Genetics
Discipline Handbook
2020-2021

The information provided in this document serves to supplement the requirements of the Graduate School of Biomedical Sciences detailed in the UNTHSC Catalog with requirements specific to the Genetics discipline.

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1. Description of the Genetics Discipline

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Graduate Faculty: Allen; Barber; Budowle; Cihlar; Coble; Ge; Phillips; Planz; Woerner

Genetics is a broad interdisciplinary field that unites biochemistry, microbial and cellular biology, molecular processes, biotechnology, computational biology, biogeography and human disease to gain an integrated understanding of environmental and clinical observations. The Genetics discipline offers training in analytical techniques and computational methods necessary for studies in the different fields of applied genetics. Our faculty have broad research interests as most analytical approaches to genetics studies are applicable to myriad biological processes. Faculty programs are funded by multiple sources including the federal government, state government, private foundations and industry, and collaboration between the various UNTHSC programs and schools is strongly supported. Students may undertake research in areas such as cancer genetics, computational genetics, pharmacogenetics, evolutionary genetics, medical genetics, microbial genetics, and many other interrelated disciplines.

The faculty of the Genetics discipline have identified Student Learning Outcomes specific to the discipline. In addition to the GSBS competencies graduates will:

- Demonstrate mastery of cutting edge research approaches in genetics/genomics;
- Describe, critically evaluate, and apply current theoretical perspectives in genetics;
- Demonstrate proficiency in analytical and statistical procedures appropriate for genetic analyses; and
- Describe role of genetic and genomic assessment in clinical practice, including applications in disease screening, diagnosis, and pharmacogenetics.

Students may enter the program with a variety of academic backgrounds, provided they have fulfilled prerequisite courses in molecular biology, biochemistry, genetics, and statistics, or their equivalent and have completed their required rotations with a minimum of one (1) Genetics faculty member. Experience in laboratory methods, computer programming and bioinformatics is strongly recommended. Students wishing to enter the discipline should meet with the Graduate Advisor at the earliest possible time to obtain information on the discipline and guidance in selecting lab rotations and potential mentors. Students may request to join the discipline at the end of the first semester. Students must have completed the first semester GSBS core courses and been enrolled in a rotation with a minimum of one Genetics faculty member prior to submitting a discipline change form to the GSBS Dean's Office. Although the program has several uniform course requirements, we try to work with each student in tailoring a program that fits his/her particular interests and goals. Students entering Genetics must enroll in the two discipline specific courses: MIMG 6301-Molecular Genetics and MIMG 6302-Medical Genetics for the Spring semester of their first year. Students are expected to score a minimum B grade in the GSBS core courses (BMSC 6200, BMSC 6201, BMSC 6202, BMSC 6203, and BMSC 6204). A student who receives a single "C" in a GSBS core course but

maintains an overall GPA of 3.0 or better after the first semester will be permitted to enter the disciple. Acceptance into the Genetics Program is dependent on the signing a Designation/Compact between the graduate student and a research advisor/mentor and completion of the Discipline Change Form.

Students in Genetics are required to enroll and participate in the Genetics Journal Club course (MIMG 5170) beginning in the Spring semester and during all long semesters for the duration of their enrollment. The faculty encourage students to explore the other areas of biomedical science that are available at UNTHSC. Students are advised to discuss course selection with their mentor and advisors to determine the courses from Genetics, as well as other disciplines, that are most advantageous for achieving their individual goals and objectives.

Students will receive extensive training in the foundations and techniques of contemporary molecular genetics in their laboratories and through elective courses. Students will perform original, publishable research, and present their research findings at scientific meetings. Doctoral students are required to have a minimum of one paper published in their dissertation research area prior to applying to defend their dissertation. In addition, students are required to present an update on their research and solicit suggestions during the Department of Microbiology, Immunology and Genetics Works in Progress (WIPs) (MIMG 5140) sessions held weekly. With the consent of their research mentor, students present their research progress at the annual UNTHSC Research Appreciation Day (RAD). Students should be aware that the timeline for their successful completion of the degree program will vary depending upon the nature of their research, their time management skills and their level of academic development.

Graduates with advanced degrees in Genetics typically find employment in higher education, industry and government agencies.

2. Graduate Faculty and their Research Interests

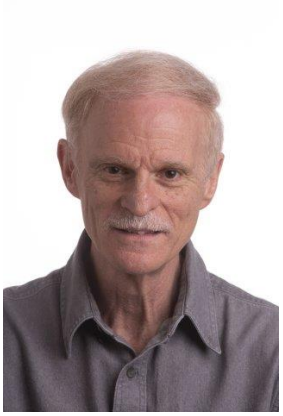
Michael Allen, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics

Research in the Allen Laboratory focuses on microbiology of vector-borne diseases and microbiome-host studies of human and animal systems. The former includes testing of all ticks submitted to the state of Texas for the presence of specific bacterial pathogens, and research into the factors influencing disease transmission and pathology. Microbiome research includes investigation of complex bacterial communities and their interactions with a wide variety of hosts (humans, arthropod vectors of disease, etc.), defining factors that disrupt or support microbial community assembly and structure, exploring community dynamics in polymicrobial diseases of different organ systems (e.g. gut, lung), development of genetically engineered probiotics for the treatment of disease, and applications of microbiome research to problems in forensic science.

Robert Barber, Ph.D.
Associate Professor, Pharmacology & Neuroscience

Research projects in Dr. Barber's group include investigations of how DNA methylation and microRNA expression impact risk for neurodegeneration; efforts to use patterns of DNA variation to predict the age at onset of Alzheimer's disease (AD); and scanning the intestinal microbiome to determine how an individual's profile of gut bacteria may impact their cognitive ability as they age. I am also interested in AD pathophysiology among Mexican Americans and how disease mechanisms differ between members of this underrepresented ethnic group and Caucasians. Students in my lab are trained in the analysis of large genetic and biomarker data sets through collaborations with researchers at UNTHSC and other Texas Alzheimer's Research & Care Consortium institutions as well as the University of North Carolina at Chapel Hill. Active collaborative projects are ongoing with Drs. O'Bryant, Allen, Hall, Cunningham and others at UNTHSC; Drs. Sohrabji and Miranda at Texas A&M Health Science Center; Drs. Huebinger and Reisch at UT Southwestern; Drs. Royall and Palmer at UT Health Science Center at San Antonio and Drs. Wilhelmsen and Tilson at the University of North Carolina at Chapel Hill. Work in his lab is focused on personalized medicine. They are interested in how an individual's genetic makeup, epigenetic profile and microbiome impact risk for disease, rate of disease progression or likelihood of responding to various treatment options. Our work is focused on neurodegeneration and dementia (primarily Alzheimer's disease), but many of the tools and discoveries we make can be readily applied to other conditions and treatments.

Bruce Budowle, Ph.D.
Professor, Microbiology, Immunology & Genetics



Forensic genetics traditionally has been dedicated to analysis of human DNA markers for identity purposes to support criminal and civil investigations. However, with the demands of stakeholders and advances in technologies and bioinformatics, there is a substantial expansion of the applications of forensic genetics (or better yet forensic genomics). In addition to identification of humans associated with crime or missing persons due to mass disasters or other crimes, other areas of application include molecular autopsy and microbial forensics. Our research group has an advanced forensic genomics program using cutting edge genomics and technologies to effectively bolster current forensic and biosecurity capabilities. Some areas of interest are: computational genomics and bioinformatics; mixture interpretation; development of genetic diagnostics and detection capabilities; identification of novel genetic markers for human identification; population genetics studies; human microbiome studies for identification purposes; molecular autopsy (i.e. pharmacogenetics); and molecular mechanisms for DNA repair. These research efforts support a healthier and safer society as well as the government in achieving its mission of law enforcement, combatting terrorism, and providing biosafety and preserving national biosecurity.

Michael D. Coble, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics

DNA evidence from crime scenes (including evidence from victims of sexual assault) can often contain mixtures of two or more contributors and can be challenging for the forensic scientist to interpret. Our research focuses on issues associated with DNA mixture interpretation and probabilistic methods of interpretation using software analyses. Other areas of research include haploid marker systems for forensic testing (mitochondrial DNA and Y-chromosome testing), and non-traditional marker systems (e.g. X-chromosomal STRs, insertion-deletion markers, etc.) to increase genetic information from challenged samples.

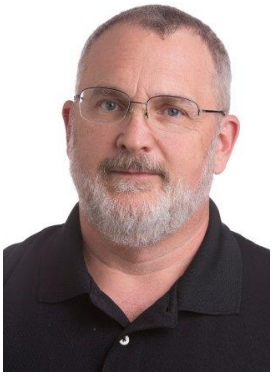
Deanna Cross, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics

Dr. Cross's research interests focus on translating genetic and genomic advances into patient care. Her projects include implementation of family health history tools for improvement of patient care, as well as creation of tools that explain genetic and genomic advances to diverse patient populations. She is particularly interested in identifying and eliminating barriers to implementation of genetic and genomic medicine in populations that have been traditionally underrepresented in genomic research and medical testing. With rapidly growing fields such as epigenetics and genomic sequencing there is a need to determine the clinical utility of burgeoning tests. Dr. Cross utilizes large patient populations to interrogate real world applications for genetics in healthcare. She is particularly interested in the correct application of genetic testing throughout a patient's life from pre-conception through healthy aging.

Nicole Phillips, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics

Dr. Phillips' research interests lie in the study of genetic interactions that contribute to one's risk for developing complex, age-related diseases. The bulk of her wet lab work has focused on the role of mitochondrial genetics in the progression of late onset Alzheimer's disease. She has investigated several indices of mitochondrial DNA integrity as related to disease progression using the longitudinal samples from the Texas Alzheimer's Research and Care Consortium (TARCC). These studies have opened many avenues for further work in this space, which she is currently pursuing here at UNTHSC. In addition to mitochondrial genetics, she has also worked extensively with whole genome data sets. Dr. Phillips served as one of the primary analysts in a genome wide association (GWA) analysis of the same TARCC Alzheimer's disease cohort. This work aimed to identify genomic regions that are associated with the blood-based biomarkers associated with Alzheimer's disease (Sid O'Bryant et al., 2011, Dementia and geriatric cognitive disorders) and regions associated with the mitochondrial DNA integrity indices established in her laboratory. Dr. Phillips continues to build on her prior work with TARCC, using both *in silico* and experimental approaches. While she has found her passion in the study of Alzheimer's disease, she also looks forward to extending her skill set to the study of other age-related, complex diseases. She is currently the Director of Genomics Research for the Osteopathic Research Center here at UNTHSC, where she oversees genetic testing for PRECISION TEXAS, a North Texas low-back pain registry.

John V. Planz, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics



Dr. Planz's research interests are in the areas of molecular evolutionary genetics and population genetics applications for studying inter- and intra-specific diversity and the effects of admixture on energy metabolism, genetic diseases and the genetics aspects of health disparities. Dr. Planz's lab is currently optimizing approaches related to Nanopore sequencing which allow for long read (>10KB) direct sequencing of genomic DNA. These methods will allow for direct phasing of polymorphisms in gene regions, exon/intron junctions and recombination hotspots. These approaches are being applied to mitochondrial genome studies, microbial genome characterization and evaluation of recombination signatures and their biomedical impact in admixed populations, especially Hispanics.

August Woerner, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics

Dr. Woerner is an Assistant Professor in Dr. Budowle's research group. He has a M.S. in Computer Science and Ph.D. in Genetics from the University of Arizona. His research interests are generally in the areas of computation and population genetics, with a focus in forensics, bioinformatics and machine learning. His current research projects run the gamut from streamlining bioinformatics pipelines, making them faster and more user friendly, to machine learning and statistical approaches to processing and calling sequencing data, to inference problems in population genetics and genomics.

Yan Zhang, Ph.D.
Research Assistant Professor, Microbiology, Immunology & Genetics

Dr. Zhang has interests in how the microbiome and host interact in health and disease. Her projects include tick microbiome and disease associated human microbiome, using genomic and metagenomic approaches to investigate the microbiome dynamics and understand its role in disease development (such as tick born disease, Phenylketonuria, Alzheimer's disease, inflammation after severe injury and etc). Dr. Zhang provides services for Next Generation Sequencing using IonTorrent and Miseq platform. She also develops bioinformatics and statistical tools for metagenomic analysis.

3. Requirements

The requirements below are in addition to the GSBS requirements listed in the GSBS Degree Programs chapter of the UNTHSC Catalog.

I Genetics Required Courses

Genetics students are required to take the following discipline specific courses:

MIMG 6301 – Molecular Genetics
MIMG 6302 – Medical Genetics

A student who receives a "C" or "F" in one of the discipline-specific required courses (MIMG 6301 or MIMG 6302) will be allowed to self-remediate the course and still take the oral qualifying exam in the Summer of year 1 or the Fall of year 2. A student who receives two or more "C's" or "F's" in the discipline-specific required courses must retake those courses in their entirety the following year. If the remediating student receives "A's" and/or "B's" upon retaking the courses, they will be allowed to take the oral qualifying exam. Remediation must be completed prior to scheduling the Oral Qualifying Exam. Failure to obtain a minimum B upon retaking in the discipline-specific required courses will result in dismissal from the Genetics Program.

II Journal Clubs and Seminar Courses

Students are required to enroll in each of these courses every long semester until program completion. All MS and PhD students are required to present their research in Seminar in Current Topics (MIMG 5140), also known as "Works in Progress or WIPs," once per year beginning in their second year.

MIMG 5140 Seminar in Current Topics (1SCH)
MIMG 5170 Journal Club in Genetics (1 SCH)

III Advanced Elective Courses and Technique Courses

Students are encouraged to select elective courses from the following and explore offerings from other programs under the advice of their Advisory Committee. (4-6 SCH for M.S. students and 8-10 SCH for Ph.D. students).

MIMG 6303 Statistical Genetics (3 SCH)
Offered on request
MIMG 6304 Introduction to Genomics and Bioinformatics (3 SCH)
Offered Fall odd years
MIMG 6200 Mitochondria and Complex Diseases (2 SCH)
Offered Fall even years
MIMG 5500 Emerging Role of the Microbiome in Health and Disease (2 SCH)
Offered Spring even years
MIMG 6340 Molecular Evolutionary Genetics (2 SCH)

Offered on request

MIMG 6202 Advanced Molecular Biology: Techniques and Principles (2 SCH)
Offered Fall odd years

MIMG 6230 Practical Laser Capture Microdissection (1 SCH)
Offered every Fall

MIMG 6250 Molecular and Cell Biology of Cancer (2 SCH)
Offered every Spring

MIMG 6206 Fundamentals of Microbiology (2 SCH)
Offered every Spring

MIMG 6203 Advanced Cell Biology (2 SCH)
Offered every Spring

NTER 5200 Introduction to Bioinformatics (2 SCH)
Offered every Summer

NTER 6440 Methods in Molecular Biology (4 SCH)
Offered every Summer

4 Degree Plans

M.S. Degree Plan for Genetics

Year 1: Fall

BMSC 6200 Introduction to Experimental Design and Biostatistical Methods	2 SCH
BMSC 6201 Fundamentals of Biomedical Science I	2 SCH
BMSC 6202 Fundamentals of Biomedical Science II	2 SCH
BMSC 6203 Fundamentals of Biomedical Science III	2 SCH
BMSC 6204 Fundamentals of Biomedical Science IV	2 SCH
BMSC 5150 Lab Rotations (2)	2 SCH
	12 SCH

Year 1: Spring

MIMG 6301 Molecular Genetics	2 SCH
MIMG 6302 Medical Genetics	2 SCH
BMSC 5160 Biomedical Ethics	1 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
BMSC 5315 Principles of Scientific Communications	2 SCH
BMSC 5998 Individual Research, Advanced Courses (or 1 addl. lab rotation)	3 SCH
	12 SCH

Year 1: Summer

BMSC 5998 Individual Research	1-6 SCH
Advanced Electives and/or Technique Courses	0-5 SCH
	6 SCH

Year 2: Fall

BMSC 5998 Individual Research	4-8 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	2-6 SCH
	12 SCH

Milestone: Complete Research Proposal

Year 2: Spring

BMSC 5395 Thesis	7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
(continued enrollment in these courses until completion)	**9 SCH**

TOTAL	**51 SCH**

Ph.D. Degree Plan for Genetics

Year 1: Fall

BMSC 6200 Introduction to Experimental Design and Biostatistical Methods	2 SCH
BMSC 6201 Fundamentals of Biomedical Science I	2 SCH
BMSC 6202 Fundamentals of Biomedical Science II	2 SCH
BMSC 6203 Fundamentals of Biomedical Science III	2 SCH
BMSC 6204 Fundamentals of Biomedical Science IV	2 SCH
BMSC 5150 Lab Rotations (2)	2 SCH
	12 SCH

Year 1: Spring

MIGN 6301 Molecular Genetics	2 SCH
MIGN 6302 Medical Genetics	2 SCH
BMSC 5160 Biomedical Ethics	1 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
BMSC 5315 Principles of Scientific Communications	2 SCH
BMSC 5998 Individual Research, Advanced Electives (or w/ 1 additional lab rotation)	3 SCH
	12 SCH

Year 1: Summer

BMSC 6998 Individual Research	1-6 SCH
Advanced Electives and/or Technique Courses	0-5 SCH
	6 SCH

Milestone: Complete Oral Qualifying Exam

Year 2: Fall

BMSC 6998 Individual Research	0-10 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-10 SCH
	12 SCH

Milestone: Complete Research Proposal (Advanced to Candidacy)

Year 2: Spring

BMSC 6998 Individual Research	0-7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-7 SCH
	9 SCH

Year 2: Summer

BMSC 6998 Individual Research	1-6
Advanced Electives and/or Technique Courses	0-5 SCH
	6 SCH

Year 3: Fall

BMSC 6998 Individual Research	0-7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH

MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-7 SCH
	9 SCH
Year 3: Spring	
BMSC 6998 Individual Research	0-7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-7 SCH
	9 SCH
Year 3: Summer	
BMSC 6998 Individual Research	1-6 SCH
Advanced Electives and/or Technique Courses	0-5 SCH
	6 SCH
Year 4: Fall	
BMSC 6998 Individual Research	0-7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-7 SCH
	9 SCH
Year 4: Spring	
BMSC 6998 Individual Research	0-7 SCH
MIMG 5140 Seminar in Current Topics	1 SCH
MIMG 5170 Journal Club in Genetics	1 SCH
Advanced Electives and/or Technique Courses	0-7 SCH
	9 SCH
Year 4: Summer	
BMSC 6395 Doctoral Dissertation	6 SCH
	6 SCH
Year 5: Fall	
BMSC 6395 Doctoral Dissertation	9 SCH
(maintained in continuous enrollment until completed)	**9 SCH**
TOTAL	**114 SCH**

5. Advancement to Doctoral Candidacy

I. Master of Science

Advancement to Master's Candidacy is achieved after successful completion of a research proposal.

The research proposal is a detailed outline of the thesis project. It must include a summary of the proposed project, the hypothesis and aims to be investigated, significance and innovation of the project, research design and methodology to be used, a review of the salient literature that supports or opposes the hypothesis, and potential limitations. To take advantage of the advisory committee's expertise and advice, and to clearly define the project and the committee's expectations, it is imperative that the student meets with his/her advisory committee before preparing the research proposal. **The research proposal should be provided to the advisory committee no later than 14 days prior to the defense.** The formal presentation and defense of the research proposal will only be to the members of the student's advisory committee. The research proposal must be approved by the advisory committee and the Dean prior to registering for Thesis (BMSC 5395). It is expected that M.S. students will complete their Research Proposal in the Fall of year 2. Research Proposal Guidelines and the Research Proposal approval forms are available on the GSBS Forms and Guidelines website.

Research Proposal Guidelines and the Research Proposal approval forms are available on the GSBS Forms and Guidelines website.

Once a master's student has successfully advanced to candidacy, he/she may use "MS Candidate" as a title on any general business correspondence such as business cards, e-mail messages, etc.

II. Doctor of Philosophy

Doctoral students must complete the following two-part process to be advanced to candidacy. First, a program-based qualifying examination, designed and administered by the Program's graduate faculty, must be successfully completed. Second, the student must submit and defend their research proposal to their advisory committee. When successfully completed, the student is advanced to candidacy and may enroll in Doctoral Dissertation (BMSC 6395) in the first long semester immediately following approval of the research proposal and maintain continuous enrollment in this course until dissertation is defended and approved.

A. Qualifying Examination

The qualifying examination within the Genetics Discipline must be successfully completed by the end of Summer of Year 1 or Fall of Year 2. The qualifying examination ensures that a doctoral student has sufficient mastery of fundamental principles in the biomedical sciences to be successful as a Ph.D. candidate and subsequently, as an

independent researcher. Topics included in the oral qualifying examination consist of fundamental understanding of biomedical sciences, genetics, experimental design, statistics and research techniques based on relevant GSBS core courses and the Genetics Program advanced courses.

The qualifying exam will consist of an oral exam administered by the student's advisory committee. The University Member appointed to the student's advisory committee must be in attendance for the oral examination. The student's mentor does not serve on the testing committee nor attend the oral qualifying examination. Students are provided the general categories of topics to expect on the exam from each of their advisory committee members. The Graduate Advisor will serve as the examination coordinator and aid the student in scheduling the examination. The oral examination typically is scheduled for a two-hour period. The qualifying examination will be graded on a Pass/Fail basis, following the Scoring Rubric implemented by the GSBS. Following completion of the oral qualifying examination the Graduate Advisor will submit the signed Oral Qualifying Examination Notice to the Graduate School of Biomedical Sciences Office of Admission and Services (GSBS OAS).

Two attempts to successfully pass the qualifying examination are allowed. Failure of the student to pass the qualifying examination results in dismissal of the student from the doctoral program. A doctoral student who does not pass may be allowed to complete the requirements for a Master of Science degree.

B. Research Proposal

Following the successful completion of the qualifying examination the student should meet with their advisory committee to establish a tentative timeline for their development of their research proposal and establish a tentative date for their proposal defense. All doctoral students must submit their dissertation research proposal no later than the end of the second year of study. The research proposal is an outline of the dissertation project. It must include a summary of the proposed project, the hypothesis to be investigated, significance of the project, research design and methodology to be used, and a thorough review of the salient literature that supports or opposes the hypothesis and potential limitations. To take advantage of the advisory committee's expertise and advice, students are encouraged to meet with committee members regularly during the development of their research project. Students should refer to the GSBS Research Proposal Guidelines in the preparation of their document. The written proposal must be supplied to the Advisory Committee **no less than two weeks (14 days) prior** to the scheduled proposal defense date for review. The student must prepare a formal oral presentation outlining their project, specific aims and proposed methodology in sufficient detail for the Advisory Committee to assess the scientific merit of the project. The research proposal must be approved by the Advisory Committee and the Dean prior to registering in Dissertation (BMSC 6395). Thereafter, the student is required to enroll for dissertation credit and must maintain continuous enrollment in Doctoral Dissertation (BMSC 6395) until the dissertation has been completed.

Upon completion of the qualifying exam and the research proposal, a Ph.D. student will be advanced to candidacy and he/she may use "PhD Candidate" or "Doctoral Candidate" as a

title on any general business correspondence such as business cards, e-mail messages, etc. In addition, the minimum number of credit hours required for full-time enrollment drops from 12 SCH to 9 SCH in long semesters.

6. Additional Information

In addition to all of the information provided in this document, students should consult the GSBS catalog for admissions information, general degree information, and academic procedure information.