

Course Outline Form: Winter 2018

General Information

Course Code: ANSC*4350

Course Title: Experiments in Animal Biology

Course Description:

This course provides an opportunity for directed hands-on projects involving live animals and laboratory techniques. A set of selected projects will be provided by ASc faculty within their broad fields of study, for example animal behaviour and welfare, environmental physiology, endocrinology, and reproduction.

Over the course of the semester, groups of students will be involved in conducting a single experiment on agricultural animals either on campus or at one of the research stations. Students will be provided with an outline for the experiment but will develop their own hypotheses and experimental plan and execute data collection. Individual groups conducting separate projects will meet separately for the development of hypotheses, experimental design, data collection and analysis. Students will be responsible for measuring behaviour, monitoring growth, production or reproduction and collecting blood or saliva. Students will learn and practice sampling techniques and assays for measuring hormones or metabolites. They will also analyze data and interpret and present their results in written and oral format.

Students will meet periodically (Tuesday at 2:30 p.m., ANNU Room 030) for presentations on techniques used in different areas of research and to present group status reports. This will expose students to the variety of experimental approaches used in various fields of research. Students will be expected to integrate or consider the impact of these ideas in their experimental design.

Credit Weight: 0.5

Academic Department (or campus): Animal Biosciences

Campus: Guelph

Semester Offering: Winter 2018

Class Schedule and Location:

Tuesday 2:30 p.m. - 5:30 p.m., ANNU 030, other times as required

Instructor Information

Instructor Name: Dr. Jim Squires

Instructor Email: jsquires@uoguelph.ca

Office location and office hours: Room ANNU 146, by appointment

Lab Coordinator information

Name: Dr. Julie Kim

Email: jungmi@uoguelph.ca

Office location and hours: ANNU

GTA Information

GTA Name: Charlene Hanlon

GTA Email: chanlon@uoguelph.ca

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GTA Name: Bishwo Pokharel

GTA Email: pokhareb@uoguelph.ca

GTA office hours: By appointment

Course Content

Specific Learning Outcomes:

The goal of this course is to introduce you to the world of independent research.

By the end of the course, you will:

1. be familiar with issues of animal care and safety in the laboratory
2. be familiar with the development of hypotheses and the design of experiments
3. be exposed to laboratory techniques used in different areas of animal biology research
4. develop skills for observing and measuring animals' responses to the physical social or nutritional environment
5. develop skills to measure the animal's endocrine responses to environmental changes
6. be able to organize your group time to perform experiments, collect and analyse data
7. critically evaluate and interpret your results to integrate various measures of response in order to deepen understanding of biological function
8. write a scientific paper and present your results to the class

Lecture Content:

PLEASE NOTE THIS SCHEDULE IS BY WEEK- CLASS IS ALWAYS ON THE TUESDAY BUT YOU MUST SCHEDULE ADDITIONAL TIME TO COMPLETE LAB WORK.

Week of	Lecture	Lab Work
Jan. 8	Introduction	Organize groups, choose topic and discuss/plan the literature review
Jan. 15	Behaviour data collection techniques	Develop hypotheses and work schedule
Jan. 22	Presentation of research protocols	Set up experiments
Jan. 29	Animal Care (Dr. Anna Bolinder) Farm and Lab Safety (Christi Cooper, EHS)	Data and sample collection
Feb. 5		Data and sample collection
Feb. 12	Groups present status reports	Data and sample collection
Feb. 19	Winter break	Winter break
Feb. 26	Hormone assay validation	Validation study Data and sample collection
Mar. 5	Groups present status reports	Hormone assays
Mar. 12		Hormone assays completed
Mar. 19	Discussion of data analysis and report preparation	Data analysis
Mar. 26	Draft report for comments	
Apr. 2	Lab report due and presentation of projects	

Labs:

The class will be divided into 4 groups of 5 students, with each group conducting a different project at either Arkell Poultry or Arkell Swine Research Stations. Students will focus on measuring performance, behaviour and endocrine changes in the animals.

The potential projects are:

1. Effects of persistency of lay on three different strains of aging hen
2. Carry-over effects of rearing density on peak production between strains of laying hens
3. Piglet feed management during the post-weaning period
4. Behaviour and physiology of sows in different farrowing environments

5. Behaviour and physiology of piglets in different farrowing environments

Each group of students will conduct one experiment and individuals within each group will receive training and be assigned responsibility for animal handling, sample collection and hormone analysis. Sample and data collection and analytical procedures will be conducted both during and outside of scheduled lab time as arranged by the groups. Each group member is expected to do their fair share of the work and to participate in group meetings. Evaluations of all individual group members will be conducted at the end of the course. Technical assistance will be provided as needed. Schedules vary with experiment but all animal measurements and sampling will be completed by early March.

Each member of the group will receive a complete data set for their experiment and will write an individual lab report in the format of a journal paper (*Journal of Animal Science*). **Please refer to links under “Writing Up your Report” posted on CourseLink for instructions, format and help guides.**

Each group will present their experimental results in the last week of the semester. The format of the presentation may be similar to that of the lab report.

Course Assignments and Tests:

Assignment or Test	Due Date	Contribution to Final Mark (%)	Learning Outcomes Assessed
Literature review, development of hypotheses and experimental design	January 23	15% Individual mark	2, 3, 4, 5
Presentation of research protocol	January 23	10% Group mark	2, 3, 4, 5, 6
Refinement of wet lab protocol	March 6	5% Individual mark	1, 3, 5
Laboratory report Journal format	April 6	40% Individual mark	4, 5, 7, 8
Presentation of results	April 3	20% Group mark	4, 5, 6, 7
Participation and contribution for group work		10% Individual mark	6

Final examination date and time:

There is no final exam for this course. Final presentations will be completed on April 3. Final papers will be due at the end of the week.

Course Resources

Required Texts: None

Recommended Texts: None

Lab Manual: None

Other Resources:

Lecture notes and additional information pertinent to the course are posted on CourseLink

Course Policies**Grading Policies**

Hard copies of the assignments should be submitted at my office ANNU room 146 or directly to the TAs by 4:30 p.m. on the due date. Late penalties of 2 % per day will be assessed for late submissions.

Course Policy on Group Work:

All groups will determine and agree to expectations for themselves and their fellow group members using a contract with terms given below. At the end of the semester, group members will provide a review of themselves and their fellow group members regarding compliance with the expectations and contract. 10% of the course mark will reflect each student's participation and contribution to the group.

Group Contract

List Group members:

Expectations (grade) for major project:

Five Processes for Effective Teams:

1. How will we make decisions? (e.g. consensus, leader dictates)
2. How do we make sure that everyone gets a chance to discuss or raise concerns?
3. How will we handle differences amongst us?
4. How will we ensure the completion of our work?

5. How will we change things that are not producing results?

Signatures:

Course Policy regarding use of electronic devices and recording of lectures:

Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

University Policies

Academic Consideration:

The University of Guelph is committed to supporting students in their learning experiences and responding to their individual needs and is aware that a variety of situations or events beyond the student's control may affect academic performance. Support is provided to accommodate academic needs in the face of personal difficulties or unforeseen events in the form of Academic Consideration.

Information on regulations and procedures for Academic Consideration, Appeals and Petitions, including categories, grounds, timelines and appeals can be found in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).

Academic Misconduct:

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community, faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring.

University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Detailed information regarding the Academic Misconduct policy is available in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).

Accessibility:

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS), formerly Centre for Students with Disabilities (CSD), as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email sas@uoguelph.ca or visit the [Student Accessibility Services website \(http://www.uoguelph.ca/csd/\)](http://www.uoguelph.ca/csd/).

Course Evaluation Information:

End of semester course and instructor evaluations provide students the opportunity to have their comments and opinions used as an important component in the Faculty Tenure and Promotion process, and as valuable feedback to help instructors enhance the quality of their teaching effectiveness and course delivery.

While many course evaluations are conducted in class others are now conducted online. Please refer to the [Course and Instructor Evaluation Website](#) for more information.

Drop period:

The drop period for single semester courses starts at the beginning of the add period and extends to the Fortieth (40th) class day of the current semester (the last date to drop a single semester courses without academic penalty) which is listed in [Section III \(Schedule of Dates\) of the Undergraduate Calendar](#).

The drop period for two semester courses starts at the beginning of the add period in the first semester and extends to the last day of the add period in the second semester.

Information about Dropping Courses can be found in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).

Additional Course Information

Project 1 - Effects of persistency of lay on three different strains of aging hen

Background

Laying hen breeding companies need to be able to produce a hen with the ability to lay an optimal number of eggs in a laying cycle. In the initial stages, much of the focus was placed on decreasing the time to sexual maturity and the peak of lay to obtain the greatest number of eggs possible in the beginning of the laying cycle (peak of lay = 95-99%). With this mostly accomplished, the goals have now shifted to improving the end of lay. In Ontario, the typical laying cycle involved 20 weeks of pullet growth and then 52 weeks of lay (therefore a 72-week cycle). After 52 weeks of lay, production drops to approximately 80%.

Over the last few generations, breeding companies have aimed to produce a hen that can lay 500 eggs in 100 weeks. However, with the use of genomic technology to obtain the rapid generation interval of the laying hen, there has been minimal considerations towards the hen's ability to handle this extended period, in terms of health, welfare, and nutritional compensation.

As the hen ages, she will experience a decrease in bone strength, due to the massive amount of calcium laid onto each egg over the laying cycle, assuming that the shell quality is maintained. Estradiol, a major reproductive steroid hormone, has been implicated in the switch from the formation of structural bone to the formation of medullary bone. There is a concern that selecting for both early onset and late termination of lay may be detrimental to the hen's bone structure and may lead to cage layer fatigue.

Objectives and overview

The objectives of this trial are to determine the ability of the current commercial hen to remain in an extended laying period. 90 Lohmann LSL lite and 76 Shaver Heritage White Leghorns are kept in colony cages (n=2), divided randomly throughout two identical rooms. Birds will be approximately 75 weeks of age during the trial.

There are several parameters that can be measured in the different breeds:

- Reproductive condition:
 - measure the egg quality (both internal and external as these are critical to the consumer).
 - measure the blood levels of reproductive hormones (estradiol) or circulating calcium levels (previous blood samples are available for baseline).
- Calcium Utilization in the aging hen
 - record the Ca input (in the feed)
 - measure Ca output (eggshell and feces)

Monitor Behaviour

- Compare breed activity and appropriate measures of bird welfare

References:

Al-Bateshan, H.A., Scheideier, S.E., Black, B.L., Garlich, J.D., and Anderson, K.E. 1994. Duodenal calcium uptake, femur ash, and eggshell quality decline with age and increase following molt. Poultry Science 73: 1590-1596.

Bain, M.M., Nys, Y., and Dunn, I.C. 2016. Increasing persistency in lay and stabilizing egg quality in longer laying cycles. What are the challenges? British Poultry Science. Doi: 10.1080/00071668.2016.1161727.

Bar, A., Razaphkovsky, V., and Vax, E. 2002. Re-evaluation of calcium and phosphorous requirements in aged laying hens. British Poultry Science. 43: 261- 269.

Bédécarrats, G.Y. 2015. Control of the reproductive axis: Balancing act between stimulatory and inhibitory inputs. Poult Sci. 94: 810-815.

Ohashi, T., Kusuhara, S., and Ishida, K. 1991. Estrogen target cells during the early stages of medullary bone osteogenesis: immunohistochemical detection of estrogen receptors in osteogenic cells of estrogen-treated male Japanese quail. Calcification of Tissue international 49: 124-127.

Project 2 - Carry-over effects of rearing density on peak production between strains of laying hens

Background

Pullet rearing is a huge area of discussion as adult housing systems continue to change. In order to allow hens to function in aviary systems, they need to be exposed to these systems in early life. This means rearing hens in combination-styled cages, with levels and perches, similar to that of the aviary itself. However, with the new systems, rearing densities must be established.

Higher density cages allow for less access to the feeders, leading to some variation in body weights between cage mates. In the lower density cages with free access to feed, the birds tended to be heavier. Density also impacts the hens stress levels during rearing and there is a potential for a carry-over effect as a result.

The age of sexual maturity is dependent on many variables, including body weight, metabolism and photostimulation. This means that rearing densities may impact the initiation of lay and therefore peak production itself, as well as the timing of lay.

Objectives and overview

The objectives of this project are to determine the potential carry over effects of rearing densities (High = 91 birds, Low = 67 birds) on behaviour, stress, and reproductive performance. 48 laying hens are housed in 3 pens (n=16), with 1 breed per pen (Lohmann White, Lohmann Brown, and Dekalb White).

There are several parameters that can be measured between the different rearing densities:

- Reproductive Performance:
 - Egg production can be monitored on a daily basis
 - Blood samples will be taken weekly in order to measure reproductive hormones (ie. Estradiol).
- Stress Response:
 - Measure corticosterone in the blood to see if there is a carryover stress response due to density (also able to look at breed*density interactions).
- Monitor Behaviour
 - Pecking order or foraging behaviour as hens were mixed at 15 weeks of age
 - Perching behaviour to see if the combination cages allowed for learned behaviour evenly from all breeds
 - Compare breed activity

References:

Bédécarrats, G.Y. 2015. Control of the reproductive axis: Balancing act between stimulatory and inhibitory inputs. Poult Sci. 94: 810-815.

Habinski, A.M., Caston, L.J., Casey-Trott, T.M., Hunniford, M.E., and Widowski, T.M. 2017. Development of perching behaviour in 3 strains of pullets reared in furnished cages. *Poultry Science*. 96: 519-529.

Widowski, T.M., Caston, L.J., Hunniford, M.E., Colley, L., and Torrey, S. 2017. Effect of space allowance and cage size on laying hens housed in furnished cages, Part 1: Performance and well-being. *Poultry science*. 96: 3805-3815.

Widowski, T.M., Caston, L.J., Casey-Trott, T.M., and Hunniford, M.E. 2017. The effect of space allowance and cage size on laying hens in furnished cages, Part II: Behaviour at the feeder. *Poultry Science* 96: 3816-3823.

Project 3 – Piglet feed management during the post-weaning period

Background

Piglets experience a post-weaning growth lag that is related to poor feed intake, limited gut capacity, exposure to novel pathogens, introduction of feed allergens (e.g. soybean meal), and social stressors (i.e. establishment of a new social hierarchy). To combat this post-weaning growth lag, nutritionists and producers often feed very expensive and highly digestible diets to promote feed consumption.

It is common for nursery piglets to be fed multiple phases of diets with decreasing nutrient density and digestibility. Based on mathematical models, we estimate the optimum body weight to conduct feed switches. However, the piglet itself may be more effective at eating to its nutrient requirements given the choice between high and low nutrient density diets.

Additionally, when piglets are mixed into new social groups (i.e. litter mates are often separated) piglets are preoccupied with establishing new social hierarchies in the first several hours after weaning. During this time, piglets often do not explore the feeders or consume any feed. Adding feeders and feed after the initial social hierarchy is established may promote increased exploratory behaviour and an overall greater feed intake within the first 24 hours of weaning.

Objectives and overview

The objectives of this project are to determine the effects of various feed management strategies after weaning on feed intake, piglet growth, and feeding and social behaviour. Sixty four piglets will be obtained at the Arkeill Swine research station on the day of weaning and randomly assigned to 1 of 8 identical nursery pens (ensuring that equal numbers of littermates are present in each pen). One of many different feed management strategies can be studied. For example:

1. Timing of feed introduction - In half of the pens feeders will be pre-filled with nursery diet (standard practice; control group). In the remaining pens feeders and feed will not be provided until 4-6 hours after mixing (treatment group). Behaviour will be monitored immediately after mixing and 4-6 hours later (when feeders are added to treatment pens). Collect saliva samples for cortisol analysis throughout the day. Monitor per pen daily feed intake and individual piglet body weights.
2. Feed selection by piglets post weaning - In half of the pens 2 feeders will be provided, one with a high and one with a low nutrient density feed (treatment). In the remaining pens, two feeders will be provided with a standard ration (control; nutrient composition is the average of the treatment diets). Monitor feeding behaviour, piglet growth rates, and feed disappearance from each of the feeders.

References:

- Bruni A, Quinton VA, Widowski TM. 2007. The effect of feed restriction on belly nosing behaviour in weaned piglets. *Appl. Anim. Behav. Sci.* 110:203-215.
- Colson V, Martin E, Orgeur P, Prunier A. 2012. Influence of housing and social changes on growth, behaviour and cortisol in piglets at weaning. *Physiol. Behav.* 107:59-64.
- Dybkaer L, Jacobsen AP, Togersen FA, Poulsen HD. 2006. Eating and drinking activity of newly weaned piglets: Effects of individual characteristics, social mixing, and addition of extra zinc to the feed. *J. Anim. Sci.* 84: 701-711.
- Ettle T, Roth FX. 2005. Dietary preferences for feeds varying in threonine concentration by the piglet. *Physiol. Behav.* 85:289-295.
- Ferguson NS, Nelson L, Gous RM. 1999. Diet selection in pigs: choices made by growing pigs when given foods differing in nutrient density. *Anim. Sci.* 68: 691-699.
- Pluske JR. 2013. Feed- and feed additives-related aspects of gut health and development in weanling pigs. *J. Anim. Sci. Biotech.* 4:1-7. (Review paper)
- Widowski TM, Torrey S, Bench CJ, Gonyou HW. 2008. Development of ingestive behaviour and the relationship to belly nosing in early-weaned pigs. *Appl. Anim. Behav. Sci.* 110:109-1027.

Projects 4 and 5.

The Behaviour and Physiology of Sows and Piglets in Different Farrowing Environments

Background

Neonatal mortality accounts for significant losses to the swine industry and crushing by the sow is most often the cause of these losses during the first week postpartum. Farrowing crates were developed to prevent crushing; they restrict the sows' movements, which deter the sows from rolling over on the piglets. Because piglets require a much higher temperature than sows, supplemental heat is used in the farrowing environment to provide piglets with a comfortable thermal environment. The supplemental heat source may be located some distance from the sow's udder, which attracts piglets away from the sow and may also reduce crushing.

On the day before farrowing sows are highly motivated to engage in nest-building behaviour. Farrowing crates are criticized on animal welfare grounds because they prevent nest-building behaviour and may increase stress in the sow. Their design may also impair the sow's ability to perform the movement required for normal postural adjustments (i.e. changing from lying to standing and vice-versa) and the resulting stress can impair lactation. Alternative farrowing systems provide more space to the sow and enrichment allows sows to perform nestbuilding, Enriched farrowing environments have also been shown to affect behaviour of piglets.

Objectives and overview

The objectives of this experiment are to examine the effects of farrowing accommodation and environmental enrichment on the behaviour and physiology of sows and their piglets. One group will focus on sow behaviour and physiology, the other group will focus on piglets. The Arkell Swine Research Station has convertible farrowing crates/pens that can provide different amounts of space and enrichment. Groups will share access to sows beginning several days before farrowing. Half of the sows will be kept in standard farrowing crates; half will be kept in pens supplied with enrichments. The behaviour of sows and piglets can be measured using live observation and video recordings. Routine management practices such as teeth clipping and castration will be done by animal care staff, and piglets' behavioural and physiological responses to these practices can be compared in the different housing systems. Body weights, growth rates and mortality of piglets can be measured. Endocrine changes associated with parturition and onset of lactation or stress response can be analyzed from saliva samples collected from the sows or urine collected from piglets. Measures of immune response can be made in the sows' colostrum. Sows are due to farrow February 9-15, 2017.

There are a couple of different approaches that groups can use to address this topic. For example you can:

- Compare nest-building behaviour, stress response and immune status of sows and/or gilts in the two farrowing environments
- Assess the effect of farrowing environment on thermoregulatory behaviour, suckling behaviour, growth rates and stress response of piglets
- Compare the standing and lying behaviour of sows and/or in the two farrowing environments in relation to risk of crushing piglets

- Compare the responses of piglets to teeth clipping, tail docking or castration in the different housing systems

References:

- Cronin, G.M. and J.A. Smith, 1992. Suckling behaviour of sows in farrowing crates and straw-bedded pens. *Appl. Anim. Behav. Sci.* 33:175-189.
- Cronin, G.M., J.A. Smith, F.M. Hodge and P.H. Hemsworth, 1994. The behavior of primiparous sows around farrowing in response to restraint and straw bedding. *Appl. Anim. Behav. Sci.* 39: 269-280.
- Hrupka, B.J. et al., 1998. The effect of farrowing crate heat lamp location on sow and pig patterns of lying and pig survival. *J. Anim. Sci.* 76:2995-3002.
- Jarvis, S., Calvert, D.M. Weary, E.A Pajor, D. Fraser and A.M. Honkanen 1996. Sow body movements that crush piglets: a comparison between two types of farrowing accommodation. *Appl. Anim. Behav. Sci.* 49: 149-158.
- Jarvis, S., D'Eath, R. B., Robson, S. K., and A.B. Lawrence. 2006. The effect of confinement during lactation on the hypothalamic-pituitary-adrenal axis and behaviour of primiparous sows. *Physiol. & Behav.* 87, 345-352.
- McGlone, J.J., T.M., Widowski, K.D., Stricklen, D. Mitchell, S.E., Curtis. 1996. Sow access to tassel pre-farrowing: preliminary evidence of stillbirth rate. *J. Anim. Sci.* 74 (1), 127, Suppl.
- von Borell, et al. 2009. Animal welfare implications of surgical castration and its alternatives in pigs. *Animal* 3:1488-1496.
- Vanheukelom, V., B. Driessen and R. Geers, 2012. The effects of environmental enrichment on the behaviour of suckling piglets and lactating sows: A review. *Livestock Science* 143:116-131.
- Widowski, T.M., S.E., Curtis. 1990. The influence of straw, cloth tassel or both on the pre-partum behavior of sows. *Appl. Anim. Behav. Sci.* 27, 53-71.