the M.S. Degree in Animal Science or the M.S. Degree in Food Science are generally encouraged to pursue the Ph.D. at other universities.

7. Research Proposal. Advancement to degree candidacy requires successful oral defense of a research proposal. The proposal will be submitted to the Doctoral Committee at least ten working days prior to the scheduled defense. The student will give an oral presentation summarizing the proposal. The committee members will question the student to verify that the student understands the research problem and the experimental approaches need to address it. The committee will also ensure that the student has the proper training and resources to do the research. As a result of the meeting, the student may be required to revise the proposal and/or take additional course work. The research proposal defense should precede the comprehensive examination.

8. Comprehensive Examination. Successful completion of the comprehensive examination is required of all Ph.D. students prior to their admission to candidacy. The examination normally is given to the student after completion of all course work and selection of a dissertation topic. The student is required to have a minimum grade point average of 3.0 (4 point scale) at the time of the examination. The examination will cover the student's major and minor (if applicable) areas of study. Each member of the student's Doctoral Committee will submit examination questions to the student via the advisor who will administer the written portion of the comprehensive examination. Following completion of the written exam, the advisor will return the student responses to the appropriate committee members for their evaluation. Students passing the

written examination may continue for the oral portion of the written examination. In the oral portion of the comprehensive examination, the student must appear before all committee members and demonstrate competency in this forum. A favorable vote by a majority of the committee is required for passing. Based on the performance of the student in the comprehensive examination, the committee may recommend one of the following actions:

1. The student be admitted to candidacy, without qualification or subject to fulfillment of certain conditions determined by the committee and advisor.
2. The student be re-examined at a later date.
3. The student be disapproved unconditionally for the degree, with either immediate dismissal from the program, completion of a Master's degree based on work accomplished, as deemed by the committee and advisor.

9. Dissertation. The ability to conduct independent research and competence in scholarly writing must be demonstrated by the preparation of a dissertation on the main topic of specialization in accordance with the regulations of the Office of Graduate Studies (or its equivalent administrative office). The contents and conclusions of the dissertation must be defended at the time of the final oral defense (see below) and approved by the Doctoral Committee. Copies of the dissertation must be available in the department office at least ten working days before the date of the final oral examination. Preparation of a manuscript(s) for publication of the information contained within the dissertation is expected prior to, or within one month after, approval of the dissertation by the committee at the final oral examination.

10. Dissertation Defense. Upon recommendation of the Doctoral Committee, a final oral defense of the dissertation will be scheduled for the doctoral candidate who has satisfied all other requirements for the degree. The examination must be scheduled at least two weeks prior to the time the examination is to be held. The examination, which is open to the public, shall be related in a large part to the dissertation, but it may cover the entire field of study of the candidate. The examination will be administered by the student's Doctoral Committee. The student will give an oral presentation (seminar) summarizing the dissertation research, followed by a period of public question and comment. The Committee members will then dismiss the public and question the student about the dissertation and related subject areas to verify that the candidate fully understands the research findings and their implications. A favorable vote of a majority of the

members of the committee is required for passing. If the candidate fails, it is the responsibility of the Doctoral Committee to determine whether he/she may take another examination.

III. Additional Graduate Policies, Procedures and Program Assessment

A. Graduate Seminar

Enrollment in the graduate seminar is required of each graduate during his/her first semester in the department graduate program. Although formal enrollment is not required in subsequent semesters, attendance is required at all seminars each semester of the student's graduate program. A grade designation of "S" will be assigned at the end of the first semester and carried to the completion of the student's graduate program. At that time, a letter grade, based upon performance and participation of the student in seminars each semester of his/her program, will be assigned. Generally, seminar presentations will be made by outside speakers each fall semester, and graduate students will be responsible for presentations each spring semester.

B. Graduate Assistantships and Fellowships

Students are nominated for assistantships based on the needs of the department and qualifications of the students. It is anticipated that not less than one-half of the students admitted will receive some type of financial support.

C. Graduate Student Teaching

All graduate students, especially Ph.D. candidates, are expected to assist in the teaching of at least one course in the department (guest lectures, proctoring exams, grading, etc.).

D. Evaluation of Graduate Student Progress

If a graduate student, his/her faculty advisor, a member(s) of his/her Graduate (Doctoral) Committee, or the Department Chairperson perceives that the graduate student is not making satisfactory progress toward his/her degree, an evaluation of the student's progress will be conducted by the Graduate Advisory Committee and Department Chairperson. If, in the opinion of the Graduate Advisory Committee, the student is not making satisfactory progress, the student and advisor will be notified and the Department Chairperson advised in writing of any actions the Graduate Advisory Committee feels necessary. The student and/or advisor will have the opportunity to meet with the Graduate Advisory Committee and/or Department Chairperson, as a group or on an individual basis, to discuss the Committee's actions. Possible outcomes of this action include reassignment of the student to another faculty advisor or termination of the student from his/her graduate program.

Termination of a graduate student from his/her program is rare. Conditions for termination may include any one of the following:

1. Failure to maintain a grade point average of 3.0 (4 point scale) throughout the student's program.
2. Failure to make adequate progress in the student's research required for the degree (see above), or as consequence of failing the comprehensive examination.
3. Unethical professional conduct (plagiarism, fabrication of data, sabotage of another's experiment, etc.).

Specific details on the University's conduct expectations of students are given in the section entitled, "Student Guide to University Policy" in the University of Delaware Official Student Handbook.

E. Graduate Course Offerings

For the ANFS graduate degrees (M.S. in Animal Science, M.S. in Food Science, the Non-Thesis Master's, and the Ph.D. in Animal and Food Sciences), the following courses, grouped into focus areas, are approved for inclusion. Additional courses, as developed within these focus areas, may be included. This collection serves to guide advisors and graduate students in appropriate course selection for their degrees. Some courses may not be offered each semester, year, or may be discontinued in the future, however, the following are active courses at the time of this writing.

1. Host-Pathogen Interactions:

| College | Department | Course # | Course Title |
|---------|------------|----------|----------------------------|
| CANR | ANFS | 633 | Poultry Pathology |
| CANR | ANFS | 635 | Animal Virology |
| CANR | ANFS | 640 | Comparative Histopathology |
| CANR | ENWC | 619 | Biological Control |
| CANR | ENWC | 635 | Population Ecology |
| CANR | ENWC | 821 | Wildlife Spatial Ecology |
| CANR | ENWC | 842 | Ecological Modeling |
| CAS | BISC | 625 | Cancer Biology |
| CAS | BISC | 682 | Bacterial Pathogenesis |

2. Nutrition and Immunology:

| College | Department | Course # | Course Title |
|---------|------------|----------|--------------------------------|
| CANR | ANFS | 636 | Immunology of Domestic Animals |
| CANR | ANFS | 642 | Lactational Physiology |
| CANR | ANFS | 654 | Advanced Ruminant Nutrition |

| | | | |
|------|------|-----|-----------------------------------|
| CANR | ANFS | 655 | The Gut Microbiome: |
| CAS | BISC | 671 | Cellular and Molecular Immunology |
| CAS | NSCI | 640 | The Immune System & Behavior |

3. Technical and Practical Training:

| College | Department | Course # | Course Title |
|---------|------------|----------|---|
| CANR | ANFS | 644 | Bioinformatics |
| CANR | ANFS | 650 | Applied Biomedical Communications |
| CANR | ANFS | 671 | Paradigms in Cell Signaling |
| CANR | APEC | 603 | Simulation Model. & Analysis |
| CAS | BISC | 602 | Molecular Biology of Animal Cells |
| CAS | BISC | 605 | Adv. Mammalian Physiology |
| CAS | BISC | 606 | Adv. Mammalian Physiology II |
| CAS | BISC | 609 | Molecular Biology of the Cell |
| CAS | BISC | 610 | Endocrine Physiology |
| CAS | BISC | 612 | Advanced Cell Biology |
| CAS | BISC | 635 | Population Ecology |
| CAS | BISC | 643 | Biological data analysis |
| CAS | BISC | 654 | Biochemical Genetics |
| CAS | BISC | 656 | Evolutionary Genetics |
| CAS | BISC | 665 | Adv. Molecular Biology & Genetics |
| CAS | BISC | 816 | Systems Biology of Cells... |
| CAS | BINF | 644 | Bioinformatics |
| CAS | BINF | 650 | Protein Modifications |
| CAS | BINF | 694 | Systems Biology I |
| CAS | BINF | 695 | Computational System Biology |
| CAS | BINF | 815 | Ethics, Business and Communication |
| CAS | CHEM | 624 | Principles of Mass Spectrometry |
| CAS | CHEM | 645 | Protein Structure and Function |
| CAS | CHEM | 646 | DNA-Protein Interactions |
| CAS | NSCI | 637 | Behavioral Epigenetics |
| CENG | BMEG | 640 | Attachments in Biology |
| CENG | BMEG | 662 | Engineering Biomedical Nanostructures |
| CENG | BMEG | 665 | Tissue Biomechanics and Modeling |
| CENG | BMEG | 671 | Mathematical Physiology |
| CENG | BMEG | 679 | Introduction to Medical Imaging Systems |
| CENG | BMEG | 695 | Computational System Biology |
| HESC | MMSC | 603 | Research Design |
| HESC | MMSC | 608 | Molecular Prep. Techniques |
| HESC | MMSC | 625 | Basic Molecular Techniques |
| HESC | MMSC | 626 | Protein Purification and Characterization |
| HESC | MMSC | 627 | Flow Cytometry |
| HESC | MMSC | 635 | Practical Genomics, Proteomics & Bioinformatics |
| HESC | MMSC | 651 | Cell and Tissue Culture Techniques |
| HESC | MMSC | 690 | Genetic & Molecular Diagnostics for Clin. Prac. |
| HESC | MMSC | 691 | Molecular Diagnostics |
| HESC | MMSC | 692 | Applications of Molecular Diagnostic Techniques |

4. Research Data Analysis:

| College | Department | Course # | Course Title |
|---------|------------|----------|--------------------------|
| CANR | STAT | 608 | Research Methods |
| CAS | BISC | 643 | Biological data analysis |
| CAS | STAT | 656 | Biostatistics |

F. Graduate Program Assessment

A. Thesis-based Graduate Program Assessment Plan

| Assessment plan for Thesis-requiring Graduate Degree in Animal or Food Science | | | | |
|--|---|--|---|---|
| Objectives | Strategic Activities | Measures | Short-term Outcomes | Long-term Impact |
| 1. Expand knowledge and develop experimental design and performance skills | Course work, Proposal preparation and defense | Faculty evaluation of student progress in coursework. Successful proposal development and implementation, progress reports | Students acquire skills necessary for hypothesis development, experimental design and data collection | Students acquire fundamental reasoning skills essential for project completion |
| 2. Acquire laboratory ethics, method, technique, and data collection and presentation skills | Coursework in ethics, communication, hands-on laboratory work, data collection and presentation at Departmental, College, and University symposia | Faculty evaluation of coursework, Advisor evaluation of lab performance and productivity, Evaluation of research by judges at symposia, Publication of data in proceedings and journal articles, Successful completion of comprehensive (qualifying) exam (PhD students) | Maintenance of GPA >3.0 in all coursework, successful presentations at symposia, increased visibility of research | Students acquire increased aptitude for research project, Students learn to complete projects and tasks, budgeting time for studies and research, Increased role of student as scientist and mentor in laboratory |
| 3. Application of knowledge through thesis/ dissertation project completion, generation of independence as investigator | Writing of publications based on research, communication of project results in thesis or dissertation. | Successful Thesis or Dissertation completion and defense | Exit surveys of graduates to determine the strengths and challenges of graduate program | Graduates accepted to PhD program (MS students), post-doctoral positions (PhD students), Industry or Government positions as independent investigators, |

B. Non-thesis Master's Program Assessment Plan

| Assessment plan for Non-thesis Master's Degree Concentrations in Animal or Food Science | | | | |
|---|---|---|--|--|
| Objectives | Strategic Activities | Measures | Short-term Outcomes | Long-term Impact |
| 1. Expand knowledge and skills in the animal and food sciences | Course work covering the disciplines of animal or food science | Faculty evaluation of student progress in coursework. Surveys of graduate students in the program and post-graduation | Students are prepared for subsequent coursework | Graduates enjoy long term success in animal and food science careers. |
| 2. Acquire knowledge and skills in areas of leadership, organization, project management, organizations and entrepreneurship | Coursework in ethics, communication, leadership, entrepreneurship, management, statistics, and other approved courses | Surveys of students focusing on their experiences in these classes. Surveys of graduates to determine the utility of these classes to their career. Faculty evaluation of student progress in coursework. | Course work for the NON-THESIS OPTION degree helped students secure initial employment Students and graduates report applying knowledge from courses to work settings | Acceptance to Professional and/or Graduate School. Graduates enjoy long term success in animal and food science careers |
| 3. Application of knowledge through design and completion of a problem-solving project | Identify a problem and potential solution and design project to solve the problem. | Quality of the project study design and results. Faculty evaluation of quality and scope of the project. | Surveys of graduates to determine the utility of their project experience to their career. | Graduates enjoy long term success in animal and food science careers. |