

Topics in Stress, Behavior and Welfare

Stress & Immunity

Course Objectives:

- To familiarize students with current and classical scientific literature in areas of:
 - Immunology
 - Brain and endocrine mechanisms of stress
 - Stress-Immune interactions and mechanisms
 - Application of mechanistic information in research models
- To give graduate students an opportunity to interact with graduate students at different universities with similar interests

Collaborating Institutions

Texas Tech University (John McGlone & Mhairi Sutherland)

University of Illinois (Janeen Salak-Johnson)

Iowa State University (Anna Butters-Johnson)

Course Format

* This course will meet on conference call, on line, and possibly by video conference. At the beginning of the semester, students will receive a required reading list. Reading assignments should be completed before class each week.

* Instructors will present information about the core topics in the early weeks of the class.

* Students will prepare written summaries of certain papers, and will be assigned parts of papers or whole papers to present to the group. Instructors will ask questions prior to each class period and the students must be prepared to answer each question. For each paper (or parts of papers, or set of papers, depending on the complexity of the papers), students will be assigned as either a primary or secondary reviewer. All students must read and be familiar with all papers, regardless of their role. Instructors will provide questions about the papers before class.

During the Student Paper weeks

For a given paper, the responsibilities of the student reviewers are:

Primary reviewer. This person provides a summary of the paper. The summary should include the major findings. The primary reviewer sends their review, largely in bullet point format, to the secondary reviewer and the instructors at least 1 day before class meeting time. The primary reviewer summarizes and supports the paper.

Secondary reviewer. This person identifies the weak points of the paper. This person sends their review to the primary and secondary reviewer and the instructors at least 1 day before class meeting time.

*For a given topic (paper, part or a paper or collection of papers), the assigned students take a total of 5 minutes to summarize the paper as described above. Then the 2 assigned students will answer the instructor's questions for 5 minutes. Instructors will clarify and add to the discussion. Then, for the next 5 minutes, the entire class can comment on what has been said and on the instructor questions. It is important that primary and secondary reviewers prepare information prior to class.

* One instructor will lead the discussion, and another will be the time keeper.

Grading

Students will be graded in participation, abstracts, and 2 exams. Grades will be based on the following

points:

5 abstracts @ 25 points each	125
2 exams @ 100 points each	200
Participation	125

<u>Total</u>	<u>450</u>

90 % = A

80 % = B

70 % = C

60 % = D

< 60 % = F

Class Schedule

Day	Date	Topic	Papers
Wed	6-Sep	Introduction; overview of Stress & Immunity	S. Levine, 2005, Stress: An historical perspective
Mon	11-Sep	Immunology review	Immunology lecture on line; P Kidd, 2003 Th1/Th2 Balance
Mon	18-Sep	Immunology review	IJ Elenkov, Glucocorticoids and the Th1/Th2 balance Wiegers et al., 2005. Glucocorticoids & immunity
Wed	27-Sep	Brain-Endocrine-Stress review	AJ Fulford and MS Harbuz, 2005, An introduction to the HPA axis; KB Abel and JA Majzoub, Molecular Biology of the HPA axis.
Mon	2-Oct	Brain-Endocrine-Stress review	KJ Kovacs et al., 2005, Psychological and physiological stressors; I Akirav and G Rickett-Levin, 2005, Involvement of the Amygdala in the neuroendocrine and behavioral consequences of stress.
Mon	9-Oct	Stress & Immunity reviews	E Sternberg, 2006. Neural regulation of innate immunity Elenkov et al., 2005, Cytokine Dysregulation, Inflammation and Well-Being
Mon	16-Oct	Stress & Immunity reviews	Calcagni and Elenkov, 2005, Stress system activity, innate and T-helper cytokines, and susceptibility to immune-related diseases Salak-Johnson & McGlone 2006 review;
Mon	23-Oct	Exam	
Mon	30-Oct	Student papers	
Mon	6-Nov	Student papers	
Mon	13-Nov	Student papers	
Wed	15-Nov	Student papers	
Mon	27-Nov	Student papers	
Mon	4-Dec	Final	

Potential Student Papers:

- 1) Salak-Johnson, J. L., J. J. McGlone and R. L. Norman. 1996. In vivo glucocorticoid effects on porcine natural killer cell activity and circulating leukocytes. *J. Animal Science*. 74:584-592.
- 2) Salak-Johnson, J. L., J. J. McGlone, C. S. Whisnant, R. L. Norman and R. R. Kraeling. 1997. Intracerebroventricular porcine corticotropin-releasing hormone and cortisol effects on pig immune measures and behavior. *Physiology & Behavior*. 61:15-23.
- 3) Penturf, M. E., J. J. McGlone and J. A. Griswold. 1997. Lipopolysaccharide-induced enhancement of natural killer cell cytotoxicity: Comparison of rats fed menhaden, safflower and essential fatty acid deficient diets. *J. Nutritional Immunology*. 5(2):47-56.
- 4) McGlone, J. J., D. L. Anderson and R. L. Norman. 2001. Floor Space Needs for Laboratory Mice: BALB/cj Males or Females in Solid-bottom Cages with Bedding. *Contemporary Topics in Laboratory Animal Science*. 40:21-25.
- 5) Hulbert, L. and J. J. McGlone. 2006. Evaluation of Drop vs. Trickle Feeding Systems for Crated or Grouped Penned Gestating Sows. *J. Anim. Sci.* 84:1004-1014
- 6) Ting STL, B Earley, MA Crowe. 2004. Effect of cortisol infusion patterns and castration on metabolic and immunological indices of stress response in cattle. *Dom Anim Endo* 26:329-349.
- 7) Gupta S, B Earley, STL Ting, MA Crowe. 2005. Effects of repeated regrouping and relocation on the physiological, immunological, and hematological variables and performance of steers. *J. Anim. Sci.* 83:1948-1958.
- 8) Takamatsu HH, MS Denyer, C Stirling, S Cox, N Aggarwal, P Dash, T E Wileman, P V Barnett. 2006. Porcine $\gamma\delta$ T cells: Possible roles on the innate and adaptive immune responses following virus infection. *Vet Immunol Immunopathol* 112:49-61.
- 9) Díaz MA, N Villalobos, A de Aluja, G Rosas, E Gómez-Conde, P Hernández, C Larralde, E Sciutto, G Fragoso. 2003. Th1 and Th2 indices of the immune response in pigs vaccinated against *Taenia solium* cysticercosis suggest various host immune strategies against the parasite. *Vet Immunol Immunopathol* 93:81-90.
- 10) Caroprese M, M Albenzio, G Annicchiarico, A Sevi. 2006. Changes occurring in immune responsiveness of single- and twin-bearing Comisana ewes during the transition period. *J Dairy Sci* 89:562-568.
- 11) Hangalapura, BN., Nieuwland, MGB., de Vries Reilingh, G., van den Brand, H., Kemp, B., Parmentier, HK. 2004. Durations of cold stress modulates overall immunity of chicken lines divergently selected for antibody response. *Poult. Sci.* 83:765-775.
- 12) Geverink, NA., Parmentier, HK., de Vries Reilingh, G., Schouten, WGP., Gort, G., Wiegant, VM. 2004. Effect of response to backtest and housing condition on cell-mediated and humoral immunity in adult pigs. *Physiol. Behav.* 80:541-546.
- 13) Tuchscherer, M., Kanitz, E., Puppe, B., Tuchscherer, A., Stabenow, B. 2004. Effects of postnatal social isolation on hormonal and immune responses of pigs to an acute endotoxin challenge. *Physiol. Behav.* 82:503-511.
- 14) Stull, CL., Rodiek, AV. 2000. Physiological responses of horses to 24 hours of transportation using a commercial van during summer conditions. *J. Anim. Sci.* 78:1458-1466.
- 15) De Groot, J., Ruis, MAW, Scholten, JW., Koolhaas, JM., Boersma, WJA. 2001. Long-term effects of social stress on antiviral immunity in pigs. *Physiol. Behav.* 73:145-158.

- 16) McGlone, J. J., E. A. Lumpkin and R. L. Norman. 1991. ACTH stimulates natural killer cell activity. *Endocrinology*. 129:1653-1658.
- 17) Lumpkin, E. A., J. J. McGlone, J. L. Sells and J. M. Hellman. 1993. Modulation of murine natural killer cell cytotoxicity by dietary fish oil. *J. Nutritional Immunology* 2:43-53.
- 18) McGlone, J. J., J. L. Salak, E. A. Lumpkin, R. I. Nicholson, M. Gibson and R. Norman. 1993. Shipping stress and social status effects on pig performance, plasma cortisol, natural killer cell activity and leukocyte numbers. *J. Animal Science*. 71:888-896.
- 19) Morrow-Tesch, J. L., J. J. McGlone and R. L. Norman. 1993. Consequences of restraint stress on natural killer cell activity, behavior, and hormone levels in Rhesus Macaques (*Macaca mulatta*). *Psychoneuroendocrinology*. 18:383-395.
- 20) Salak, J. L., J. J. McGlone and M. Lyte. 1993. Effects of in vitro adrenocorticotropin hormone, cortisol and human recombinant interleukin-2 on porcine neutrophil migration and luminol-dependent chemiluminescence. *Veterinary Immunology and Immunopathology*. 39:327-337.
- 21) McGlone, J. J., J. L. Salak-Johnson, R. I. Nicholson and T. Hicks. 1994. Evaluation of crates and girth tethers for sows: reproductive performance, immunity, behavior and ergonomic measures. *Applied Animal Behaviour Science*. 39:297-311.
- 22) Morrow-Tesch, J. L., J. J. McGlone, J. L. Salak and R. J. Hurst. 1994. Heat and social stress effects on pig leukocyte numbers, mitogen-induced lymphocyte proliferation, antibody synthesis and plasma immunoglobulin G concentration. *J. Animal Science*. 72:2599-2609.
- 23) Penturf, M, J. J. McGlone and J. A. Griswold. 1996. Modulation of immune response in thermal injury by essential fatty acid diet. *J. Burn Care and Rehabilitation*. 17:464-470.
- 24) Elodie Merlot, Elisabeth Moze, Alessandro Bartolomucci, Robert Dantzer and Pierre J. Neveu. 2004. The rank assessed in a food competition test influences subsequent reactivity to immune and social challenges in mice. *Brain Behav. Immun*. 18:468-475
- 25) Tuchscherer M, Kanitz E, Puppe B, Tuchscherer A, Stabenow B. 2004. Effects of postnatal social isolation on hormonal and immune response of pigs to an acute endotoxin challenge. *Physiol. Behav*. 82:503-511.
- 26) Grippo AJ, Francis J, Beltz TG, Felder RB, Johnson AK. 2005. Neuroendocrine and cytokine profile of chronic mild stress-induced anhedonia. *Physiol. Behav*. 84:697-706.
- 27) deGroot J, Boersma WJ, Scholten JW, Koolhaas JM. 2002. Social stress in male mice impairs long-term antiviral immunity selectively in wounded mice. *Physiol. Behav*. 75:277-85.
- 28) Kiank C, Holtfreter B, Starke A, Mundt A, Wilke C, Schutt C. 2006. Stress susceptibility predicts the severity of immune depression and the failure to combat bacterial infections in chronically stressed mice. *Brain Behav. Immun*. 20:359-68