

# **GRADUATE STUDIES IN ANIMAL AND POULTRY SCIENCES AT VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY**

## **GENERAL INFORMATION**

The Department of Animal and Poultry Sciences at Virginia Tech offers the M.S. and Ph.D. degrees. Students may specialize in the areas of genetics, genomics, immunology, management, molecular biology, muscle biology, nutrition, physiology, and product quality assurance. M.S. students may also specialize in the area of livestock or poultry management. Interdisciplinary and interdepartmental programs are encouraged and students are given wide latitude to develop customized programs of study directed toward specific career goals. The department has 23 faculty members who serve the needs of about 500 undergraduate and about 40 graduate students.

The College of Agriculture and Life Sciences at Virginia Tech has a total enrollment of 1,372 undergraduate and 233 graduate students. The College is composed of 10 academic departments and offers comprehensive programs in instruction, research and extension.

Virginia Tech is a Land-Grant University. Founded in 1872, it has the largest student body in Virginia with more than 21,000 undergraduate students. As a comprehensive research university, Virginia Tech is committed to serving the needs of people within the Commonwealth of Virginia and beyond. Graduate education is an integral part of Virginia Tech's overall mission with a graduate enrollment of more than 3,600 students. With an instructional faculty of 1,410 in eight academic colleges and an annual research budget of more than \$130 million, Virginia Tech is nationally recognized for its programs in teaching, research and public service.

International programs are an important part of the mission of Virginia Tech. Currently more than 1,500 international students representing 108 countries are enrolled at the University. Cooperative programs between Virginia Tech faculty and international colleagues abound as the University seeks to take advantage of unique educational opportunities that arise from international collaboration. The Office of International Research and Cooperation, located in the College of Agriculture and Life Sciences, provides leadership in this area, and the Cranwell International Center serves as a focal point for meeting the needs of international students.

Blacksburg, VA, the home of Virginia Tech, is a town of 41,000 people located on a high plateau between the Blue Ridge and Appalachian Mountains. The area is noted for its natural beauty and outdoor recreational opportunities. Comprehensive airline service is provided through Roanoke, VA, 40 miles away. Virginia is a diverse state encompassing Atlantic beaches, forested mountains, areas of great historical significance and thriving urban and cultural centers. Although often thought of in terms of its urban areas, the state produces large numbers of feeder cattle and slaughter hogs, has a thriving horse industry and is one of the largest sheep-producing states in the Eastern U.S. The state also ranks fourth nationally in turkey production, eighth in broiler production and twenty-fourth in egg production. Virginia has a long tradition of national leadership in agriculture, and agriculture remains the state's largest industry.

## FACILITIES

The Department of Animal and Poultry Sciences is located in Litton-Reaves Hall which was constructed in 1981. The Department shares that building with the Department of Dairy Science and maintains close relationships and active collaboration with that department. Laboratory and animal handling facilities in Litton-Reaves Hall provide support for the more intensive elements of the Department's research programs.

State of the art research laboratories supporting all areas of graduate research are located on campus in Litton Reaves Hall. Livestock facilities are located on campus, at the nearby Kentland farm and at outlying agricultural research and extension centers across the state. Biosafety Level 2 animal research facilities are located in Litton Reaves Hall. On campus, a 200-ewe sheep flock, a 300-cow beef herd, a 70-sow swine herd, a five-building turkey center with facilities for >2,000 young and 1,500 adult chickens, a poultry research center with hatchery, brooding and layer facilities, and a herd of 25 horses provide resources for teaching, research and outreach. The historical Kentland Plantation, 20 miles from campus, provides resources for grazing and animal research. The Shenandoah Valley and Southwest Virginia Agricultural Research and Extension Centers, each 100 miles from campus, provide additional resources for beef cattle and sheep research and outreach activities. The Tidewater Agricultural Research and Extension Center in Suffolk supports an active off-campus program in swine research and extension. The Middleburg Agricultural Research and Extension Center, near Washington, D.C., is the centerpiece for a unique program in equine reproduction and forage nutrition.

Extrdepartmental facilities also contribute importantly to the overall program of the Department. These include comprehensive data processing facilities maintained by the Computer Center, an electron microscopy laboratory, DNA sequencing facility, animal health and physiology laboratories in the Virginia-Maryland Regional College of Veterinary Medicine, and embryo manipulation and microinjection facilities for production of transgenic animals in the Department of Dairy Science. The Fralin Biotechnology Center has a shared confocal microscope facility.

For further information about the Department of Animal and Poultry Sciences, visit our web page at <http://www.apsc.vt.edu>.

## FACULTY

### ***M. A. Cline***

B.S., M.S., Ph.D., Virginia Tech, 1999, 2002, 2005

Phone: 540-231-4477      Email: [macline2@vt.edu](mailto:macline2@vt.edu)

The overarching goal of Dr. Cline's research program is to explain appetite regulation and to inspire the next generation of neurobiologists. His group studies neurotransmitters that are associated with the perception of hunger and satiety with a particular interest at the diencephalon and myelencephalon level. The animal models most commonly used are chicks including those from lines that have undergone selection for body weight. These lines consist of anorexic and obese individuals. From an agricultural standpoint, the results of their research may contribute to increased production efficiencies in chickens. Their research findings may also eventually contribute to the pharmacological cure for anorexia or obesity in a variety of species, including humans. They were the first to report the appetite-associated roles of seven

neurotransmitters in any species and we have contributed to the elucidation of other mechanisms of appetite adjustment.

***R. A. Dalloul***

B.S.: American University of Beirut (Lebanon), 1993

M.S.: American University of Beirut (Lebanon), 1995

Ph.D.: University of Maryland (College Park), 2002

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Dr. Dalloul's research goals are directed towards better characterizing the host-pathogen interactions in the context of host immunity and resistance to pathogens, with emphasis on poultry gastrointestinal immunity and overall health. Also of particular interest is the stimulation of avian mucosal immunity and investigating the underlying mechanisms of mucosal immune responses to dietary and environmental stimuli. Technologies such as microarrays, real-time PCR, and flow cytometry help dissect the molecular and cellular processes of immunity to such antigenic challenges. Dr. Dalloul's Avian Immunobiology Laboratory tackles such challenges employing both basic and applied methodologies, thus exposing students to the most fundamental as well as the whole-animal approach of research.

***D. M. Denbow***

B.S.,M.S.: University of Maryland, 1975, 1977

Ph.D.: North Carolina State University, 1980

Phone: 540-231-6843      Email: denbowdm@vt.edu

Dr. Denbow's research is in the areas of physiology and management of poultry. Specific areas of interest include food intake regulation, dietary effects on behavior, effects of gut microflora on obesity and use of medicinal plants as substitutes for antibiotics. Considerable research has been conducted on the role of various neurotransmitters on food intake regulation within the brain, and how diet can influence these neurotransmitter levels and thereby alter behavior. Such studies involve injection of neurotransmitters directly into the central nervous system and measurement of neurotransmitter levels in response to various manipulations. Recent research has also focused on whether alterations in gut microflora are associated with changes in growth or obesity. In addition, research is also being conducted on the use of plants and their products as possible substitutes for antibiotics.

***Ben Dorshorst***

B.S.: University of Wisconsin – Madison, 2005

Ph.D.: North Carolina State University, 2009

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Research in the Dorshorst lab focuses on genetic mechanisms underlying basic developmental processes affecting morphological variation, pigmentation and patterning in avian and mammalian domestic agricultural animal species. This work often focuses on single gene traits representing a mutation that was under positive selection during animal domestication or breed creation. Recent studies are documenting a large role for structural genomic variation (deletions, duplications, rearrangements) of the genome in causing these types of single gene traits with large phenotypic effects. The degree of involvement of structural genomic variation on economically important polygenic traits like milk or meat production is an area of active research interest in the Dorshorst lab. Technologies used in this lab include a mix of standard molecular biology techniques such as qPCR for gene expression and genomic copy number analysis, DNA sequencing by conventional capillary based and “next-gen” massively parallel methods and high density SNP genotyping for linkage and association based genetic mapping.

Research projects in the Dorshorst lab typically entail an equal mix of hands on animal, bench molecular biology and bioinformatics type work.

**Alan D. Ealy**

B.S. Penn State University, 1987

M.S. Michigan State University, 1990

PhD University of Florida, 1994

Phone: 540-231-4425      Email: ealy@vt.edu

Dr. Ealy's laboratory is interested in learning more about the molecular and cellular events that dictate pregnancy outcome and neonatal health in cattle, sheep and humans. The laboratory studies early embryo development, lineage specification and placental development and differentiation. This work focuses on uncovering embryo-uterus interactions that are needed for the establishment and maintenance of pregnancy. The laboratory also examines how maternal and environmental events impact the developmental origins of health and disease. Students who study in Dr. Ealy's laboratory receive training that prepares them for academic and industry careers in reproductive physiology, developmental biology and biomedical science.

**Samer W. El-Kadi**

B.S.: Agriculture, American University of Beirut, Lebanon, 1998

M.S.: Poultry Science, American University of Beirut, Lebanon, 2000

Ph.D.: Animal Science, University of Maryland, 2006

Phone: 540-231-0376      Email: elkadi@vt.edu

My research interest is primarily to elucidate the underlying factors that contribute to macronutrient metabolism. My research is centered on two areas. One research area has focused on understanding why amino acids are catabolized excessively by splanchnic tissues (mainly liver and intestines), and whether dietary or physiologic factors such as amino acid supplies or muscle growth could affect their metabolism. To get insight into the partitioning of amino acids to anabolic and catabolic pathways we are using the multi-catheterized ruminant model and primary epithelial cell culture in combination with stable isotope dilution and <sup>13</sup>C-mass isotopomer distribution analysis (<sup>13</sup>C-MIDA) techniques. Another area has focused on investigating the *in vivo* regulation of protein turnover in growing pigs. To achieve this goal we are using a multifaceted approach that combines protein expression and targeted metabolite analyses to measure protein synthesis and degradation in muscles. The immediate objectives are to improve our understanding of how amino acids are utilized and how protein synthesis and degradation are controlled in the growing animal. The overarching goal is to identify areas where novel dietary or management interventions could be used to enhance growth and improve the efficiency with which amino acid are deposited in muscles.

**M. J. Estienne**

B.S., M.S.: Virginia Polytechnic Institute and State University, 1982, 1984

Ph.D.: University of Georgia, 1987

Phone: 757-657-6450, ext. 408      Email: mestienn@vt.edu

The broad objective of Dr. Estienne's research is increasing reproductive efficiency in swine operations employing artificial insemination. Basic and applied studies are conducted that focus on enhancing semen quality and libido in boars and synchronizing estrus and ovulation in gilts. The program also endeavors to evaluate the interaction between nutrition and reproduction in swine.

**D. E. Eversole**

B.S.: The Ohio State University, 1973  
Ph.D.: Michigan State University, 1978  
Phone: 540-231-4738      Email: deversol@vt.edu

Dr. Eversole's areas of research include applied studies in mineral supplementation, cow/calf management, and feedlot nutrition. The research is directly applicable to the beef cattle industry and has elucidated solutions to problems affecting the efficacy of beef cattle performance and management. Considerable work has focused on vitamin E, selenium, copper, and zinc supplemental levels in salt-mineral mixtures for weaned calves, gestating cows, and growing bulls. Studies are conducted to examine the effects of vitamin and trace-mineral supplementation on immune function in beef cattle.

**D. E. Gerrard, Department Head**

B.S.: Purdue University, 1983  
M.S.: Purdue University, 1985  
Ph.D.: Purdue University, 1992  
Phone: 540-231-9157      Email: dgerrard@vt.edu

The overall goal of Dr. Gerrard's laboratory is to understand those mechanisms responsible for the controlling the growth of animals. More specific efforts to that end are to: 1) understand muscle energy metabolism especially as mediated by the enzyme AMPK, the major energy sensor in most cells; 2) define the cellular mechanisms responsible for controlling muscle fiber type, a determinant of muscle growth; and 3) establish the signaling pathways responsible for muscle satellite cell activation, growth and fusion into existing muscle fibers, requisites of muscle growth.

**E. R. Gilbert**

B.S.: Virginia Tech, Wildlife Biology  
M.S. and Ph.D.: Virginia Tech, Animal Nutrition  
Phone: 540-231-4750      Email: egilbert@vt.edu

My research is focused on the molecular and cellular signaling mechanisms associated with energy metabolism in skeletal muscle and adipose tissue across different species. This research is aimed at improving animal production traits and meat quality, and at developing strategies to reduce the prevalence of obesity and diabetes. I am interested in epigenetic modifications and interactions of genetic background, diet and development on regulation of selective lipid deposition, insulin resistance and adipocyte turnover. Specific endeavors include 1) elucidating mechanisms underlying food intake and adiposity in chickens and 2) investigating the use of flavonoids as anti-obesity/diabetic compounds through improving insulin resistance in adipose tissue and skeletal muscles.

**S. P. Greiner: Extension Specialist, Beef and Sheep**

B.S.: Iowa State University, 1988  
M.S.: Michigan State University, 1993  
Ph.D.: Iowa State University, 1997  
Phone: 540-231-9159      Email: sgreiner@vt.edu

Dr. Greiner is responsible for developing statewide educational programs and leadership in beef cattle genetics as well as sheep production and management. His programs focus on applied strategies for genetic improvement, carcass merit evaluation and improvement, value-added management opportunities, and animal identification. Scott's current research interests involve the application of animal identification technologies for beef cattle, use of ultrasound in beef and sheep breeding programs, beef cattle retained ownership strategies, and evaluation of hair sheep genetics.

**A. F. Harper: Director, TAREC, and Extension Animal Scientist, Swine**

B.S.,M.S.,Ph.D.: Virginia Polytechnic Institute and State University, 1979,1982,1992

Phone: 757-657-6450, ext. 410 Email: alharper@vt.edu

Dr. Harper is responsible for the development and dissemination of educational programs in the area of swine production and management. Target clientele for this program include local Virginia Extension Agents, swine producers and related swine industry people. Potential graduate opportunities in this program include production oriented swine research on commercial farms and at the Virginia Tech-Tidewater Agricultural Research and Extension Center.

**Honglin Jiang**

B.S.: Nanjing University, 1987

M.S.: Nanjing Agricultural University, 1993

Ph.D.: Purdue University, 1997

Phone: 540-231-1859 Email: hojiang@vt.edu

Dr. Jiang's research is in the areas of Animal Physiology and Functional Genomics. He is interested in identifying genes that play important roles in animal growth and reproduction, and characterizing the function and control of these genes. He is particularly interested in genes that are expressed in hypothalamus, pituitary, liver and ovary that are involved in the neuroendocrine and endocrine control of growth, metabolism and reproduction. Dr. Jiang's research involves a variety of techniques including those of molecular biology, genomics (bioinformatics and microarray), and whole animal physiology. His current research focuses are on 1) delineating the molecular mechanisms for liver-specific, hormonal and nutritional control of the growth hormone receptor gene expression, 2) identifying and characterizing ovarian genes that control follicular development, and 3) identifying and characterizing hypothalamic genes that control anterior pituitary hormone secretions.

**Sally Johnson**

B.S.: Michigan State, 1984

M.S.: Michigan State, 1987

Ph.D.: University of Arizona, 1993

Phone: 540-231-0776 Email: sealy@vt.edu

The normal processes that control the growth and development of soft tissues often participate in the reparative period following tissue damage. Intimate to both events is the engagement and contribution of adult stem cells. Using horse and mouse models, the laboratory seeks to uncover the biological mechanisms that mediate tendon and muscle progenitor cell activity during periods of growth and damage repair. Specific projects ongoing in the laboratory include development of tendon progenitor cell lines as tools for discovery research, identification of transcriptional networks that regulate stem cell plasticity, and niche regulation of stem cell activity during post-exercise recovery.

**R. M. Lewis**

B.S.: University of California-Davis, 1981

M.S.: Texas A&M, 1989

Ph.D.: Virginia Polytechnic Institute and State University, 1990

Phone: 540-231-1906      Email: rmlewis@vt.edu

Dr Lewis's research interests are in animal breeding and genetics with three main themes: (i) assessing risk when making selection decisions; (ii) devising strategies and objectives for breeding schemes; and, (iii) predicting animal performance, including growth, maternal merit and disease resistance under different conditions of genetic selection and nutrition. His work involves theory, simulation and field studies. Dr. Lewis is also investigating ways gene-assisted selection interacts with more classical quantitative selection regimes, using gene expression in hepatic tissue under environmental challenges, such as beneficial nutrients and toxicants, as the model system. Dr. Lewis's experimental and field work historically have focused on sheep, which continues through close collaboration with colleagues in the United Kingdom. His species interests have expanded to consider mice as part of his toxicogenomics program and, more recently, poultry. Dr. Lewis teaches graduate level courses in Animal Breeding and Genetics, including matrix algebra for the biological sciences, stochastic simulation modeling in quantitative genetics, and design of economic selection indices. He is also leading a national initiative to develop a graduate-level distance learning curriculum in Animal Breeding and Genetics.

**Mark McCann**

B.S.: North Carolina State University, 1980

M.S.: North Carolina State University, 1983

Ph.D.: Texas Tech University, 1986

Phone: 540-231-9153      Email: mmccnn@vt.edu

Research interests include forage, nutritional and management options for cattlemen and the impact on the sustainability and profitability of beef cattle production.

**A. P. McElroy**

B.S., M.S., PhD.: Texas A&M University, 1993, 1995, 1998

Phone: 540-231-8750      Email: amcelroy@vt.edu

Dr. McElroy is involved in the development and applications of research to address concerns of the broiler industry and improve efficiency and profitability of broiler production. Research interests are in the areas of physiology, immunology, and endocrinology and how the systems interact with regard to disease resistance. Her primary research program involves the investigation of nonclassical mechanisms of immunity, with particular emphasis on intestinal mechanisms of immunity to pathogens. Current research includes the identification and investigation of effector cells in the chicken gut in response to intestinal pathogens, the specificity and role of these responses in the development of partial or complete immunity to the pathogen, and how these cellular responses can be modulated and applied for improved vaccine development, bird health, and productivity.

**Michelle Rhoads**

B.S.: University of Missouri - Columbia, Animal Science

M.S.: Cornell University, Animal Science

Ph.D.: University of Missouri - Columbia, Animal Science

Phone: 540-231-4740 Email: rhoadsm@vt.edu

Current research interests focus on the fertility of early lactation dairy cattle. Specific interests include: 1) the nutritional and metabolic regulation of dairy cow fertility, and 2) how gene expression within the reproductive tract changes during the estrous cycle and from non-pregnancy to pregnancy. The primary aim is to elucidate factors involved in the apparent decrease in dairy cow fertility, including changes in growth hormone, insulin-like growth factor-I and ghrelin.

**R. P. Rhoads**

B.S.: Cornell University, Animal Science

M.S.: Cornell University, Animal Science

Ph.D.: Cornell University, Animal Science

A.S.: Cayuga Community College, Math and Science

Phone: 540-231-5134 Email: rhoadsr@vt.edu

My research program investigates the interaction between physiological stressors (e.g. disease, nutrition, immune and thermal challenges) and molecular mechanisms governing development, growth, and metabolism. Currently, two specific areas underpin my laboratory's research interests and focus. First, we are examining the cellular basis for skeletal muscle development, growth or regeneration during disease or conditions noted for poor skeletal muscle performance or atrophy. Second, the laboratory is focused on the impact of environmental influences on the regulation of energy metabolism and physiology on whole body and cellular levels. To accomplish our research priorities, my laboratory uses a combination of in vivo and in vitro models based on domestic and rodent species coupled with molecular and physiological techniques to answer key experimental questions and maintain a productive, extramurally funded research program.

**E. J. Smith**

B.S.: University of Sierra Leone, 1984

M.S.: Oregon State University, 1989

Ph.D.: Oregon State University, 1991

Phone: 540-231-6797 Email: esmith@vt.edu

Dr. Smith's research, teaching and experiential learning interests involve the development of genomic tools essential for understanding the hereditary basis of economically important poultry traits. These tools have primarily involved random and gene-based DNA markers essential for developing high-density genetic maps in the turkey and chicken. The tools developed have also permitted comparative genome analysis with genetic-information rich species including human and mouse. Current research efforts involve the development of microsatellite- and EST-based turkey genome map as well as the use of ESTs developed from a normalized chicken cDNA library to characterize the chicken genome. The chicken ESTs are also being used to compare genomes of economically important poultry, to characterize commercialized poultry lines for single nucleotide polymorphisms, and for linkage disequilibrium analysis of the chicken genome.



**R. K. Splan**

B.S.: Michigan State University, 1994

M.S.: University of Nebraska-Lincoln, 1996

Ph.D.: University of Nebraska-Lincoln, 1999

Phone: 540-687-3521 ext 26      Email: rsplan@vt.edu

Dr. Splan's areas of research include equine breeding and genetics, conformation and biomechanics, and applied studies in equine management. Specific interests include genetic evaluation and selection procedures for performance horses and characterization of founder contributions and genetic variability in equine populations. She is also keenly interested in educational research and directs graduate programs in equine science education.

**E. A. Wong**

B.S.: Massachusetts Institute of Technology, 1976

Ph.D.: University of California, San Diego, 1981

Phone: 540-231-4737      Email: ewong@vt.edu

Dr. Wong's principal responsibilities are to teach and conduct research in the application of molecular biology techniques to the improvement of farm animals. Research projects in the laboratory involve an analysis of the regulation of expression of genes involved in growth and reproduction. In particular, his laboratory has cloned and characterized the cDNAs and genes encoding turkey prolactin and the transcription factor Pit-1 and cDNAs encoding peptide transporter proteins from ruminants and nonruminants. He is interested in determining the molecular mechanisms which control expression of these genes and ultimately utilizing this knowledge to alter growth or reproductive traits of farm animals.

**C. M. Wood**

B.S.: University of Florida, 1979

M.S.: Mississippi State University, 1982

Ph.D.: Iowa State University, 1986

Phone: 540-231-6937      Email: piglady@vt.edu

Dr. Wood's responsibilities include undergraduate advising and teaching (Livestock Handling Lab, Swine Production, Sophomore Seminar, and coordinating capstone experiences), research in swine genetics and management, and swine extension work. Current animal research focuses on swine management techniques and viability of smaller swine enterprises. Other areas of interest include the pedagogy of teaching, learning and advising in the animal sciences.

## **ADMISSION PROCEDURES AND REQUIREMENTS**

Application materials can be requested directly from the Department or from the Graduate School. Prospective applicants are encouraged to contact the Department early in the application process in order to allow interaction with prospective major professors. Applications and all related materials for admission must reach the Graduate School Office at least eight weeks before the beginning of the semester in which enrollment is requested.

Minimum requirements for acceptance are based upon the student's grade point average and on the results of the Graduate Record Examination (GRE). The Graduate Record Examination is required for all applicants. Consideration for admission to the Graduate School is contingent upon receipt of:

- 1) an official academic transcript showing courses taken and degree(s) earned;
- 2) evidence of a Bachelor's degree from a four-year or equivalent accredited college or university;
- 3) documentation of at least a 3.0 Grade Point Average (on a 4.0 scale) for the last half of the credits earned for the undergraduate degree; or, the completion of 12 graduate course credits with at least a 3.0 Grade Point Average.

Students who do not meet the admission requirement of a 3.0 Grade Point Average may be considered for Provisional Acceptance based on performance on the Graduate Record Exam or other mitigating factors. Requirements and funding restrictions for students admitted with Provisional status are described in detail on the Graduate Education website at [www.grads.vt.edu](http://www.grads.vt.edu).

The results of the analytical writing section of the GRE will be considered in admission decisions, but there is no minimum score for admission. GRE subject tests are not required.

We attempt to evaluate both U.S. and international students on the same quality standards and neither favor nor discriminate against either group in our acceptance policy. International students whose first language is not English are required to submit results of the Test of English as a Foreign Language (TOEFL) and to meet University requirements of certification of competence in English. A TOEFL score of 550 (paper) or 213 (computer) is required by the Graduate School. A minimum TOEFL score of 550 paper-based (PBT), 213 computer-based (CBT) or 80 internet-based test (iBT) is required for consideration of the application. On the iBT, subscores of at least 20 on each subtest (Listening, Speaking, Reading, and Writing) are required for admission. A minimum IELTS score of 6.5 is required for admission.

## **FINANCIAL AID, STIPENDS AND FEES**

Graduate teaching and research assistantships are available from the Department on a competitive basis. Most involve a one-half-time (20 hr/wk) commitment to the Department. Teaching assistantships are awarded for the academic year. Support during the summer months may be available from the research program of the major professor. Students who receive graduate teaching assistantships normally are required to assist with one course/semester during the academic year. All assistantship students will assist with the research program of their major professor and with other departmental activities. The background, level of experience and educational goals of the student are considered in assigning specific responsibilities in order to maximize the

student's opportunities for professional development. All students must assist with the department teaching program for a minimum of one semester per degree.

Base monthly assistantship stipends (effective August 10, 2013) range from \$1,674 for first-year M.S. students to \$1,821 for Ph.D. students who have completed the preliminary examination. Costs (per semester) for graduate students to attend Virginia Tech for 2013-14 include in-state tuition of \$5,592.50, technology fee of \$33.00, library fee of \$10.00, comprehensive fees (including health center, student center, athletic and bus fees) of \$876.00, and out-of-state tuition of \$5,480.50. Out-of-state students must also pay a \$302 capital fee. Waivers of tuition, but not of the \$876 comprehensive fees or the capital fee, are provided students holding graduate assistantships and fellowships.

Students who wish to be considered for academic-year assistantships beginning in the Fall Semester (August) must have their **completed applications (including transcripts, letters of reference, GRE scores, and, if necessary, TOEFL scores)** received by March 1 of that year. Students who wish to be considered for assistantship funding beginning with the Spring Semester (January) must have completed applications received by August 1 of the previous year.

#### For Additional Information

Graduate Coordinator  
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Virginia Tech (0306)  
Blacksburg, VA 24061

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**Online application: <https://www.applyweb.com/apply/vtechg/index.html>**